CIVIL MILITARY FUSION FOR NAVAL OPERATIONS – A PERSPECTIVE

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"An Italian of the early sixteenth century terming Charles V's conquest as a sudden tempest, a Sudanese warrior in 1898 confronting British machine guns, a Frenchman in 1940 experiencing the German blitz-krieg, or an Iraqi in 1991 facing American smart bombs, all found them-selves in the midst of a military revolution they did not understand – and all paid a heavy price for their backwardness."[1]

Introduction

China's endeavour to surpass the US as a global superpower by 2049, has seen an unprecedented expansion of its military capabilities, incorporation of advance military technologies and focus on dual use technologies. Academic pursuit in Western universities, employing it for development of technologies and equipment, primarily through technological theft, have been resorted to by China, in particular the PLA. Civil Military Fusion (CMF)[2] for development and induction of technologies and state-of-the-art military capabilities, has been a well construed and organised effort of China since 1990s. In the history of military affairs, contributions of academia, innovators and engineers have been key to evolution of warfare. Warfare in the 21st century is transforming 'Revolution in Military Affairs' of the late 20th Century, with the advent of advance military technologies. As has technology evolved, so has the means of warfighting.

The First Gulf War introduced post-modern, networked and seamless warfare, capable of completely overwhelming enemy forces, thus

compelling aspiring countries to recalibrate, adopt advance military technologies and reorganise. The recent wars between Armenia-Azerbaijan and Russia-Ukraine have brought to fore the emergence of Unmanned Systems as lethal means, disrupting the post-modern way of warfighting. Hence, it reinforces the fact that challenging the status quo, employment of dual use technologies and innovative methods of warfighting can provide advantages to a weaker force over its adversaries in the battlefield. Moreover, wars can be prolonged as has been the case in Russia-Ukraine war, emphasising the need to be self-reliant in military capabilities with adequate capacities.

The push for greater indigenisation, through introduction of a ban on 'Buy Global', introduction of Positive Indigenisation Lists, promoting participation of private industry and start-ups in defence manufacturing and re-vitalisation of DRDO and DPSUs, has been calibrated to fulfil India's Vision@2047, the centenary year of independence, in order to become a true global leader. Faced with prospects of greater friction and military contact with China and a volatile global scenario, underlining the adage of 'no permanent friends and enemies in international politics', an *Atmanirbhar Bharat*, especially in military and security capabilities, is the only way to counter such threats. Consequently, the need to fuse civil and military efforts in defence R&D and manufacturing is key to achieve self-reliance and weaning away from foreign OEMs.

As regards naval operations, there is a need to understand the changing nature of naval warfare and align efforts to harness the potential of India's entrepreneurial resources, business companies, academia, DRDO and DPSUs to achieve indigenous capabilities to prevail in the maritime domain. This article is an attempt to analyse these two aspects, evolving nature of naval operations and indigenous development of naval warfighting capabilities, with a roadmap for CMF in development of naval technologies.

Evolving Nature of Naval Warfare

The nature of warfighting has transformed due to Information Revolution, Quantum Technology, Artificial Intelligence and Big Data Analysis. The effective use of cyberwarfare as was demonstrated by Russia in Georgia

and Ukraine wars, and space-based operations including protection and disruption of satellites, make modern warfare complicated and highly contested. Moreover, large scale employment of Unmanned Systems, as witnessed in recent wars, is amalgamating the use of sub-conventional means with regular conventional warfighting. The innovative application of modern technologies by the Ukrainians has denied freedom of operations to Russian forces both on land as well as at sea. Sinking of the flagship of Russian Black Sea Fleet, Moskova in April 22, within the second month of war, while operating 60-65 nm from the Ukrainian coast, forced withdrawal of the fleet to safer waters.[3] However, that too was challenged by the employment of lethal Autonomous Unmanned Vessels (AUVs), allowing Ukraine to attack Russian warships off Sevastopol, home base of the Russian Black Sea Fleet at Crimea.[4]

Multi-Domain, Cross-Domain and Integrated Joint Operations. In a highly contested and degraded operational environment, the concept of Multi-Domain Operations focuses on "combined arms full spectrum operations" through integration and synchronisation of various capabilities.[5] A Multi-Domain Task Force (MDTF) was also created within the U.S. Army Pacific Command in 2017 that consists of an Intelligence, Information Ops, Cyber, EW and Space (I2CEWS) detachment with assets to counter enemy capabilities.[6] Japan too has recognised the need to adapt to "warfare that combines capabilities in the new domains - space, cyberspace and EM spectrum - and traditional domains land, sea and air."[7] Japan's National Defense Program Guideline describes in detail the capabilities required to be developed to counter future threats in all the domains. The PLA had initiated the "Integrated Joint Operations (IJO) concept of warfighting under informationised conditions" with "highly integrated and networked tactical forces."[8] It is also aimed at providing greater flexibility of employment of joint forces across organisational divisions and between services. The need to adapt to multi-domain warfare in future conflicts cannot be disregarded any further. It will require a focused approach at the joint operational command level.

Battlefield Transparency. Transparency of the battlefield both on land and at sea, is being achieved with credible ISR, supplemented with Space Based Surveillance. The unprecedented proliferation of surveillance

satellites, both state and private, combined with databasing of ISR inputs from multiple sources, their analysis and availability of actionable intelligence over networks, are rapidly evolving naval operations. In this regard, private satellite imagery companies like Planet Lab and Maxar Technologies have transformed OSINT.[9] Planet Lab's Dove satellites that have enabled spotting of warships at sea, and Maxar Technologies satellite imagery providing OSINT extensively during the Russia-Ukraine war, can impact the course of a war. While the US and Western allies possess high resolution satellite imagery capabilities, China's space based ISR capabilities have also achieved a fair degree of transparency in the West Pacific and to a large extent in IOR.

In an increasingly transparent maritime battlespace, a 'Systems of Systems' approach with dispersed, but connected, units for application of concentrated combat power on the enemy would define naval operations. A case in point is the strangulation of freedom of operations of the Russian Black Sea Fleet off the Ukrainian coast, through classical employment of 'Sea Denial' operations. This has been largely achieved with the help of Western aerial and space-based ISR, cueing precision shore-based missile batteries.

Autonomous Unmanned Vessels. Autonomous unmanned surface and sub-surface vessels and aerial vehicles are greatly impacting warfare. Tactical employment of drones in battle for spotting and observation has tremendously lethalised precision firepower, denying the enemy tactical advantage in achieving its military objectives. Similarly in the maritime domain, use of autonomous unmanned vessels and aerial drones for swarming attack, tactical ISR, underwater surveillance, kamikaze attacks on ships at harbour, are revolutionising naval operations. AUVs, teamed with manned platforms, termed as Manned Unmanned Teaming (MUM-T), is further altering warfare at sea, which will allow long duration surveillance by unmanned vehicles, relaying of ISR information to Maritime Operations Centres and manned platforms, and cueing of manned platforms or long-range precision guided weapons for prosecution of enemy units.

AUVs are being increasingly employed in naval operations by both militaries as well as non-state actors. China's capability of swarm vessels that can be employed for attacking adversary ships, has been developed by Yunzhou-Tech, partnering with Zhuhai's municipal government and the Wuhan University of Technology.[10] In September 2021, the US Naval Forces Central Command set up a new task force, TF-59 to deploy and integrate unmanned systems, which includes "surface vessels Sea Hunter and Seahawk, the MQ-9B Sea Guardian HALE RPA, and the MQ-8B Fire Scout autonomous helicopter, supported with AI, for Maritime Domain Awareness and aid regional partners to increase deterrence".[11] Ukraine, in a surprise commando-style operation, employed aerial and sea surface drones to attack the Black Sea Fleet ships off Crimea in end October 22. The Houthis in Yemen too have extensively been employing drones and unmanned vehicles against Saudi Arabia, in attacks on oil refineries and naval ships at port.[12] The utility and employment of AUVs in the maritime domain has gained ascendency in naval operations.

Defence Indigenisation

Indigenous Shipbuilding. Indigenisation in defence capabilities has been endeavoured since independence. Though the Indian Navy inducted ships from the Royal Navy in the initial years, followed by that from erstwhile Soviet Union, yet at the same time, naval planners had comprehended the importance of indigenous shipbuilding. From the first indigenous warship, INS Ajay built at GRSE, Kolkata and delivered to Indian Navy on 21 September 1960, to INS Vikrant, the first Aircraft Carrier indigenously built by Cochin Shipyard Limited and commissioned on 02 September 2022, India has taken giant strides in indigenous shipbuilding. Hon'ble PM Modi has described INS Vikrant as a "testament to the hard work, talent, influence and commitment of 21st Century India, and a symbol of indigenous potential, indigenous resources and indigenous skills."[13] It is reported that, INS Vikrant's "76 % of the overall 'Float' component has been local in origin, nearly 70 % of its 'Fight' component and an equal proportion of its 'Move' component have been imported."[14] Indigenisation in Indian warship building in its three categories, that is Float, Move and Fight, has been achieved to a great extent, while at the same time implying that considerable efforts in the 'Fight' component are required.

Indigenous Weapons and Sensors. Efforts in indigenisation of weapons and sensors remains a key focus area for the three Services. Established in 1958, DRDO has been the torchbearer of Defence R&D and indigenisation. Beginning with 10 units, the organisation presently has 50 labs organised under seven clusters. Several flagship projects i.e., Indian Missile Development Programme, LCA Tejas, LCH Prachanda, ALH Dhruv, MBT Arjun, Multi-barrel Rocket system Pinaka, Sonars and EW systems have culminated successfully, albeit with long gestation time. DRDO's development programmes are based on the three Service's Long Term Integrated Perspective Plan (LTIPP) and its technology forecasting, resulting in DRDO's Five Year Plans under three major categories, Mission Mode projects, Technology Demonstration projects and Science and Technology projects. Measures such as Govt policies, Services participation, industry initiative to qualify as Development cum Production Partners (DcPP), involvement of academia and DRDO initiatives in project management and HR are critical in the growth of India's defence industry.[15]

Nonetheless, India remains predominantly dependent on Russia, Israel, France and the US for supply of weapons and sensors, with specialised equipment such as Air and Surface Surveillance Radars, Maritime Patrol Radar, ESM, Airborne Sonar, SONICS suite and sonobuoys as well as associated weapons without indigenous replacements. Moreover, DRDO and the DPSUs remain reliant on foreign OEMs for niche technologies in development and manufacturing of products e.g., seeker homing head and engines for missiles, processors, and microchips to name a few. In 'Buy Indian' defence products, while more than 50% Indigenous Content (IC) is being claimed, most often the core sub-systems are outsourced from foreign suppliers. Furthermore, a CAG report tabled in the winter session of parliament in December 2022, has brought out "time and cost overrun in completion of DRDO projects, irregular closure of projects declaring them successful despite non-achievement of one or more key objectives or parameters, and taking up of new projects for realising the unachieved objectives of earlier closed projects declared as successful", thus reiterating the fact that DRDO alone cannot be a one-stop solution to *Atmanirbharta* in defence manufacturing.[16]

Course Corrections. Major course corrections have been initiated by the Govt of India (GoI) towards incorporation of technology as a principal characteristic of military advantage, promoting increased participation of the private industry and innovation of technologies, which will aid in overcoming the deficiencies in advance military technologies and wean away from foreign OEMs. The Kelkar Committee 2004 recommended streamlining of defence acquisition process, emphasising the criticality of "rapidly transitioning technology from Science and Technology to an operational capability."[17] It also recommends the need to develop partnerships between the Ministry of Defence (MoD), academia and research institutes, DRDO, DPSUs and OFB, Private and Public Industry, other agencies and international collaboration for technology development in areas where indigenous R&D is weak or deficient. Since then, several measures have been introduced in defence procurement procedures that encourages participation of private industry and development of advance military technologies, which include 'Buy Indian (IDDM)' as first priority, setting up of Technology Development Fund, 'Make' procedures with 70 % Govt funding with specific reservations for MSMEs, FDI in the defence sector up to 74 %, 'Strategic Partnership' Model and above all promoting an ecosystem of innovation for defence (Innovations for Defence Excellence -iDEX).[18]

Indian Navy's Initiatives. In Naval Commanders Conference 2019, the Hon'ble RM called for greater indigenisation of cutting-edge naval weapons and sensors, urging the Indian Navy to keep its focus on futuristic capability development.[19] Since the Defence Acquisition Procedure 2020 has envisaged creation of Innovation and Indigenisation Organisation (IIO) within Services, accordingly the Indian Navy has established a Naval Technology Acceleration Council (NTAC) to accelerate induction of disruptive combat technology to enhance warfighting capabilities and focus primarily on the 'Fight' component. To aid NTAC in its objective, Naval Innovation and Indigenisation Organisation (NIIO) Working Group and Technology Development and Acceleration Cell (TDAC) have been established to enable and coordinate technological development of warfighting capabilities. In order to absorb futuristic and emerging technologies for naval use, TDAC has been mandated to identify such

technologies and ideas, formulate operational requirements and Concept of Operations (CONOPS) for adaptation to naval operations, at the same time, identify industry partners to develop prototype and production models. This process is synchronised with the acquisition process of the navy, wherein the Directorates responsible for indigenisation and acquisition are entrenched in the process.

Swavlamban. A document, 'Swavlamban – Ship's System, Weapons, Aviation and Electronics Atmanirbharta Abhiyan', issued by Naval Headquarters, New Delhi, brings out the items that have been indigenised and those that need to be indigenised in all three categories of 'Float', 'Move' and 'Fight'.[20] As efforts are being stepped-up in the field of military technologies from leap-frogging to pole-vaulting, the Indian Navy launched 75 iDEX Supporting Pole-vaulting in R&D through iDEX, NIIO and TDAC (SPRINT) challenges, unveiled by the Hon'ble PM during NIIO Swavlamban Seminar on 18-19 July 22. Spanning across a wide range of niche technology fields including Artificial Intelligence (AI), autonomous and unmanned systems and Information Technology, in addition to regular *suo moto* proposals, challenges are being considered under both Defence India Startup Challenge (DISC) and Prime categories of iDEX with grants up to Rs 1.5 Cr and Rs 10 Cr respectively.[21] While eight editions of DISC have Problem Statements related to technologies for the navy, the 7th edition was launched with 75 Problem Statements from Indian Navy alone, of which six were recategorised to iDEX Prime.[22] These challenges include a range of technologies and products, and includes AUVs, AI enabled equipment, underwater technologies, material sciences and many other naval technologies. Concerted initiatives from NIIO along with nodal Directorates and project facilitation teams for indigenisation and innovation will be key to ensure adoption and adaptation of futuristic and niche technologies in naval warfighting.

Road Ahead

The process for indigenisation and innovation of military technologies has been well initiated and laid out in detail. It depends on the right fusion of civil military institutes, including the MoD, DRDO, DPSUs, academia and private industry. There exist many challenges in organising and

shepherding initiatives for benefits in the long term. A high degree of trust and handholding between the stakeholders is required to allow Defence startups to successfully develop technologies and products, as well as aid DRDO and the private industry in absorption of defence technology and achieve indigenous manufacturing. Given the evolving nature of naval operations and ascendency of futuristic technologies in warfighting, there is an increasing need to streamline innovative development of indigenous technologies and defence manufacturing. A few pointers towards fulfilling the objectives of defence innovation and fusing civil and military capabilities would be as follows: -

- **Integrated and Networked Forces.** Naval operations with integrated and networked tactical forces will provide operational flexibility in a highly contested and degraded environment. Development of a robust NCO structure and the establishment of sensor, operational information and weapon grids, over a High Level Data Network, has been made possible due to the advent of Internet of Things, 5G and Mobile Ad hoc Network (MANET). Harnessing GoI's Digital India initiative, including 5G driven automated guided vehicles, has great potential for military application.

- **Satellite Imagery.** As has been brought out, proliferation of private imaging satellites has tremendously augmented battlefield transparency. The historic launch of India's first private Vikram-S rocket from Sriharikota, developed by Hyderabad based startup Skyroot Aerospace Private Ltd., has opened up possibilities of building India's own space ecosystem, including development and launching of private imaging satellites.[23]

- **Unmanned Systems.** AUVs for swarming, as well as their utilisation for long endurance surface, sub-surface and aerial surveillance have revolutionised naval operations. Indian Navy has published '*Integrated Unmanned Roadmap for Indian Navy*' in Naval Commanders Conference 2022/2 in October 22, that aims to provide overall guidance for AUV capability development in consonance with naval CONOPS, whilst staying ahead of the technology curve.[24] Accordingly, Indian Navy is engaging DRDO labs/ units such as

Aeronautical Development Establishment (ADE), DRDO's Young Scientist Lab (D-YSL), Mazagon Dock Shipbuilders Limited, Larsen & Toubro, and private startups for development of unmanned capabilities.[25] Incorporation of indigenously developed sensors and weapons on AUVs would further solidify Indian Armed Force's ability in unconventional warfare.

- **Integration of Indigenous Sensors and Weapons.** Indian Navy has a mixed bag of platforms, indigenous and foreign, with imported weapons and sensors. Ability to integrate indigenised sensors and weapons on such platforms, especially aircraft, has been a challenge. Focused approach with assistance from the private industry and foreign OEMs is being explored and taken forward.

- **Absorption of ToT and Defence Manufacturing.** Towards creation of facilities to absorb Transfer of Technology and boost India's defence manufacturing capability, several projects have been concluded in the recent past. A case in point is Tata Aerospace and Defence (Tata A&D). Tata has made a foray into Aerospace and Defence by collaborating with Boeing for manufacturing of fuselages of Apache helicopter and aerostructures for Boeing's commercial and military aircraft, including P8I and C-17.[26] This has further been consolidated by the Tatas with a Joint Venture with Airbus and bagging the contract for manufacturing C-295 medium-lift transport aircraft. Equipping such aircraft with indigenous sensors and weapons developed by DRDO or other private and public industry, will catalyse defence manufacturing in India and boost *Atmanirbhar Bharat*.

- **Interfacing Civil Initiatives with Military Requirements.** Thorough interface between the three Services, defence R&D and manufacturing agencies, including private industry, is essential to achieve the objectives of *Atmanirbhar Bharat* and self-reliance in defence capabilities. The Indian Navy has taken initiatives in this regard by establishing TDAC to interface with private defence startups and also putting in place a Naval Project Monitoring Team to liaise with DRDO labs to facilitate progress of naval projects to logical conclusions. These initiatives would coalesce R&D for military

technology development and their materialisation as warfighting means.

- **Promoting Innovation within the Services.** While efforts have been put in place for DRDO and private startups to innovate and develop military technologies, there are many potential innovators within the Services. A prime example is Commodore Arogyaswami Joseph Paulraj (Retd), a naval electrical engineer, who while in service did pioneering work in development of the indigenous APSOH sonar and was also the 'founding director for three major labs in India - Centre for Artificial Intelligence and Robotics (CAIR), CDAC (Center for Development of Advanced Computing) and CRL (Central Research Labs of Bharat Electronics)'.[27] Finding the 'next Paulraj' initiative, promoting promising and genuine innovators within the Service, is being intensely followed up by the Indian Navy.

Conclusion

China's military modernisation and focus on development of futuristic technology for warfighting capabilities has in effect put India's efforts in defence indigenisation under the spotlight. As China races away in the '100 years marathon', India too has set goals to be achieved by its centenary year of independence. Accordingly, the MoD and three Services have set themselves goals to be achieved in indigenous defence manufacturing. Major steps towards achieving Vision@2047 are the introduction of Positive Indigenisation Lists and ban on 'Buy Global'. In such circumstances, the defence industry has no other choice but to 'pole-vault' in adoption and adaptation of indigenous advance military technologies. This is certainly going to make India less dependent on foreign OEMs, and also boost India's defence exports, which has gained traction in the recent years. The Indian Navy is cognisant of the evolving nature of naval operations and has put in place several initiatives to meet future warfighting requirements. In addition to its personnel now being technically qualified, encouragement of personnel with aptitude for defence innovation has also been instituted. Interaction with DRDO and private industry as well as startups has been a key focus area for the Services, which encompasses handholding of defence industry,

academia and startups, and coordination of projects to their fruition. There are many success stories and there are many in the anvil. However, *Atmanirbharta* in defence innovation and manufacturing is a continuous and long term process, and the Indian Navy has been fastest off-the-block in the *SPRINT* towards *Atmanirbhar Bharat* and being a 'Combat Ready, Credible, Cohesive and Future Proof' force.

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