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December 2024

raksha ANIRVEDA

DECODING SELF-RELIANCE & DEFENCE DYNAMICS

AATMANIRBHAR INDIAN NAVY

POWERING ITS TRANSFORMING JOURNEY THROUGH INNOVATION & INDIGENISATION

SPECIAL EDITION

SCHIEBEL INDIA

EXTENSIVE SHIPBOARD EXPERIENCE

UNMANNED MARITIME ISR SOLUTIONS

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MESSAGE FROM THE EDITOR

Celebrating Indian Navy's Guts, Grit, and Glory

With the growing success of *Raksha Anirveda*'s experimental Navy Day website feature over the years, stakeholders' demand for a dedicated print edition on the Indian Navy has culminated in this special edition. This edition coincides with the Navy Day 2024 celebrations across India, offering a comprehensive look at the Navy's evolution and its crucial role in national security.

This special edition traces the Indian Navy's transformative journey since independence. From its early adoption of indigenisation and innovation as strategic imperatives, the Navy has, by 2024, positioned itself as a leading force in achieving Aatmanirbharta (self-reliance). This progress reinforces its broader mission to safeguard India's maritime sovereignty and contribute to global security efforts.

Navy Day, observed annually on December 4, commemorates the courageous naval operations of the 1971 Indo-Pak War while raising public awareness about the Navy's role in national defence and humanitarian missions. This year, the celebration in Puri, Odisha, will feature an operational demonstration, providing civilians with a rare opportunity to witness the Indian Navy's capabilities firsthand. The event will be graced by President Draupadi Murmu, the Supreme Commander of the Armed Forces, underscoring its significance within India's military calendar.

This edition offers a rich tapestry of in-depth articles that explore significant developments within the Indian Navy, highlighting its transformative journey towards self-reliance and enhanced operational capabilities. The articles examine the Navy's remarkable strides in indigenisation and modernisation, showcasing how it has integrated home-grown technologies across critical domains. From advancing shipbuilding capabilities to developing sophisticated submarine systems, these initiatives underline a decisive shift away from foreign dependencies, reflecting a strong commitment to fostering domestic innovation and expertise.

The operational transformation of the Navy is the focal point of the cover story, which provides a detailed analysis of its evolving capabilities to address contemporary maritime challenges. The story delves into the strategic impact of indigenisation, illustrating how reduced reliance on imports has bolstered the Navy's innovation drive and enhanced its readiness to protect India's interests in blue waters effectively.

The edition also includes insightful articles focusing on harnessing Generative AI for Naval excellence, new concepts to make Indian Navy mightier, Indian Navy's focused embracement of indigenous technology. Additionally, the article on Maritime Domain Awareness (MDA), a crucial aspect of national and regional security, evaluates the progress made in strengthening India's MDA architecture while identifying persistent gaps that require urgent attention. With the exponential growth in maritime trade and escalating undersea threats, the piece underscores the critical need to secure the nation's extensive coastline and vital sea lanes amidst a rapidly evolving maritime environment. Together, these articles offer a comprehensive picture of the Indian Navy's advancements and the challenges that lie ahead in its mission to safeguard India's maritime sovereignty.

This edition also acknowledges the invaluable guidance of Indian Navy veterans and the support of industry partners, whose collaboration has enriched this initiative. Their contributions have been instrumental in spotlighting the Navy's role as a formidable blue-water force, dedicated to protecting India's maritime sovereignty and projecting power responsibly in the Indo-Pacific.

This special edition serves as both a reflection on the Navy's achievements and a call to sustain its momentum in navigating future challenges. *Sam No Varunah*.

Jai Hind!

Ajit Kumar Thakur
Editor & Business Director

> "This edition offers a rich tapestry of in-depth articles that explore significant developments within the Indian Navy, highlighting its transformative journey towards self-reliance and enhanced operational capabilities"

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Aatmanirbharta in Naval Domain

The year 2023 was a landmark year for the Indian Navy (IN), as giant strides were made towards Aatmanirbharta through modernisation and renewed thrust on indigenisation, as a result of which India witnessed record defence exports and all-time high defence production in 2023.

• **Asad Mirza**

Indian Navy has constantly strived towards achieving 'Self-Reliance through Indigenisation' and synchronised the efforts in tandem with various flagship schemes of the Government viz., 'Make in India', 'Technology Development Fund' and 'Innovation for Defence Excellence', in addition to procurements under the 'Revenue' route.

IN has been the torchbearer amongst the three Services to leverage the distinct advantages of government schemes and has engaged actively with industry partners including MSMEs and Start-ups, to encourage their active participation in India's Indigenisation Programmes.

Currently, IN is pursuing a total of 38 Make-I category, 26 projects are being steered under Make-II category, 10 projects under Make I category and two projects under Make III Category. In addition, Eight Make II joint projects are being steered with

Aircraft carrier INS Vikramaditya

Indian Navy has been the torchbearer amongst the three Services to leverage the distinct advantages of government schemes and has engaged actively with industry partners including MSMEs and Start-ups, to encourage their active participation in India's Indigenisation Programmes

IA and IAF as lead services.

To introduce cutting edge technology on board IN platforms, 25 projects are being pursued under the 'Technology Development Fund' scheme. Contract has been concluded for 10 projects at a cost of Rs 34.92 crore.

Exchange of various iDEX proposals by both India and US startups under 'India-US Defence Acceleration Ecosystem (INDUS-X)' initiative was commenced in July 2023. Two proposals pertaining to maritime domain were launched by Raksha Mantri in presence of US Ambassador to India Mr Eric Garcetti during the NIIO Seminar.

IN is progressing 41 problem statements under Defence India Startup Challenge (DISC) and Open Challenge (OC) categories through 59 startups.

A wide range of niche technologies are being inducted for the Navy, to enhance its long-range precision attack capabilities. Loitering Munitions in land and sea-based versions are being inducted to enhance the targeting capabilities. Additionally, containerised missile systems are being inducted to enhance the operational capability and to augment flexibility in operations.

In toto, Indian Navy has transformed from a 'Buyers Navy' into a 'Builders Navy', with aircraft carrier, destroyers, stealth frigates, corvettes, submarines, and other war vessels being constructed in our country.

As of today, of the 66 ships under construction 64 are being built in India. Further, AoN has been accorded for 24 ships and submarines that are all planned to be constructed in Indian Shipyards. At present, IN has achieved approximately 90% indigenisation in the Float segment, 60% in the Move segment, and 50% in the Fight segment.

Indian Navy is committed to becoming a fully Aatmanirbhar Navy by 2047. As on date, India is on track towards achieving this goal, and 80% of the IN budget has been earmarked for domestic procurements in support of GoI vision of an Aatmanirbhar Bharat.

Successful maiden landing of LCA (Navy) and MIG-29K aircraft was achieved onboard INS Vikrant as part of Aviation Integration trials on 6 Feb 23. Maiden day landing of indigenous LCA (Navy) demonstrated Aatmanirbharta in India's capability to design, develop, construct, and operate indigenous Aircraft Carrier with indigenous Fighter Aircraft. INS Vikrant completed Initial Operational Clearance (IOC) on 31 May, 2023. With the IOC, the ship has proven the Aviation Facilities Complex, achieved day and night landing of MiG-29K, and completed landing trials of all helicopters in the Naval inventory.

The Challenge

This all seems rather rosy and well-meaning, but the debate is whether the Indian Navy has really transformed into a global regional force? The answer to this is a categorical NO. Though it is burdened with guarding a huge water boundary. Yet, it stands nowhere near the might of the Chinese Navy (PLAN), its closest rival in the region.

For decades, India had focused its defence policy on its land borders with rivals Pakistan and China. Now, as its global ambitions expand, it is beginning to flex its naval power in international waters, including anti-piracy patrols and a widely publicised deployment close to the Red Sea to help protect ships from attacks during Israel's war with Hamas.

India sent three guided missile destroyers and reconnaissance aircraft to the Red Sea in November 2024, when Yemen-based Houthi rebels began targeting ships in solidarity with Hamas, causing disruptions in a key trading route that handles about 12% of global trade.

Defence Minister Rajnath Singh with former CNS, Admiral R Hari Kumar and General Anil Chauhan, Chief of Defence Staff

India is widely publicising the deployments, signalling its desire to assume a wider responsibility in maritime security to the world and its growing maritime ambitions to regional rival China.

However, a realistic comparison with China shows that China has a fleet strength of 730, which includes 61 submarines and 3 Helicopter Carriers. India has a fleet strength of 294 with 18 subs and 0 Helo carriers. China's submarine fleet consists of more than 70 submarines, including seven nuclear ballistic missile submarines (SSBN), 12 nuclear attack submarines (SSN), and more than 50 diesel attack submarines. The Chinese fleet size is more than three times the size of the Indian Navy which operates less than 20 submarines.

Although both India and China observe 'no first-use' nuclear policy, larger fleet size will give China an advantage in sea-based nuclear domain. The majority (six) of the SSBNs in active service with the Chinese Navy are second-generation nuclear-powered submarines, which are designed to carry up to 12 JL-2 submarine-launched ballistic missiles (SLBMs).

The Indian Navy, on the other hand, has just one nuclear-powered ballistic missile submarine, INS Arihant, in active service. China has two aircraft carriers, CNS Liaoning and CNS Shandong, with India also possessing Two aircraft carrier, INS Vikramaditya and INS Vikrant, but their capabilities differ vastly.

This comparison forces us to ponder how the IN is going to safe guard the huge water boundaries? Perhaps the solution lies in 'thinking out of the box'. Putting-on this sort of thinking cap may force our defence planners to opt for utilising the latest advances in ship manufacturing and signals and communications, to build naval ships which have the attack and deterrent capability, both.

To ensure that the Navy is equipped with the latest vessels, submarines, and related ammunitions, will it not be more prudent to proceed with building a consortium of nations desirous of selling submarines and ships to India, with the caveat that the submarine and ships would be built in India. This would give a huge boost to the capability of Indian shipyards and its engineering personnel besides saving a huge amount in foreign reserves, too.

Indian Navy is committed to becoming a fully Aatmanirbhar Navy by 2047. As on date, India is on track towards achieving this goal, and 80% of the IN budget has been earmarked for domestic procurements in support of GoI vision of an Aatmanirbhar Bharat

The same logic could be applied to build more frigates and aircraft carriers and, in this case, using bloc chain technology of module-based technology, various Indian shipyards could be given the responsibility to manufacture those modules in which they possess expertise and later all modules could be assembled, in collaboration with whichever country is willing to transfer technology and build the new ships in India.

This apparently will leave the US out of consideration, but India can utilise its long-standing ties with the British, Dutch, German and Belgian or even Korean companies to build smart naval ships and allow the Indian Navy to grow at a fast pace in the shortest span of time. ■

–The writer is a political commentator and media consultant, based in New Delhi. He can be contacted on www.asadmirza.in. The views expressed are of the writer and do not necessarily reflect the views of Raksha Anirveda


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Securing India's Maritime Frontiers

India's MDA architecture has improved over the years, but significant hurdles persist. While coastal radar networks and warship patrols have been ramped up, coordination between multiple agencies and a lack of effective implementation still hampers the maritime security. As maritime trade grows and undersea threats intensify, ensuring the safety of the nation's vast coastline and sea lanes has become increasingly vital.

• **Commodore Anil Jai Singh**

Indian soldier aiming his weapon towards The Taj Mahal Hotel in Mumbai during the 26/11 terrorist attack

The November 26, 2008 Mumbai attacks exposed critical vulnerabilities in India's coastal security, prompting the government to undertake a comprehensive overhaul of the national maritime security framework. The immediate response focused on fortifying coastal security with a coordinated effort involving key stakeholders such as the Marine Police, Customs and Revenue authorities, and the fishing community. At the forefront of this initiative were the Indian Navy and the Coast Guard, with responsibilities clearly delineated and a command and control structure put in place. In the 16 years since, the security framework has made significant progress, though challenges remain. These issues stem less from deficiencies in the structure itself and more from the prevailing attitudes within some

implementing authorities.

The appointment of a National Maritime Security Coordinator (NMSC) was a critical step towards addressing these gaps, promising better coordination moving forward. Vice Admiral G. Ashok Kumar (Retired) was appointed as India's first NMSC on February 16, 2022. The NMSC is part of the National Security Council Secretariat (NSCS) and reports to the National Security Adviser (NSA). The NMSC's responsibilities include coordinating with stakeholders and agencies; coastal surveillance; addressing non-traditional threats to maritime security; balancing terrorism threats, and increasing the number of coastal radars and Automatic Identification System (AIS) on small boats.

The coastal security apparatus features an integrated coastal radar network designed to provide seamless coverage along India's extensive coastline. Although still a work in progress, this network has extended its surveillance reach to India's maritime neighbours, helping to foster regional cooperation in maritime security.

India, as a dominant maritime power in the Indian Ocean (IO) region, has firmly positioned itself as a responsible stakeholder in maintaining a free and open Indo-Pacific. Its proactive stance in ensuring a safe and secure maritime environment has established the nation as a preferred security partner in the region. However, with its large and porous coastline–spanning 7,516 kilometres and encompassing 12 major and over 200 non-major ports–the nation's maritime strength also presents vulnerabilities. The nation's Exclusive Economic Zone (EEZ), covering over 2 million square kilometres, presents both opportunities and challenges.

India's ambitious economic targets–envisioning a developed country status by 2047–depend heavily on maritime trade, with over 90 per cent of its trade by volume and 80 per cent of its energy imports travelling across the sea. As the nation approaches its goal of becoming a $5 trillion economy within the next few years and potentially a $10 trillion economy within a decade, the security of its Sea Lines of Communication (SLOC) will become increasingly critical. As part of this effort, the nation is expanding its port and coastal infrastructure, with deep-water transhipment ports in Vizinjham, Vadhavan, and the Nicobar Islands set to play pivotal roles. India's geographical position, sitting at the crossroads of critical sea lanes, offers it a strategic vantage point in the IO. With land resources depleting and a growing population to support, India's reliance on the sea for its future growth is inevitable. Ensuring maritime security is thus a strategic imperative.

India's focus on Maritime Domain Awareness (MDA) stems from its need to safeguard its 7,516 km coastline and vital Sea Lines of Communication. The country has made strides in improving its coastal radar network, maritime patrols, and warship deployments, positioning itself as a reliable security partner in the Indo-Pacific

India's maritime security strategy is closely linked to its SAGAR (Security and Growth for All in the Region) policy, articulated by Prime Minister Narendra Modi during his 2015 visit to Mauritius. This policy emphasises collaboration with India's maritime neighbours to enhance their capacity to secure their own maritime domains. Smaller neighbours with disproportionately large EEZs, such as Sri Lanka, the Maldives, and Seychelles, have benefited from Indian assistance, with India providing platforms, infrastructure, and personnel to support their coastal and EEZ surveillance efforts, as well as Search and Rescue (SAR) operations. This inclusive and collaborative approach underpins India's efforts to foster a robust regional Maritime Domain Awareness (MDA) capability.

India's naval forces are constantly engaged in mission-based deployments across the Indo-Pacific, with 12-15 warships patrolling the region at any given time. These deployments offer India critical situational awareness and enable it to respond swiftly to emerging crises. The Indian Navy's air assets, including long- and medium-range maritime patrol aircraft and rotary-wing platforms, are continuously monitoring vast expanses of the ocean.

Indian Navy's frontline frigate, INS Tabar during her return leg from St Petersburg

Beneath the surface, India's submarine fleet contributes valuable intelligence, enabling the Navy to better understand underwater environments and deploy resources efficiently.

Frequent bilateral and multilateral exercises, along with coordinated patrols involving both regional and extra-regional navies, have enhanced India's ability to share information and foster interoperability in the maritime domain. Such initiatives are vital for ensuring safety and adherence to established maritime laws and conventions.

Technological advancements in space, cyber, and autonomous systems–along with the application of artificial intelligence, quantum communication, and advanced surveillance technologies–are expected to further bolster India's MDA capabilities. These innovations will allow the country to remain ahead of both traditional and non-traditional threats emerging in the maritime domain.

Institutionally, India has established robust mechanisms to enhance its MDA efforts, such as the Information Fusion Centre for the Indian Ocean Region (IOR-IFC) and the Information Management and Analysis Centre (IMAC), both based near the national capital. In 2021, the Prime Minister launched 'Sagarmanthan,' a real-time vessel-tracking system named Mercantile Marine Domain Awareness Centre (MMDAC), and there are ongoing proposals to establish a National Maritime Domain Awareness Centre (NMDAC). These initiatives reflect India's long-term vision for maritime security and its commitment to enhancing awareness across its vast maritime frontiers.

While much of the focus in MDA tends to be on military dimensions, it is essential to recognise that non-military challenges also pose significant risks to maritime security. Global trade relies heavily on the oceans, yet regulatory oversight of maritime activities is limited compared to the heavily monitored airspace. The AIS, which tracks vessels over 20 meters in length or displacing over 300 tonnes, has improved monitoring at sea. However, smaller vessels often remain undetected, and even larger ships involved in illegal activities can 'go dark' by turning off their AIS transponders–a tactic frequently employed by China's fishing fleets in foreign EEZs.

The IOR-IFC maintains white shipping agreements with over 25 countries and organisations, collecting and analysing data to detect anomalies in ship movements. With observers from more than a dozen countries stationed at the IOR-IFC, regional MDA capabilities have been significantly enhanced. Improved coordination with similar centres across the Indo-Pacific will be vital in upholding the rules-based order at sea. Although the high seas are generally treated as global commons, open for use by all, this has led to a lack of regulation in comparison to terrestrial borders or airspace. The principle of 'Mare Liberum,' or 'Freedom of the Seas,' written by Dutch jurist Hugo Grotius in 1609, remains the guiding framework for maritime law. Recent efforts, such as the United Nations Convention on the Law of the Sea (UNCLOS), which established a global framework for ocean governance, are pushing to address gaps in ocean regulation, particularly concerning areas beyond national jurisdictions. The June 2023 UNCLOS Agreement on Marine Biodiversity in these areas, known as the 'High Seas Treaty,' marks a significant step towards ensuring sustainable use of marine resources.

Underwater security, a crucial yet often overlooked area in India's maritime strategy, faces growing threats. As the country leans more on offshore resources and undersea cables, addressing undersea domain vulnerabilities remains a challenge, especially with hostile foreign activities in the Indian Ocean

Undersea Domain Awareness

When it comes to MDA, much attention is given to surface-level activities, but the undersea domain remains largely overlooked. With the world increasingly turning to the sea for resources through Blue Economy initiatives, it is crucial to understand the depths of the ocean and what they offer. Undersea exploration, resource extraction, seabed mapping, and the study of acoustic dynamics–driven by environmental conditions that vary significantly from place to place–are

A recent naval exercise involved seamless integration of two Aircraft Carriers INS Vikramaditya and the indigenously built INS Vikrant- along with a diverse fleet of ships, submarines and aircraft, showcasing India's technological expertise in the maritime domain

key components of UDA. This often-overlooked aspect is vital for national security and resource management.

Subsea infrastructure, such as undersea cables and pipelines, plays an essential role in global connectivity, with over 90 per cent of the world's internet traffic travelling through these cables. These critical infrastructures are increasingly vulnerable to both natural and man-made disruptions. Recent events like the Nord Stream pipeline damage and incidents involving undersea cable disruptions underscore the importance of protecting undersea assets. Countries with little regard for ethical constraints, such as China, have frequently targeted critical infrastructure as a means of asserting power. Protecting these vital undersea assets will be a growing challenge, as threats can arise from various, often unpredictable sources.

Militarily, UDA plays a crucial role in submarine operations, sea-based deterrence, and undersea warfare. China's persistent deployment of research vessels in the IO, for instance, is widely seen as a means of collecting oceanographic data to support future submarine operations as part of its broader maritime strategy.

Takeaways

The subject of MDA is vast and multifaceted, much like the oceans themselves. As traditional, non-traditional, and transnational threats to maritime security continue to evolve, MDA has emerged as a cornerstone of 21st-century maritime strategy. For a maritime nation like India, maintaining robust MDA capabilities is no longer optional– it is a strategic imperative that will determine the country's ability to secure its future. ■

–The author is a veteran submariner and Anti-Submarine Warfare specialist. He is currently the Senior Vice President of a leading European MNC in India, Vice President of the Indian Maritime Foundation, and holds honorary positions at the National Maritime Foundation and other institutions. The views expressed are personal.

Indian Navy Proves Its Mettle: Jajati Mohanty

With the increased use of drones or Unmanned Air Systems by armies globally, Schiebel Group has demonstrated its prowess in the field of unmanned systems with its CAMCOPTER® S-100. Schiebel India has become synonymous with advanced technologies at lower cost in addition to its superb performance in the naval domain.

Jajati Mohanty, CEO of Schiebel Systems India

The Vienna-based Schiebel Group has been in business for more than seven decades and focuses on the development, testing and production of state-of-the-art mine detection equipment and the revolutionary CAMCOPTER® S-100 Unmanned Air System (UAS). This product has now found an admirer in the Indian Navy also, which has inducted a few systems and has plans for induction shipborne UAS in large numbers as can be seen from regular RFIs being issued from MoD / Navy.

The CEO of Schiebel Systems India, Jajati Mohanty, who started his career with the Indian Navy in 1992, is a trained submariner specialising in weapon systems, sensors and platform combat management. During his association with Schiebel India since 2020, the company has witnessed a steady growth coupled with recognition from the Indian Aerospace and Defense industry.

In an exclusive chat with Raksha Anirveda, commenting on the increased capability and transformation of the Indian Navy over the years, Mohanty opined that as compared to two other services, the Indian Navy has always been one step ahead in technology absorption and progressing concept of indigenisation. The Indian Navy has transformed itself into a force which has optimally utilised existing resources and the available facilities with quantifiable results. This is evidenced by the manner in which the Navy started the building blocks for "To Float To Move To Fight" encompassing frigates, destroyers, aircraft carriers and followed it up with working alongside the Indian industry to fill the gaps for move – propulsion and fight – weapons and sensors. The growth of naval warship capability can be seen from the extensive construction and integration work undertaken by PSUs like MDL, GRSE, GSL, Cochin Shipyard etc. So you can see how the navy's thought process brought together the planners and

engineers and embarked on a mission to transform the Indian Navy into a self sufficient organisation to a great extent in order to meet its operational goals. Where it lacked the capability, it decided to bring-in the technology from other countries but always with a caveat that ultimately it should be produced in India. Mohanty is of the opinion that navy's insistence towards Make within India helped it to move very comfortably once the nation decided and heralded the Make in India and Aatmanirbharta elements. And as a result of this, today, we can see that upto 70% of its requirements can be met by domestic industry.

Commenting on Schiebel's performance in India, Mohanty is of the view that in 2022 a Request for Information (RFI) was issued to facilitate the Indian Navy's acquisition of 40 Naval Shipborne Unmanned Air Systems (NSUAS) and the process is still ongoing strongly. In the meantime and in order to gain valuable experience in shipborne UAS operations, navy issued tender for a limited number of shipborne UAS. Schiebel participated and created an active footprint for S-100 with the Indian Navy where a major advancement in terms of unmanned technology was provided to sea going capability.

The induction of rotary unmanned system represents a significant step in naval innovation and supports the country's aspiration to incorporate state-of-the-art technologies in the IOR where unmanned systems are becoming the order of the day. Taking cue from the Navy, other sister services have also commenced study towards utilisation of the S-100 in their concept of operations.

On the performance of S-100, Mohanty commented that the Indian Navy has been undertaking ISR in the IOR (Indian Ocean Region) with unmanned systems since the beginning of the 21st century using fixed wing UAVs operated from shore as well as ships by handing over control to ships at sea. The exploitation of the MALE UAVs has provided a vital and crucial experience to the Indian Navy and they are now looking to gain valuable experience with shipborne tactical UAVs. These deck-based rotary UAVs provide more tactical leeway to the fleet and the warships in local ISR (Intelligence Surveillance & Reconnaissance) as well as closer air-cover to fleet warships. Combat air patrol by the deck based rotary UAVs will become the new normal, very shortly. About the growing strength and presence of the Indian Navy in the region, Mohanty feels that the Indian Navy is seen with respect not just by the regional navies but even by global navies, and it is evident by various exercises in which the Indian navy is invited to participate, which apart from showing its clout also helps it in learning from different navies in terms of operations and latest technology.

CAMCOPTER® S-100 Anti-Submarine Warfare (ASW) at a major NATO exercise

Schiebel India looks at Hyderabad MRO centre transforming into a service centre for its products in East Asia, South-East Asia, Indian Ocean, and Arabian Sea, as most countries in these regions either have the system or are in the process of acquiring one. So it makes sense for the company to make Hyderabad the nodal point for fulfilling the maintenance and after sales for these buyers at a lower cost

Schiebel India and a local firm VEM Technologies have joined hands to produce CAMCOPTER® S-100 in India wherein the complete assembly, integration, and testing (licensed production) in now happening within the country at Hyderabad and in addition Schiebel India is also setting up a state-of-the-art MRO facility to maintain these assets for the next 10-15 years as mandated by the Indian Navy. Mohanty says that Schiebel India looks at this MRO centre transforming into a service centre for its products in East Asia, South-East Asia, Indian Ocean, and Arabian Sea, as most countries in these regions either have the system or are in the process of acquiring one. So it makes sense for the company to make Hyderabad the nodal point for fulfilling the maintenance and after sales for these buyers at a lower cost at the Hyderabad MRO.

Highlighting another feather in the cap of Schiebel, Mohanty said that at REPMUS 2024, Schiebel demonstrated a novel unmanned-unmanned coupling of S-100, which for the first time showed its prowess not just in unmanned-manned systems, but in totally unmanned operation also, thus bringing down the concern regarding losing a precious human life to a minimum during actual operations. ■

Striving for Self-Sufficiency at Sea

Bolstering the nation's defence capabilities with home-grown innovation and expertise, the Indian Navy has been spearheading a comprehensive indigenisation drive across shipbuilding, submarines, and advanced technologies.

• **Commander Sumit Ghosh**

Over the past decade, the Indian Navy has been steadfastly advancing its push toward indigenisation, aiming to minimise reliance on foreign suppliers. This shift is driven by the need to mitigate risks from potential Western sanctions during regional conflicts and aligns with India's broader strategy of self-reliance under the 'Aatmanirbhar Bharat' initiative.

The Navy's efforts to indigenise critical areas like shipbuilding, submarine construction, propulsion systems, and advanced electronics have been particularly noteworthy. These sectors were once hampered by heavy dependence on imports, limiting India's defence capabilities.

The Indian Navy is breaking free from its reliance on foreign manufacturers through a multi-pronged approach that underscores its commitment to indigenisation. A strategic policy shift has seen the Navy align itself with government initiatives promoting self-reliance, embedding this objective deeply into its operational strategy. Specialised indigenisation units (IUs) have been established to collaborate with Indian companies, fostering the localisation of technology and manufacturing processes. Innovation programs such as the Technology Development Fund (TDF) and Innovation for Defence Excellence (iDEX) offer a platform for start-ups and private companies to contribute cutting-edge solutions, enhancing the Navy's technological edge.

In shipbuilding, the Navy has reinforced its commitment to domestic production by placing significant orders with Indian shipyards for projects ranging from aircraft carriers to Project 17A of frigates and submarines. This home-grown effort is bolstered by in-house expertise, with extensive training programs even for highly sensitive projects like nuclear-powered ballistic missile submarines. These initiatives reduce reliance on technology transfer agreements and fortify internal capabilities. To support these efforts, substantial investments in research and development empower Indian scientists and engineers to develop bespoke naval technologies.

While aiming for self-reliance, the Navy also strategically engages in global collaborations for co-development and technology transfer with nations like the United States, France, and Russia. This balanced approach ensures access to advanced technologies while fostering indigenous growth. Partnerships with private sector players such as Larsen & Toubro, Garden Reach Shipbuilders and Engineers (GRSE), and Bharat Heavy Electricals Limited have been instrumental in construction and system integration. Defence policies, including the Defence Procurement Policy and offset policy, create a favourable environment for private players to thrive.

Collaboration with established Indian defence giants such as Bharat Dynamics Limited, Hindustan Aeronautics Limited, and Mazagon Dock Shipbuilders Limited has enabled the design and production of critical components. Events like *Swavlamban* provide a vibrant platform for technology entrepreneurs and innovators to showcase their achievements, fostering healthy competition and advancing the spirit of indigenisation. This comprehensive strategy underscores the Navy's determination to achieve self-reliance while modernising its maritime capabilities.

The Navy has placed significant orders with Indian shipyards for projects like Project 17A of frigates, submarines, and the Indigenous Aircraft Carrier INS Vikrant, blending advanced design with a growing reliance on domestic expertise. Complementing these efforts, its focus on nuclear-powered submarines underscores a robust push towards strategic autonomy in maritime defence

Indigenous aircraft carrier INS Vikrant

A Transformation in Maritime Defence

The Indian Navy is at the forefront of India's indigenisation drive in defence production, transitioning from a "Buyer's Navy" to a "Builder's Navy". With more than 230 active projects focusing on indigenous design and development, including the construction of 55 naval vessels in Indian shipyards, the Navy demonstrates a steadfast commitment

to the national vision of self-reliance. This push encompasses shipbuilding, submarine construction, naval aviation, weapon systems, advanced technologies, and innovative combat solutions.

The indigenisation journey has seen significant milestones. INS Vikrant, commissioned in 2022, stands as India's first indigenous aircraft carrier, integrating 30–40 per cent indigenous content. This achievement will be followed by INS Vishal, expected to include 70 per cent indigenous components, a testament to India's evolving capability in aircraft carrier construction. Similarly, the Project 15B destroyers, known as the Visakhapatnam class, are advanced stealth-guided missile destroyers featuring indigenous radar and missile systems. The fourth and final vessel in the series is anticipated to be delivered by the end of 2024.

The Navy's Project 17A frigates, or the Nilgiri class, are under construction with approximately 65 per cent indigenous equipment. Designed for stealth and anti-submarine warfare, seven of these advanced frigates are being built by Mazagon Dock Shipbuilders Limited and GRSE. Submarine programs have also gained momentum. Building on the success of the Scorpene submarines under Project 75, the subsequent Project 75I will feature six conventional submarines with extended underwater endurance and land-attack capabilities. Additionally, Project 76 aims to develop the next generation of submarines, featuring vertical launch systems for long-range missiles, entirely designed by the Warship Design Bureau.

India's nuclear submarine initiatives reflect strategic foresight. INS Arighat, the country's second nuclear-powered ballistic missile submarine, is expected to be followed by INS Aridaman by 2025. The Navy is also set to commence the construction of two nuclear-powered attack submarines, a critical expansion of its strategic and tactical capabilities. Alongside these developments, projects such as the P1135.6 frigates, Anti-Submarine Warfare Shallow Water Crafts, and Survey Vessel Large further bolster India's maritime strength.

Naval aviation has seen robust progress, with efforts underway to develop a carrier-capable version of the Light Combat Aircraft (Tejas). The Naval Multi-Role Helicopters project aims to replace the aging Chetak and Sea King fleets, enhancing fleet versatility and operational reach. Indigenous missiles and weapon systems, including variants of BrahMos, Nirbhay cruise missiles, and Naval Land Attack Missiles, signify India's growing proficiency in cutting-edge armament technology. The K-series missiles, alongside next-generation cruise missile systems, add to the Navy's expanding arsenal.

From the integration of cutting-edge AI solutions to collaborations with start-ups through initiatives like SPRINT and Swavlamban, the Navy is fostering a culture of innovation. Indigenous combat systems, radar technologies, and unmanned underwater vehicles highlight a determined shift toward a self-reliant future

The Navy's focus on indigenisation extends to advanced combat and radar systems, as domestically developed Integrated Combat Management Systems, Network-Centric Warfare Systems, and electronic warfare technologies are increasingly featured aboard Indian ships. This self-reliance in radar, sonar, and combat systems mitigates vulnerabilities linked to foreign dependencies. Unmanned systems are another area of focus, with indigenous Unmanned Underwater Vehicles and Autonomous Underwater Vehicles being deployed for surveillance and exploration missions. The Navy has also introduced the Autonomous Fast Intercept Boat for enhanced maritime operations.

Technological advancements play a pivotal role in the Navy's modernisation drive. Over 25 projects are leveraging Artificial Intelligence, including initiatives for predictive maintenance, maritime awareness, language translation, and decision-making aids. AI-based autonomous

swarms of underwater drones are being developed for surveillance and countermeasure operations, while cybersecurity infrastructure is fortified with tools like Hawksecure, an AI-powered behavioural analysis engine. The exploration of blue-green laser technology for anti-submarine warfare underlines the Navy's emphasis on cutting-edge research and development.

Collaborative innovation has been facilitated through the SPRINT (Supporting Pole-Vaulting in R&D through Innovations for Defence Excellence) initiative, which has led to the induction of 118 technologies in partnership with start-ups and academic institutions. The Swavlamban seminar, organised by the Naval Innovation and Indigenisation Organisation (NIIO), enables collaboration with over 250 MSMEs and start-ups. Swavlamban 2024 recorded a 50 per cent increase in participation, with 115 agencies showcasing their products.

(Right) INS Karanj, the third Scorpene class submarine, was constructed by MDSL

(Left) Combat Management System (CMS) developed by Tata and Indian Navy's WESEE for INS Vikrant

Takeaways

Despite these achievements, challenges persist. Construction technologies, micro-electronics, advanced materials, and sub-system development require significant investment and expertise. Supply chain inefficiencies and limited industrial capacity, compounded by bureaucratic delays, present hurdles to achieving higher levels of indigenisation. These challenges make self-reliance a time-intensive and costly endeavour.

Nonetheless, the Navy's ambitious efforts to indigenise shipbuilding, submarine construction, weapon systems, and advanced technologies underscore its proactive approach in adopting the Aatmanirbhar Bharat mandate. Its long-term goal to achieve 75 per cent indigenisation by 2047 is a testament to its strategic vision, aligning with India's aspiration to become a developed nation. Its multifaceted approach underscores its determination to secure control over critical defence technologies, bolster national security, and emerge as a self-reliant maritime force. ■

–The author, a former Indian Navy submarine officer, served on Kilo-class submarines and commanded INS Sindhurakshak. A specialist in anti-submarine warfare and a deep-sea diver, he has been an instructor at the Submarine Training Centre and a directing staff at the Defence Services Staff College. Views expressed are personal.

Aatmanirbhar Navy: Navigating a New Era of Innovation

The Indian Navy's indigenisation efforts have significantly enhanced its operational capabilities, reflecting a strategic shift towards self-reliance in defence manufacturing. This transformation will reduce dependency on foreign suppliers, foster innovation and improve the Navy's readiness to address contemporary and future maritime challenges.

• **Rakesh Krishan Simha**

Historically, India's defence sector heavily depended on imports, with foreign-made warships, submarines and aircraft making up the bulk of the armed forces' assets. However, among all three services, the Navy embarked upon an extensive indigenisation programme focussing on designing and constructing naval platforms within India. This paid off in a big way with the Navy making significant strides towards reducing dependence on foreign suppliers and enhancing its operational capabilities in recent years. These efforts made the Navy a formidable force contributing to India's broader defence and economic objectives.

Today, 50 of India's 66 advanced ships and submarines are under construction at Indian shipyards, both public and private, underscoring the Navy's commitment to supporting indigenous warship-building efforts. The total value of these ships is estimated at around $ 30 billion. Significant progress has been made in this area over the decades, and the Navy is now about to sail into a new phase of self-reliance - one focused on manufacturing technologically advanced equipment within India.

Aatmanirbhar India: A Game Changer

At the heart of the push for self-reliance is the government's 'Aatmanirbhar India' initiative, which aims to promote domestic manufacturing, innovation and design in all sectors, including defence. For the Navy, this has meant prioritising indigenous design and construction of ships and submarines.

In October 2024, the Indian Navy launched the third edition of its Naval Innovation and Indigenisation Seminar, Swavlamban. Several companies and start-ups participated in Swavalamban 2024, showcasing products of niche technologies such as air and surface surveillance, autonomous systems in surface, aerial, and underwater domains, AI, and quantum technologies.

Over the last two editions of Swavlamban, the Navy has received more than 2,000 proposals from Indian

Vindhyagiri, the sixth Stealth Frigate of Project 17A being built at GRSE

industry and 155 of these proposals have progressed to the prototype development stage. The initiative has enabled collaboration with more than 200 MSMEs and startups under the Innovations for Defence Excellence (iDEX) Scheme.

The most ambitious of India's indigenisation projects include the INS Vikrant, the country's first indigenously built aircraft carrier - a monumental achievement for the Navy. Commissioned in 2022, this 45,000-tonne vessel showcases India's ability to design, build and operate complex naval platforms that were once considered the domain of a handful of global powers.

The Scorpene-class (Kalvari-class) submarines, developed with a mix of indigenous effort and foreign collaboration, have significantly enhanced India's underwater warfare capabilities. The Indian Navy has also begun building nuclear-powered submarines under the Arihant-class programme, another significant leap towards indigenisation of strategic weapons platforms.

Project 17A is a prime example of indigenisation at work, with INS Nilgiri being the first warship in the series. The project focuses on building stealth frigates equipped with cutting-edge technology and enhanced combat capabilities.

Today, 50 of India's 66 advanced ships and submarines are under construction at Indian shipyards, both public and private, underscoring the Indian Navy's commitment to supporting indigenous warship-building efforts. The total value of these ships is estimated at around $30 billion

Project 15B involves the construction of stealth-guided missile destroyers, which are designed and built in India. The lead ship, INS Visakhapatnam, was commissioned in November 2021, showcasing advanced technologies and indigenous systems.

The Navy's focus on indigenisation is not just about building hardware; it is also about building a complete ecosystem of defence technologies. R&D has been ramped up, with the Defence Research and Development Organisation playing a key role in developing naval systems such as advanced sonar technologies, naval radar systems and missile defence systems.

Innovation: Embracing Cutting-Edge Technologies

Innovation has always been the hallmark of military advancement, and the Indian Navy is no exception. As global defence paradigms shift towards network-centric warfare, artificial intelligence (AI), big data analytics and cyber capabilities, the Navy has adopted these technologies to enhance its operational readiness and strategic flexibility.

Adoption of AI and Automation

Artificial Intelligence is gradually being integrated into the Navy's operations, from predictive maintenance to autonomous systems. AI is helping the Navy optimise the functioning of its vessels, predict equipment failures and streamline logistics.

MADE IN INDIA FOR THE NAVY

Recent innovations introduced by the Indian Navy reflect a strong commitment to enhancing its operational capabilities through indigenisation and advanced technologies. Here are some key developments:

Swavlamban Initiative: This initiative has resulted in the creation of 75 cutting-edge technologies in collaboration with domestic Micro, Small, and Medium Enterprises (MSMEs) and startups.

Advanced Fire-Fighting Suit: One of the standout innovations is a fire-fighting suit developed using carbon nanotubes and aerogel-based fabric. Weighing only 1.8 kg, it is significantly lighter than traditional suits (which weigh over 18 kg) and can withstand extreme temperatures ranging from -200°C to over 1,000°C. Additionally, it can evade infrared detection, making it suitable for various military applications beyond naval use.

Fire-Fighting Robot: The Navy has deployed a fire-fighting robot on the aircraft carrier INS Vikrant. This robot is designed to detect and extinguish fires, enhancing safety for personnel onboard. This innovation is part of the broader SPRINT initiative to improve operational safety.

Underwater Communication: The Navy is developing blue-green lasers optimised for underwater applications. These lasers penetrate water more effectively than traditional lasers, making them ideal for underwater communication and imaging tasks.

Autonomous Systems: Innovations include the exploration of weaponised swarms and underwater drones capable of performing various missions such as surveillance, reconnaissance, and attack operations. These autonomous systems are crucial for enhancing maritime domain awareness.

Innovative Metal-Cutting: The introduction of a plasma-based metal cutter allows rapid cutting through steel without the need for hazardous oxyacetylene gases. This technology improves safety onboard ships and streamlines maintenance.

Special Task Forces: To accelerate innovation, the Indian Navy has established special task forces focused on acquiring niche technologies across various domains, including radars, quantum computing and electronic warfare systems. These task forces aim to address capability gaps swiftly and effectively.

Hackathon Challenges: The Navy has initiated national-level hackathon challenges as part of the Swavlamban events to engage innovators in solving real-world operational challenges. These challenges cover areas such as drone swarm coordination and maritime situational awareness.

With the Navy currently operating over 130 ships and submarines, AI-based systems are critical to maintaining fleet readiness and reducing downtime.

In addition, the Navy is exploring autonomous underwater vehicles (AUVs) and unmanned aerial vehicles (UAVs), both of which are becoming integral to modern naval strategies. These innovations enhance surveillance, reconnaissance, and reconnaissance missions without putting human lives at risk.

Space and Satellite Integration

The integration of space-based assets into naval operations is another area where the Navy is innovating. Satellite communications and navigation are crucial for modern naval operations, particularly in the vast Indian Ocean region. The Indian Navy has been working closely with the Indian Space Research Organisation to enhance its space capabilities, ensuring that the service can conduct operations seamlessly across distant waters.

Moreover, the use of satellite-based surveillance systems, including maritime reconnaissance satellites, is enhancing the Navy's ability to monitor vast maritime spaces, track enemy movements and respond swiftly to potential threats.

Cyber Warfare and Network-Centric Operations

In an increasingly digital world, the Navy has also been strengthening its cyber capabilities. Cyber warfare has become a crucial component of modern defence strategies, and the Navy is focusing on securing its networks from potential threats while also being prepared for offensive cyber operations.

Through the Information Warfare Strategy, the Indian Navy has moved towards creating a more robust, network-centric force, where the synergy between ships, submarines, aircraft and shore-based stations is enhanced through real-time information sharing.

The Indigenous Aircraft Carrier INS Vikrant

The Integrated Headquarters of the Ministry of Defence plays a critical role in this process, ensuring interoperability between various arms of the Navy and other branches of the Indian military.

Air Independent Propulsion Solutions for Submarines. The Navy is exploring Air Independent Propulsion solutions for powering submarines as it offers considerable tactical flexibility. Operational considerations like low noise, shallow water capability, size and manoeuvrability issues have garnered the Navy's interest in non-nuclear AIP solutions. Indigenous competence in this field is at a very nascent stage and is required to be built up to the range of 225 to 250 KW for retrofitment on the existing submarines/incorporation in the new designs.

Public-Private Partnerships

Collaborations with private sector companies are being encouraged to foster innovation and expedite the development of indigenous technologies. Many large and prominent industrial houses like the Tatas, Mahindras, Reliance, Kirloskar, L&T and Godrej, to name just a few, have set up special verticals to handle defence-related businesses. Some of these companies have also entered into collaborative agreements with foreign vendors for defence equipment production in the country.

There have been successful outcomes where some systems for ships have been developed indigenously, paving the way for further collaboration in self-reliance efforts. Perhaps the most spectacular example is the Arihant nuclear submarine project, where there has been considerable participation of numerous large and small private players, giving a lot of confidence to the Navy in this aspect. The successful indigenous development of missiles, rockets, torpedo launchers/loaders, ship stabilisers/steering gears, hydraulic systems, automated power management systems and a large number of components/assemblies by the private vendors indicates the willingness and ability of private players to partner the Indian Navy in indigenous developmental efforts.

Artificial Intelligence is helping the Indian Navy optimise the functioning of its vessels, predict equipment failures and streamline logistics. With the Navy operating over 130 ships and submarines, AI-based systems are critical to maintaining fleet readiness and reducing downtime

Impact of Indigenisation on Operational Capabilities

1. **Increased Self-Reliance:** The Indian Navy has indigenised around 3,400 items under its Indigenisation Plan (INIP) from 2015 to 2030, which includes critical machinery, electrical spares, and weapon systems. This shift has allowed the Navy to reduce reliance on imports, particularly in light of geopolitical tensions and supply chain vulnerabilities highlighted by events such as the Russian invasion of Ukraine.
2. **Enhanced Combat Readiness:** With a focus on indigenous development, the Navy has achieved approximately 90 per cent indigenisation in the 'FLOAT' category (ships), about 50-60 per cent in the 'MOVE' category (propulsion systems), and around 30 per cent in the 'FIGHT' category (weapons and sensors). This progress ensures the Navy operates more effectively with systems tailored to its specific operational requirements.
3. **Development of Advanced Technologies:** Collaborations with organisations like the Defence Research and Development Organisation have accelerated the development of advanced naval technologies, including anti-submarine warfare systems, electronic warfare

'Matangi' Unmanned Surface Vessel (USV) developed by Sagar Defence

equipment, and medium-range surface-to-air missiles. Such advancements bolster the Navy's capabilities in various operational scenarios.

4. **Fleet Modernisation:** The construction of modern ships and submarines in Indian shipyards has been a cornerstone of indigenisation efforts. Currently, 76 per cent of ships and submarines on order are being built domestically. This enhances fleet capabilities and ensures that maintenance and upgrades can be conducted efficiently within India.
5. **Innovation through Partnerships:** The establishment of the Naval Innovation and Indigenisation Organisation (NIIO) has fostered a culture of innovation within the Navy. By engaging with private sector companies and academia, the Navy is leveraging diverse expertise to develop cutting-edge solutions. This collaborative approach is vital for addressing complex defence challenges.
6. **Operational Flexibility:** The Navy's ability to quickly adapt to changing operational environments has improved significantly due to indigenisation. For instance, during humanitarian assistance and disaster relief (HADR) operations, indigenous capabilities have enabled rapid deployment and effective response. The Navy's swift actions during disasters have enhanced India's image as a responsible regional power.

More Resilient and Agile

As the Indian Navy continues to embrace indigenisation and innovation, its vision is to not only defend India's maritime borders but also to emerge as a dominant force in the Indo-Pacific region. With growing tensions in the South China Sea, the Indo-Pacific is becoming an increasingly strategic area for naval powers. India's growing fleet of advanced warships, submarines and aircraft, coupled with a robust indigenisation strategy, will allow it to play a leading role in this region's security architecture through force projection. In the coming decades, the Indian Navy will need to become a forward deployed force along the lines of the US Navy whose majority of combat assets are located in oceans far from continental America.

In this backdrop of rising threats and growing responsibilities in the coming years, we can expect to see:

The commissioning of more indigenous aircraft carriers and submarines.

Expansion of Blue Water Navy capabilities, allowing India to project its power far beyond its borders.

Further advancements in cyber and electronic warfare, ensuring the Navy is prepared for the digital battlespace.

Continued growth in interoperability with regional and global allies like the United States, Japan and Australia, creating a collective security framework in the Indo-Pacific.

Takeaways: Maritime Power with Global Reach

The Indian Navy's journey of transformation through indigenisation and innovation is a reflection of India's growing ambitions on the global stage. By focusing on self-reliance in defence manufacturing and embracing emerging technologies, the Indian Navy is positioning itself as a future-ready force that can tackle both traditional and non-traditional security challenges.

As the Navy continues to innovate and indigenise, its strength will not just lie in the number of ships or submarines in its fleet, but in its ability to harness the power of cutting-edge technology, its commitment to building a self-sustaining defence ecosystem, and its unwavering dedication to safeguarding the country's maritime interests.

In the vast expanse of the ocean, where power and presence matter more than ever, India is charting a course towards becoming one of the world's foremost maritime powers - driven by indigenisation, powered by innovation and supported by a vision of resilience and self-reliance. ■

–The writer is a globally cited defence analyst. His work has been published by leading think tanks, and quoted extensively in books on diplomacy, counter terrorism, warfare and economic development. The views expressed are of the writer and do not necessarily reflect the views of Raksha Anirveda

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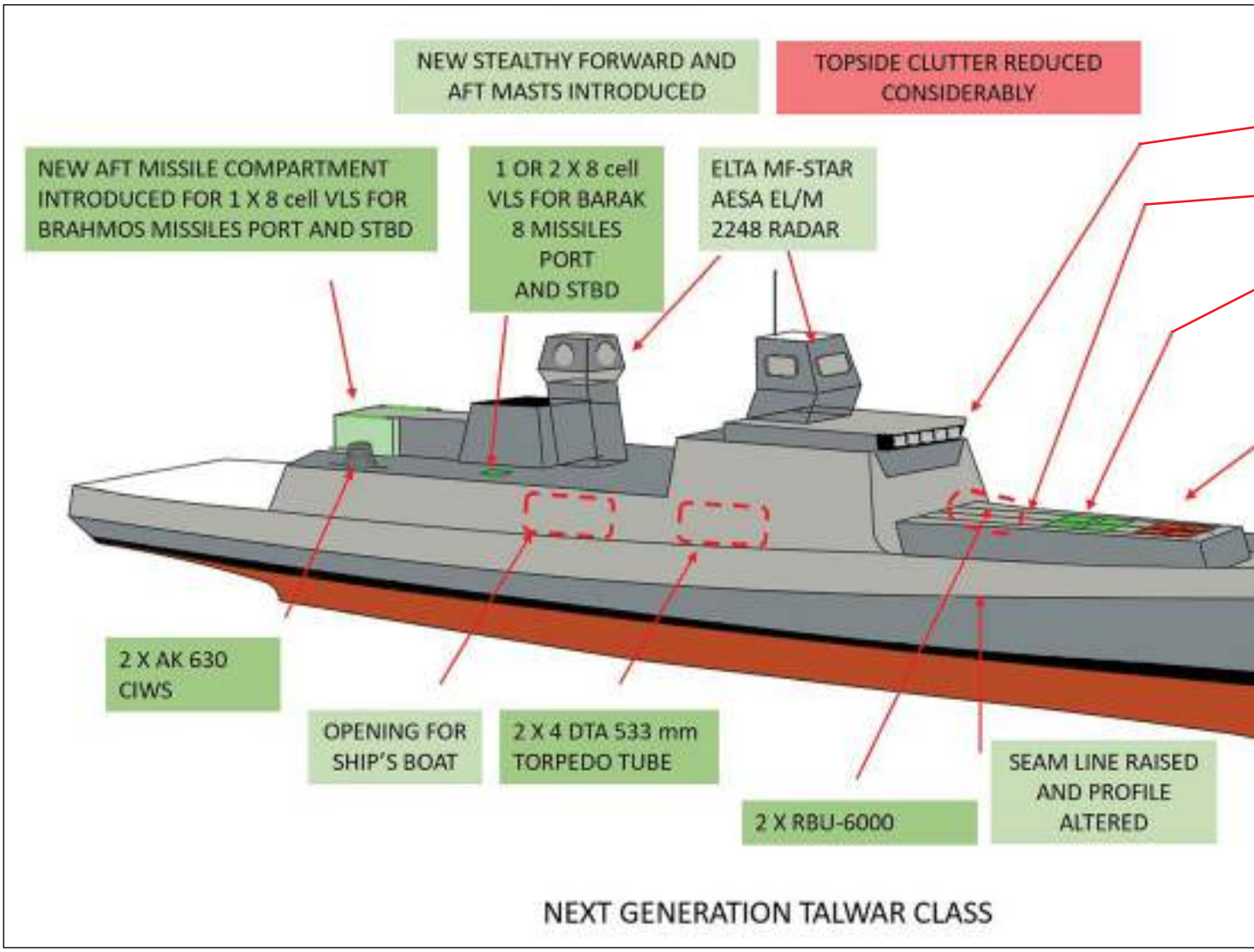


New Concepts to Indian Navy Mig

Imagine the Navy of the future with ships powered by electric drive using podded propulsion units, generating their own spare parts with on-board 3D printers and with revolutionary Command and Control areas. Is it feasible that these ships would mount weapons in Modular and therefore, interchangeable weapon bays? Can Indian shipbuilders produce ships for the Indian Navy at a lesser cost and that too in the shortest span of time? How an INS Talwar class frigate be equipped with more weapons? Here is an insightful viewpoint.

• **Rahul Vatsyayan**

Make htier

The advantages would be to sustain an entire diverse eco-system in producing ships in a timely manner without depending on two or three shipyards taking between seven to nine years to construct a 3,300-ton ASW corvette

The world over, there is an ever-increasing trend to construct warships as "Superblocks", complete with all equipment, machinery, piping, wiring, ducting etc.

These superblocks can be made in remote locations, sometimes not even at the final shipyard, and are then transported by barge to the final integrator shipyard for mating with the other blocks.

The Gerald Ford class carriers, the Queen Elizabeth class Aircraft carriers, the Type 45 destroyer, the Virginia class SSNs are but some of the few projects constructed in this way.

It is recommended that the Indian Navy adopt this process for all future projects. The advantages would be to sustain an entire diverse eco-system in producing ships in a timely manner without depending on two or three shipyards taking between seven to nine years to construct a 3300-ton ASW corvette.

Perhaps the most-complex contractual structure is that of the aircraft carrier alliance (ACA) used by the UK's MOD to manage and execute delivery of its future carriers. The British Ministry of Defence is part of the alliance with the main ship-builders, system manufacturers, and others. The ACA is an adaptation of alliance structures used in the oil and gas extraction industries.

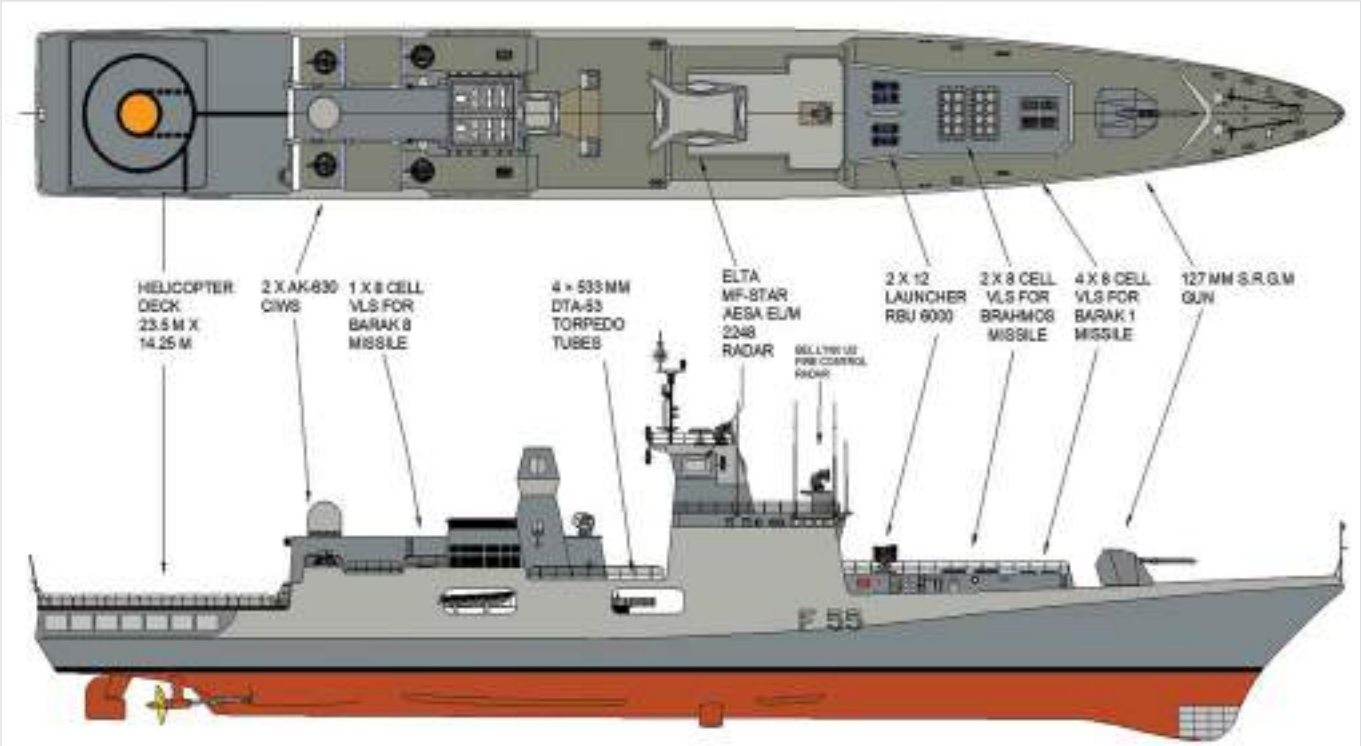
There is a hope that these and others can be amplified for ultimate development for the Indian Navy, too. Technology has progressed at a very rapid pace in the last two decades. It is critical that we harness the use of these technologies and innovations to remain current to face tomorrow's challenges.

No longer will conventional answers to conventional threats suffice to counter the intrusions of tomorrow. Innovation and out-of-the-box thinking are the only way to remain ahead of the curve in today's rapidly changing battlefield scenarios.

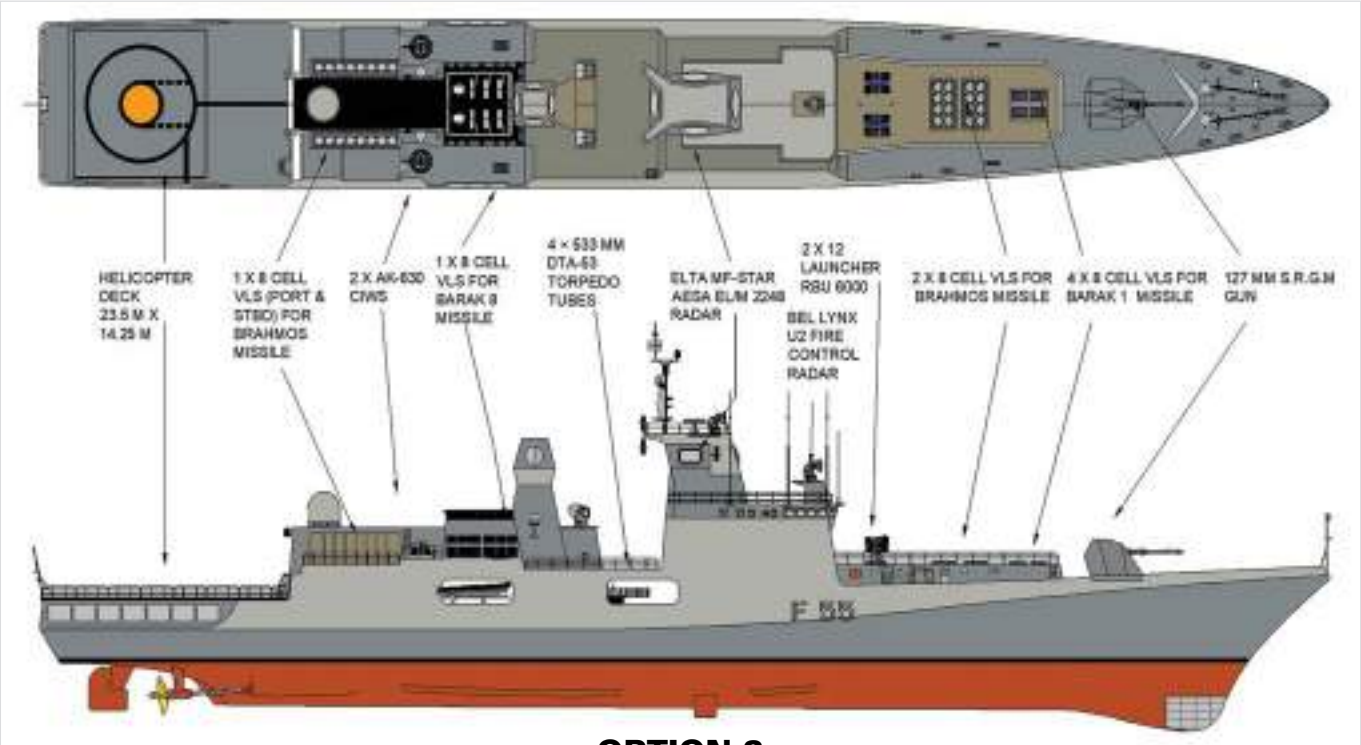
Currently the Indian Navy operates 6 Talwar class frigates: INS Talwar, INS Trishul, INS Tabar, INS Teg, INS Tarkash, and INS Trikand. Proposed additional weapon systems for improved Talwar class weapon systems are based on Admiral Grigorovich class frigates, to reduce topside clutter and introduce AESA radar mounted on a stealthy carbon composite superstructure, to make space available for 8 more VLS cells of the Kalibr missile. Further, ample space available near aft mounted AK-630 30 mm CIWS for additional weapons VLS for 24 (2 × 12) 3S90M cells for 9M317M surface-to-air-missiles.

In the following chart a comparison can be made how successfully a Talwar class frigate can be fitted with more weaponry than an Admiral Grigorovich frigate.

TYPE	ADMIRAL GRIGOROVICH CLASS	TALWAR CLASS	IMPROVED TALWAR CLASS
	Guided Missile Frigate	Guided Missile Frigate	Guided Missile Frigate
Displacement	Standard: 3,620 tons	3,850 t (4,240 short tons) standard load	4,000 t (4,405 short tons) standard load
	Full: 4,000 tons	4,035 t (4,448 short tons) full load	4,035 t (4,610 short tons) full load
Length	124.8 m (409 ft 5 in)	124.8 m (409 ft 5 in)	125.5 m (409 ft 5 in)
Beam	15.2 m (49 ft 10 in)	15.2 m (49 ft 10 in)	15.5 m (49 ft 10 in)
Draught	4.2 m (13 ft 9 in)	4.2 m (13 ft 9 in)	4.25 m (13 ft 9 in)
Propulsion	2 shaft COGAG;	Zorya-Mashproekt M7N.1E propulsion plant	
	2 DS-71 cruise gas turbines 8,450 shp (6,300 kW)	2 × DS-71 cruise gas turbines	2 X LM 2500+ Boost Gas Turbines (2X 30,200kW)
	2 DT-59 boost gas turbines 22,000 shp (16,000 kW)	9,850 shp (7,350 kW)	2 × Pielstick 16 PA6 STC Diesel engines (11,300 Kw)
	Total: 60,900 shp (45,400 kW)	2 × DT-59 boost gas turbines	
	or	22,185 shp (16,543 kW)	app 72 Mw Installed Power
	2 x M90FR FRU 20 (25/28) MW boost, 2 x cruise M70FRU-2 14 MW, 8 MW	COGAG configuration	CODAG Configuration
	total=56–68 MW		
Speed	30 knots (56 km/h; 35 mph)	32 knots (59 km/h; 37 mph)	32 knots
Range	4,850 nmi (8,980 km; 5,580 mi) at 14 knots (26 km/h; 16 mph)	4,850 mi (4,210 nmi; 7,810 km) at 14 kn (26 km/h; 16 mph)	5000 MI @15 kn
		1,600 mi (1,400 nmi; 2,600 km) at 30 kn (56 km/h; 35 mph)	2250 MI @ 30 kn
Endurance	30 days	30 days	30 Days
Complement	200	180 (18 officers)	140 (18 Officers)
Sensors and processing systems	Air search radar: Fregat M2M	1 × 3Ts-25E Garpun-B surface search radar	ELTA MF-STAR AESA EL/M 2248 Radar
	Surface search radar: 3Ts-25 Garpun-B (Plank Shave), MR-212/201-1 (Palm Frond), Nucleus-2 6000A	1 × MR-212/201-1 navigation radar	BEL LYNX FCS Radar
	Fire control radar: JSC 5P-10 Puma FCS, 3R14N-11356 FCS, MR-90 Orekh SAM FCS	1 × Kelvin Hughes Nucleus-2 6000A radar	2 X MR-90 Orekh
	Sonar: MGK-335EM-03 sonar system with Vinyetka-EM towed array	1 × Ladoga-ME-11356 intertial navigation and stabilisation	
		1 × Fregat M2EM 3D circular scan radar	
		1 × Ratep JSC 5P-10E Puma fire-control system	
		1 × 3R14N-11356 fire-control system FCS	
		4 × MR-90 Orekh	
Electronic warfare & decoys	EW suite: TK-25-5	1 × TK-25E-5 EWS	
	Countermeasures	1 × PK-10 ship-borne decoy launching systems	TBD
	4 × KT-216	4 × KT-216 decoy launchers	
Armament	1 × 100 mm A-190 Arsenal naval gun	1 × 100mm A-190E, naval gun	1 X 127 MM Naval Gun; Either a. Bae Systems Mk 45 mod 4 b. OTO-MELARA 127 mm SRGM
Surface Attack (Anti-Ship) Missiles	8 (2 × 4) UKSK VLS cells for Kalibr, Oniks or Zircon anti-ship cruise missiles	8 × VLS launched Klub, anti-ship cruise missiles (F40, F43, F44)	16 x VLS Launched Brahmos for Option 1 or max 32 x VLS Launched Brahmos For Option 2
		8 × VLS launched BrahMos, anti-ship and land-attack cruise missiles (F45, F50, F51)	
Surface to Air Missiles	24 (2 × 12) 3S90M VLS cells for 9M317M surface-to-air-missiles	24 × Shtil-1 medium range missiles	32 X VLS Cells For Barak 1
	8 × Igla-S or Verba	8 × Igla-1E (SA-16)	16 X VLS Cells For Barak 8
CIWS	2 × AK-630 CIWS	2 × AK-630 CIWS (F45, F50, F51)	2 × AK-630 CIWS
		2 × Kashtan CIWS (F40, F43, F44)	
Torpedo Tubes	2 × double 533 mm torpedo tubes	2 × twin 533mm DTA-53-11356 torpedo tubes	2 × twin 533mm DTA-53-11356 torpedo tubes
ASW	1 × RBU-6000 rocket launcher	1 × RBU-6000 (RPK-8) rocket launcher	2 × RBU-6000 rocket launcher
Aircraft carried	1 × Ka-27 series helicopter		
Aviation facilities	Helipad and hangar for one helicopter	1 × Ka-28 (or) Ka-31 (or) Dhruv	1 × Ka-28 (or) Ka-31 (or) Dhruv

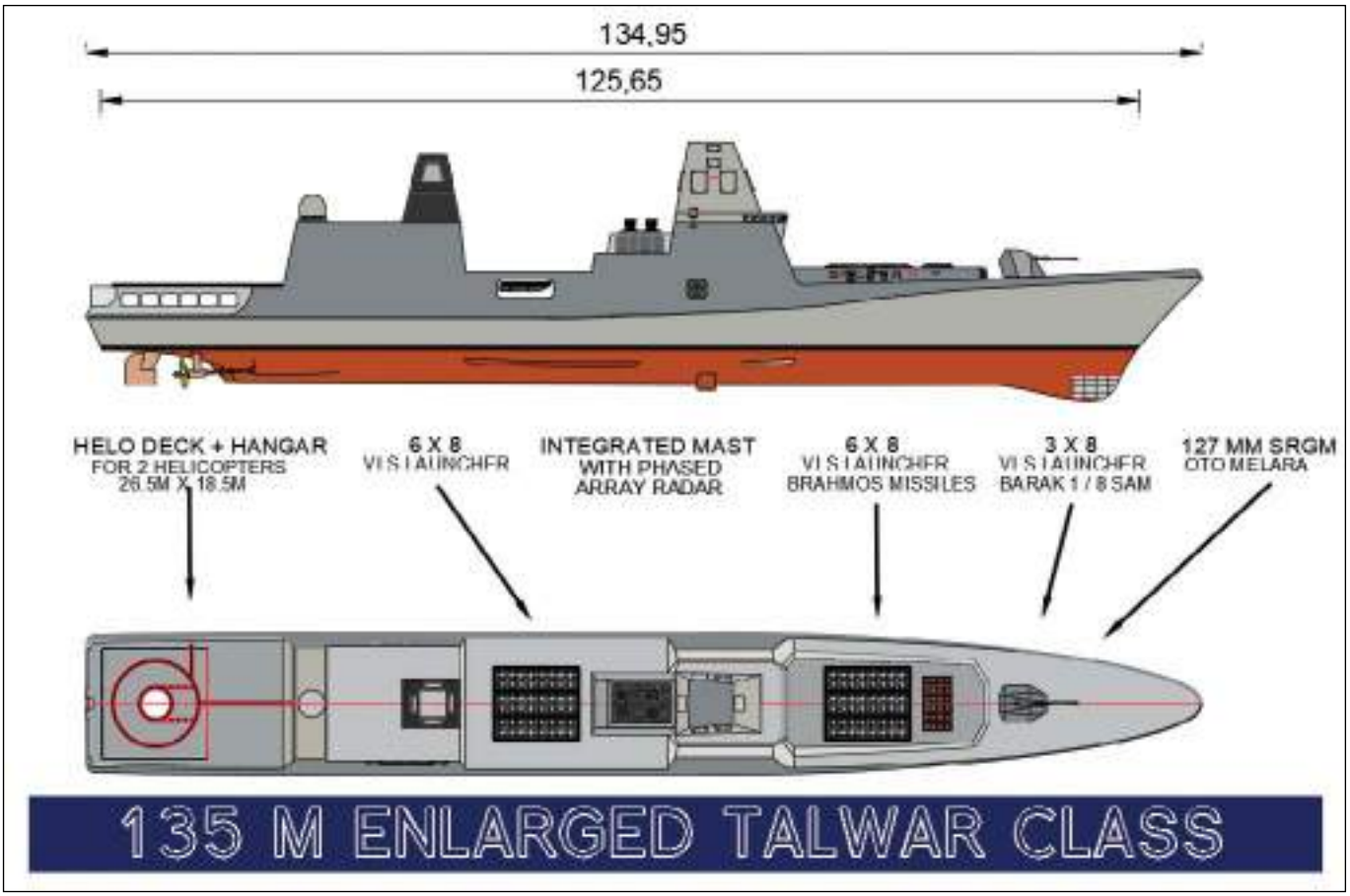


OPTION 1



OPTION 2

Proposed additional weapon systems for improved Talwar class weapon systems could be achieved by reducing topside clutter, introducing AESA radar mounted on a stealthy carbon composite superstructure, to make additional space available for eight more VLS cells of the Barak missile



Improvements Possible On Batch 3 Talwar Class

The proviso for this suggestion is the fact that considerably enhanced weaponry is mounted on the latest Admiral Grigorovich class frigates for the Russian Navy. In comparison, the Talwar class mount fewer weapons for the same hull dimensions. Even beyond the weapons load of the Russian ships, considerable enhancements are possible to make the improved Talwar class a veritable "arsenal ship" mounting as many as 32VLS cells for anti-ship BRAHMOS missiles and up to 64VLS cells for Barak 1 and Barak 8 anti-aircraft missiles. Along with this enhanced missile load, it is possible to mount a much more credible naval gun of 127 mm calibre. The ASW capability can also be enhanced with a double fitment of torpedo tubes and 2 x 12-barrel RBU-6000 systems. Some changes in the hull sheer line and bridge height have also been proposed.

An Enlarged Talwar Concept (Study)

A design proposal for an enlarged version of the highly successful Talwar class is shown above.

As per this, it would be possible to mount over 100 VLS launcher cells for a variety of missiles from Barak 1 and 8 surface to air missiles and Brahmos surface to surface missiles. This ship would be 135 m long and displace approximately 6,300 tons. The propulsion proposed would be 4 x GE LM-2500 GTs.

As could be seen, this ship could be a game changer for the modern Indian Navy with a formidable weapons load and would still be modest in dimensions. ■

–The writer is an Architect by profession with more than three decades of experience with leading corporates in the Indian real estate industry. His passion is matters Naval! He has been drawing warships since the age of 12 and following warship design in the Indian Navy for a considerable time. The views expressed are of the writer and do not necessarily reflect the views of Raksha Anirveda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Harnessing Generative AI for Naval Excellence

The Indian Navy has adopted advanced AI technologies to address critical operational needs, including effective data management. Retrieving relevant information from the large amount of operational data stored in various formats is time-consuming and challenging, especially when offline functionality is critical for data security in sensitive environments. Generative AI and Natural Language Processing have shown remarkable potential in addressing these challenges.

• **Lt Col Narendra Tripathi**

Artificial Intelligence (AI) is revolutionising defence ecosystems globally, empowering military forces to strengthen their operational capabilities and strategic preparedness. The Indian Navy, aligning with global advancements, has proactively adopted cutting-edge technologies to modernise its systems and operations. AI's transformative potential in defence is evident in its ability to deliver intelligent, intuitive solutions that facilitate decision-making and enhance efficiency and situational awareness. Recognising this, the Government of India is actively implementing measures to address critical defence challenges by fostering collaboration with startups and leading academic institutions such as the IITs to develop robust and innovative solutions.

Defence Minister Rajnath Singh interacts with Startups/iDex participants at IIT Kanpur
(Pic Courtesy: www.xterrarobotics.com

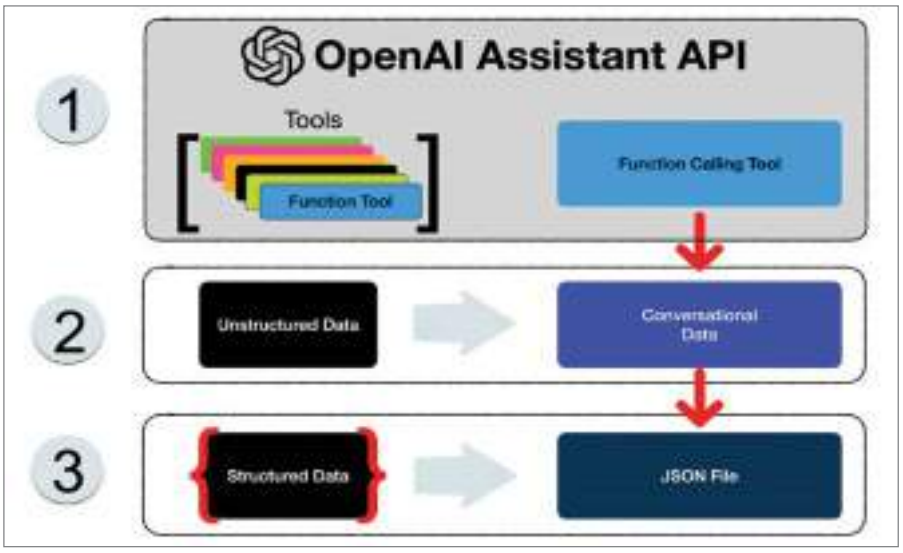
The most remarkable advancements in AI include large language models such as OpenAI's GPT (Generative Pre-trained Transformer). These models, built on deep learning and transformer architectures, can process and generate human-like text, excelling at understanding context, delivering coherent responses, and performing diverse natural language processing (NLP) tasks. They have demonstrated immense potential in solving complex problems, particularly defence applications requiring rapid, data-driven insights.

The Indian Navy is leveraging this potential by integrating NLP and large language models to extract actionable insights from vast operational data. These datasets are often stored in siloed repositories and the Naval Unified Domain (NUD). To achieve this, the Navy focuses on deploying robust AI systems capable of functioning in standalone hardware without internet connectivity, ensuring security in sensitive environments. Simultaneously, secure cloud-based solutions are being developed to support many concurrent users, catering to the Navy's diverse and distributed operations.

Recognising the importance of AI in achieving strategic superiority, the Indian Navy has proactively identified key problem statements through the Defence India Startup Challenge (DISC) under the Innovations for Defence Excellence (iDEX) initiative. DISC 11 and 12 exemplify the Navy's commitment to adopting cutting-edge technologies, particularly Generative AI and NLP to address critical operational challenges. These challenges offer transformative opportunities to modernise the Navy's knowledge management and communication systems, ensuring that India's maritime defence remains at the forefront of technological innovation.

Genesis of the Problem

The Navy operates within a highly complex environment where the effective management and utilisation of vast, diverse datasets are crucial to mission success. Operational data — spanning documents, manuals, images, videos, and diagrams — are often stored in isolated silos or in varied formats, making the retrieval of relevant information both time-consuming and challenging. Moreover, the need for seamless multilingual communication across diverse operational scenarios adds another layer of complexity, particularly when offline functionality is critical to ensure data security in sensitive environments.



Open AI function calling tools
(Pic Courtesy: www.cobusgreyling.com)

Recognising the importance of AI in achieving strategic superiority, the Indian Navy has proactively identified key problem statements through the Defence India Startup Challenge (DISC) under the Innovations for Defence Excellence (iDEX) initiative. DISC 11 and 12 exemplify the Navy's commitment to adopting cutting-edge technologies, particularly Generative AI and NLP to address critical operational challenges

Advancements in Artificial Intelligence, especially Generative AI and Natural Language Processing (NLP), have shown remarkable potential in addressing these challenges. Cutting-edge models like OpenAI's GPT have set new standards in generating human-like text, understanding context, and enabling intuitive user interactions. These technologies offer a path towards streamlining data access and improving situational awareness. However, implementing such solutions within defence frameworks requires unique adaptations, including robust offline capabilities, stringent data security measures, and the ability to handle diverse and complex data formats.

As global militaries increasingly turn to AI for strategic advantage, the Navy's efforts to integrate these technologies reflect a forward-thinking approach to overcoming data challenges in modern naval operations.

As global defence forces increasingly integrate AI into their strategic frameworks, the Indian Navy's initiatives reflect a commitment to national security and align with broader global efforts to harness AI's full potential in modern warfare. By fostering innovation through platforms like iDEX and DISC, the Navy is paving the way for smarter, faster, and more secure naval operations.

To address the need for efficient management and interpretation of vast data on the Naval Unified Domain (NUD), an AI-driven chatbot is the way ahead which can integrate Optical Character Recognition (OCR) to process diverse data formats, including scanned documents, handwritten notes, diagrams, and multimedia files. These needs to be trained on naval-specific datasets, offering intuitive dialogue management, and maintaining conversational context for seamless interactions. A dynamic user interface like this can provide features like tailored profiles, session history, timestamps, query clarification, real-time feedback, and reinforcement learning to ensure

adaptability. Needless to say, such a model needs to be optimised for standalone hardware supporting multiple concurrent users and at the same time can also incorporate secure cloud solutions for scalability.

Developing an offline Natural Language Processing (NLP) system is essential to ensure secure and efficient multilingual communication in sensitive operational environments. This system must operate without internet connectivity, providing accurate translations in near real-time while seamlessly integrating with existing communication frameworks. Tailored specifically for naval operations, the solution involves fine-tuning NLP models on multilingual datasets, and prioritising operational languages and dialects. A real-time processing engine, built on lightweight transformer architectures optimised for low-latency translation, will enable swift and precise results. To enhance security, the system will be deployed on standalone hardware and designed for seamless integration with current naval communication systems. Scalability and adaptability are key priorities, with provisions for adding new languages through modular updates and ensuring compatibility with future communication technologies. This comprehensive and robust solution is designed to meet evolving operational needs while maintaining stringent security protocols.

Existing Models and Global Insights

Globally, Generative AI models like OpenAI's GPT, Google's BERT, and Meta's LLaMA have demonstrated advanced capabilities in NLP and knowledge management. These models are adept at contextual understanding, text generation, and multimodal data interpretation. However, defence applications demand tailored modifications:

1. **Security and Privacy:** Unlike commercial models hosted on cloud platforms, defence applications require standalone deployments to safeguard sensitive data.

Advanced AI solutions for defence applications are poised to deliver huge benefits across various domains. Enhanced knowledge management systems provide seamless access to critical information, improving decision-making and operational readiness. Intuitive interfaces and multimodal capabilities will enhance user engagement, while on-the-fly learning and modular updates ensure adaptability and long-term relevance

Disc 11 & 12 challenges by Idex
(Pic courtesy: idex.gov.in/challenges)

2. **Offline Capabilities:** Real-time functionalities, such as translation, must operate without internet connectivity, ensuring uninterrupted service in remote or secure environments.
3. **Custom Training:** Models need to be fine-tuned on specific datasets, such as naval terminology, operational manuals, and equipment blueprints, to ensure relevance and accuracy.

Advanced AI solutions for defence applications are poised to deliver transformative benefits across various domains. Enhanced knowledge management systems will provide seamless access to critical information, improving decision-making and operational readiness. AI-driven insights will save time, reduce manual effort in retrieving data, and boost overall operational efficiency. Intuitive interfaces and multimodal capabilities will enhance user engagement, while on-the-fly learning and modular updates ensure adaptability and long-term relevance. Similarly, secure offline communication systems will safeguard sensitive data

Generative AI architecture (Pic courtesy: www.generativeminds.com)

and enable real-time multilingual translation, facilitating seamless collaboration in diverse operational scenarios. Supporting multiple languages and dialects, these systems will ensure global interoperability, enhancing interaction with international partners and strengthening strategic alliances. Together, these advancements promise to elevate defence capabilities, enabling smarter and more efficient operations in a dynamic global environment.

Implementing advanced AI solutions in defence operations presents several challenges. The diversity of data formats, including handwritten documents, diagrams, and multimedia, requires extensive preprocessing for effective model training. Achieving low-latency performance in standalone systems necessitates optimised hardware-software integration. Additionally, ensuring compliance with stringent cybersecurity standards while maintaining usability is critical to safeguarding sensitive information and meeting operational requirements.

Takeaways

The adoption of advanced AI technologies underscores the Navy's commitment to leveraging Generative AI and NLP to address critical operational needs. Intuitive knowledge management systems and secure multilingual communication frameworks promise to revolutionise data handling and collaboration. These initiatives provide a platform for innovation, enabling the development of transformative solutions to address the challenges of data diversity, offline deployment, and stringent security requirements. By focusing on the 'Vs' of Big Data –Velocity, Volume, Value, Variety, and Veracity – and ensuring compliance with robust cybersecurity protocols, these solutions are poised to enhance decision-making, operational efficiency, and strategic capabilities. Through strategic partnerships, rigorous implementation, and cutting-edge innovation, the Navy reaffirms its commitment to technological excellence and its readiness for the future. ■

–The writer is an SME and independent consultant in military technology. The views expressed are of the writer and do not necessarily reflect the views of Raksha Anirveda

Sailing Into the Future

With the commissioning of the state-of-the-art INS Vikrant, the successful underwater launch of the K-4 missile from INS Arighaat, progress on the classified Project Varsha submarine base, and the imminent launch of the Nilgiri-class frigates equipped with cutting-edge weaponry and sonar systems, the Indian Navy is steadfastly reinforcing its maritime dominance.

• **Commodore Ranjit B Rai**

Building a ship takes time, but forging a Navy is an even longer and more arduous journey. The process requires sustained effort, foresight, and meticulous planning. The seeds for a capable and self-reliant Navy must be sown early, a principle that has guided the Indian Navy since its inception on January 26, 1950, when it officially severed its ties with the Royal Navy. This marked the end of the Royal Indian Navy (RIN), and the newly established Indian Navy embarked on a transformative journey. Despite this severance, British influence lingered for a while, as Admirals Sir Edward Parry and Sir Thomas Pizey continued to serve as the Commanders-in-Chief (C-in-C) and Chiefs of Naval Staff (CNS) until Vice Admiral Ramdass Katari assumed the position of CNS on April 21, 1958, becoming the first Indian officer to hold this prestigious post.

During its formative years, the Indian Navy relied heavily on Britain for its fleet. Britain supplied key warships, including INS Delhi, INS Mysore, the aircraft carrier Vikrant, and eight frigates, many of which were partly financed through war reparations. However, the officers and sailors who worked in UK shipyards and brought these ships to India soon realised the importance of self-reliance. They believed that the Navy must initiate the process of constructing warships indigenously.

New launch of Nilgiri and its sea trial

The Journey Towards a Builder's Navy

The vision of an Indian-built Navy began to take shape under progressive leadership. Recognising the importance of indigenous shipbuilding, the Navy encouraged innovation, with some efforts being classified due to their strategic significance. A significant milestone came in 1964, when Rear Admiral S M Nanda was appointed the CEO of Mazagon Docks Limited (MDL) in Mumbai. Under his leadership, the Navy undertook the

ambitious task of constructing Leander-class frigates domestically. These 2,800-ton frigates, a proven and modern design, were in service with prominent navies, including the Royal Navy, Royal Australian Navy, Royal New Zealand Navy, and Royal Netherlands Navy.

Defence Secretary H C Sarin supported the project, which led to the signing of a contract with Yarrow Shipyard Ltd in Glasgow and Vickers Ltd to provide designs and construction kits. MDL established an office in Glasgow under Commodore M Kapadia to facilitate the seamless transfer of equipment and designs. By 1966, MR 249 steel was procured internationally, and the keel for the first Leander-class frigate, INS Nilgiri, was laid at MDL. Rear Admiral Nanda eventually handed over his responsibilities to Rear Admiral B.A. 'Chippy' Samson, a Dufferin graduate and a veteran of the Second World War.

INS Nilgiri: The First Indigenous Leander-Class Frigate

INS Nilgiri, the first warship built at MDL, was equipped with cutting-edge technology for its time. It featured an extensive radar suite, including the Marconi Type 965 Lima Band air search radar, the Sierra Band Type 293 surface search radar, and the X-ray Band Z-06 navigational radar. The ship was the first in the Indian Navy to be outfitted with an ASW Alouette helicopter and Seacat anti-aircraft missiles. Additionally, it boasted UA 8/9 electronic warfare (EW) receivers and jammers, a Royal Navy 2xMk 6 Vickers 4.5-inch gun, and other advanced weaponry, including 60/40mm Oerlikon guns, two sonars (Graesby from the UK and Diodon from France), Magnavox GPS receivers, and Italian A-244S torpedoes.

INS Nilgiri's fire control system, housed within the operations and sonar control rooms, marked the advent of analogue computerisation in the Indian Navy. Indian companies like Bharat Heavy Electricals Limited (BHEL) contributed significantly, supplying boilers and turbines, while smaller components such as valves, doors, galley equipment, and electrical boards were also sourced domestically. The crew, carefully selected under the leadership of Captain D.S. Paintal, underwent rigorous training, with officers and sailors sent to the UK for specialised courses on Leander-class ships.

The culmination of these efforts was celebrated on January 3, 1972, when Mrs Indira Gandhi commissioned INS Nilgiri at the Naval Dockyard in Mumbai. The ship passed all trials and tests with flying colours, setting operational benchmarks. Notably, during trials off Singapore, INS Nilgiri achieved a remarkable feat by downing two Chukar air targets using Seacat missiles and another with its 4.5-inch gun, with assistance from the Royal Navy Trials Team at Sembawang.

The commissioning of the 40,000-ton INS Vikrant in 2022, constructed indigenously by Cochin Shipyard Ltd, marks a historic leap for India in aircraft carrier technology. With its advanced systems and indigenous steel, Vikrant underscores the Navy's capability to blend innovation with self-reliance

Indigenous Warship Development Expands

INS Nilgiri's success laid the foundation for further indigenous warship construction. Two additional Leander-class frigates, INS Himgiri and INS Dunagiri, followed. Building on this momentum, the Navy's Design Directorate developed extended Leander-class designs, culminating in INS Taragiri and INS Vindhyagiri. These achievements paved the way for the construction of larger 4,000-ton frigates, such as INS Godavari, INS Ganga, and INS Gomati, at MDL. Meanwhile, Garden Reach Shipbuilders & Engineers Ltd (GRSE) was tasked with building similar warships, resulting in INS Brahmaputra, INS Betwa, and INS Beas.

Despite some setbacks, such as the undocking incident involving INS Beas and a fire aboard INS Brahmaputra in July 2024, the Navy's shipbuilding programme demonstrated resilience and adaptability. Organisations including BHEL, Bharat Electronics Limited (BEL), Hindustan Aeronautics Limited (HAL), Electronics Corporation of India Ltd (ECIL), and the Defence Research and Development Organisation (DRDO), played pivotal roles in supplying critical systems and components.

Modernisation and Technological Advancements

The Indian Navy has consistently embraced technological modernisation. From the Magnavox GPS navigation systems

of the 1970s to contemporary ring laser gyros, the Navy has steadily improved the precision and automation of its weapon systems. The transition from Termit (P-15) missiles, used in the 1971 Indo-Pak war, to supersonic BRAHMOS and Barak anti-missile systems highlights its commitment to cutting-edge technology. These advancements have extended to all major ships, including training and operational missiles, ensuring indigenous computing capabilities are at the core of all systems.

Additionally, the Navy has integrated 3D modelling, modular construction techniques, and robotics for shipbuilding, enabling faster and more efficient construction processes. Notably, INS Beas, once steam-driven, is being converted to electric propulsion at Cochin Shipyard Ltd (CSL). If successful, this endeavour will mark a significant achievement for India's maritime capabilities.

The Weapons Electronics Engineering Systems Establishment (WEESE) was established in Delhi to assist designers in developing command and communication systems. It employs technical officers to execute classified projects crucial for the Indian Navy's operational readiness. The DRDO also set up the Advanced Technology Vessel (ATV) project to construct nuclear submarines. Currently, two 6,500-ton SSBN nuclear submarines, INS Arihant and INS Arighaat, are operational. Significantly, on November 27, 2024, INS Arighaat successfully test-fired a 3,500-km K-4 (Kalam-4) ballistic missile from underwater, a milestone confirmed by Chief of Naval Staff Admiral Dinesh K Tripathi during his Navy Day address. This year marks the 53rd Navy Day, which the Indian Navy is commemorating with a grand Operational Demonstration at Puri's Blue Flag Beach on December 4, 2024. Additionally, there are reports of a rapid progress in Project Varsha, a nuclear submarine base south of Visakhapatnam equipped with underground pens.

In 2022, the Navy achieved another landmark by commissioning the 40,000-ton aircraft carrier INS Vikrant, designed and constructed indigenously by Cochin Shipyard Ltd (CSL). This achievement underscores the Navy's and Indian industry's technological prowess in ship design and

Left: Prime Minister Indira Gandhi onboard INS Nilgiri
Right: Admiral Nanda briefing PM Indira Gandhi
(Archive photos)

India's nuclear submarine programme, spearheaded by the INS Arihant and INS Arighaat, has reached new heights. On November 27, 2024, Arighaat successfully test-fired a K-4 ballistic missile from underwater, showcasing the Navy's growing strategic deterrence capabilities

construction. Today, WEESE, with 20 DRDO officers on deputation, has made significant contributions by arming warships, establishing classified communication networks, and developing command and control systems in collaboration with BEL. WEESE is also at the forefront of incorporating cyber, quantum, and artificial intelligence technologies into naval operations.

A notable breakthrough was achieved when the Navy encouraged Mishra Dhatu Nigam Limited (MIDHANI) and Indian steelmakers to produce DMR249B grade steel plates, which are critical for warship construction. These steel plates were used to construct the flight deck of the first Indigenous Aircraft Carrier (IAC), INS Vikrant, by CSL. The Navy has also been at the forefront of numerous classified innovations. For instance, Lt Cdr (L) Arogyaswami Paulraj improved sonar technology by developing an advanced trans-receiver-display for the APSOH sonar. These innovations have evolved into the HUMSA series of panoramic sonars, currently deployed by the Navy. Paulraj later migrated to the USA, where he became a celebrated academic at Stanford University and was awarded the Bharat Ratna in 2010 for his contributions.

The Navy's shift towards integrating space and internet technologies began during the first Exercise Malabar in 1982. For the exercise, the Combined Enterprise Regional Information Exchange System (CENTRIX) was loaned to the Indian

Successful test firing of new K4 nuclear ballistic missile from a Nuclear Submarine

Navy by the Pentagon, enabling space-based internet communications and a Maritime Domain Awareness (MDA) picture. This effort marked a significant leap in network-centric capabilities. The Navy also operates cutting-edge research and tracking vessels, including the 15,000-ton INS Dhruv, built by Hindustan Shipyard Ltd (HSL) for missile tracking, and the INS Anvesh (A-41), which features electric propulsion for advanced tracking. Plans for a new ship, A-42, include the integration of a ballistic missile interceptor, AD-2. Innovations like these are showcased at events like DefExpo. Furthermore, the Naval Innovation and Indigenisation Organisation (NIIO) drives initiatives such as the 'Swavlamban' seminar series, focusing on innovation and indigenisation in defence technology.

The Type 17A Nilgiri: A Benchmark for Indian Naval Power

The Type 17A Nilgiri-class frigate, the lead ship of seven Shivalik-class vessels, speaks eloquently of India's growing maritime capabilities. The 6,400-ton Nilgiri, capable of exceeding speeds of 28 knots, is powered by two MAN 12V28/33D 6,000 kW STC Diesel engines and two General Electric LM-2500 gas turbines, supplied by Hindustan Aeronautics Ltd (HAL). It has a range of 5,000 miles at 18 knots and boasts state-of-the-art systems, including the BEL HUMSA-NG bow sonar, IAI EL/M-2248 Elta MF-STAR S-band AESA radar, and a BEL Ajanta EW suite.

The 6,400-ton Type 17A Nilgiri-class frigate, set for commissioning in 2025, is equipped with cutting-edge weaponry and sonar systems, including HUMSA-NG sonar and BRAHMOS missiles

The ship's arsenal includes a naval Oto Melara 76/62 compact gun, 8 VLS BRAHMOS supersonic missiles, and 32 Barak-8 AA missiles. For anti-submarine warfare (ASW), it is equipped with RBU-6000 ASW rocket launchers, triple torpedo tubes, and Humsa NG sonar suites. Additionally, the Nilgiri is designed to embark two Sikorsky-Lockheed MH-60R multi-role ASW helicopters, armed with Hellfire missiles, Naval Strike Missiles, sonars, and Mk 52 torpedoes, significantly enhancing its operational versatility.

This advanced frigate represents a blend of indigenous innovation and global collaboration, marking a new era for India's naval capabilities. The new Nilgiri, scheduled for commissioning in early 2025, carries forward the legacy of its predecessors while setting new benchmarks for operational excellence. Its induction is expected to solidify India's position as a formidable maritime power. As the Navy embraces this technological marvel, it continues to uphold its motto, *Sam no Varunah* (May the Lord of the Water be auspicious unto us). ■

–The writer is a retired naval officer and maritime historian who curates a private maritime museum at C-443 Defence Colony, New Delhi. His latest book, Indian Navy@2025 – A Pictorial Journey, is set to be released in December 2024. The views expressed are of the writer and do not necessarily reflect the views of Raksha Anirveda

Charting Stormy Seas

As the Indian Navy strives to integrate cutting-edge technology and build a self-reliant maritime force, it grapples with an intricate web of operational demands, resource constraints, and global competition.

• **Commander (Dr) Jayakrishnan N Nair**

INS Vikramaditya and INS Vikrant

The Indian Navy, a cornerstone of India's defence infrastructure, faces increasing pressures to modernise while ensuring its operational readiness. The stakes are higher than ever, with rival forces in the Indian Ocean Region (IOR) investing heavily in advanced naval platforms. For the Indian Navy, the challenge lies in bridging technological gaps while reducing dependency on foreign equipment, a balancing act that demands sustained innovation and resource allocation.

As we celebrate Navy Day on December 4, let us explore where we can focus to help build indigenous capabilities in the coming years, Overcome the challenges on the technology front, and transform the Indian Navy into a modern, agile, and future-ready naval force.

A Legacy of Imported Systems

Over the past seven decades, the Indian Navy has relied significantly on imported platforms and weapon systems. Vessels such as the INS Vikramaditya, a refurbished Soviet-era aircraft carrier, highlight this dependence. While the induction of the indigenously built INS Vikrant in 2022 marked a major milestone, it also underscored the gaps in India's ability to independently design and construct state-of-the-art naval platforms. For example, critical technologies like catapult-assisted take-off but arrested recovery (CATOBAR), essential for modern carrier operations, are still unavailable domestically.

Similarly, the submarine fleet has struggled to meet operational demands. The much-delayed Project 75-I, aimed at building six next-generation conventional submarines with air-independent propulsion (AIP), is illustrative of the slow pace of indigenisation. While the Scorpene-class submarines built under Project 75 show promise, the lack of timely upgrades hampers operational readiness.

Self-Reliance Goals

The government's 'Make in India' initiative has sparked optimism, but its impact on naval capabilities remains mixed. Projects such as the Kamorta-class anti-submarine warfare corvettes and the ongoing construction of Project 15B Visakhapatnam-class destroyers highlight growing domestic expertise. However, indigenous systems often face delays due to resource constraints, limited technical expertise, and bureaucratic red tape. Analysts suggest it will take another 10–15 years before India achieves substantial self-reliance in naval systems.

Embracing Emerging Technologies

The Navy's modernisation strategy increasingly revolves around leveraging

emerging technologies to maintain its edge in maritime operations. Autonomous platforms, artificial intelligence (AI), and network-centric warfare are at the forefront of these efforts.

Autonomous systems, particularly unmanned underwater vehicles (UUVs) and surface vessels, are envisioned to complement manned fleets. These platforms can perform high-risk operations such as mine clearance and reconnaissance while reducing human casualties. Modular construction of these vessels, with interchangeable sensors and weapon systems, could enhance operational flexibility. However, the lack of indigenous expertise in such technologies poses serious challenges.

AI integration is another critical area. From predictive maintenance of equipment to target identification and electronic warfare, AI offers the potential to enhance decision-making and operational efficiency. For instance, leveraging AI for decision support systems (DSS) could reduce response times during critical missions. However, these capabilities remain in their infancy, with significant investments in research and development required for tangible results.

The Indian Navy stands at the cusp of technological transformation, with a focus on integrating artificial intelligence, autonomous systems, and advanced weaponry to enhance operational readiness. However, achieving self-reliance in defence remains a long-term goal fraught with challenges

The Role of Data and AI

The Navy generates vast volumes of operational data, yet harnessing this data effectively remains a challenge. The adoption of generative AI and cognitive systems could revolutionise areas such as surveillance, threat detection, and resource planning. The Navy's institutional memory, spanning decades, combined with real-time sensor data, provides a strong foundation for such systems.

However, integrating these technologies into legacy systems and ensuring secure data management are big hurdles. Initiatives like mosaic warfare, which involves integrating diverse systems for coordinated operations, could further enhance combat effectiveness but require careful planning and execution.

Laser Directed Energy Weapons Systems

(Pic courtesy: www.ndupress.ndu.edu)

Logistics and Supply Chain Challenges

Operational readiness also depends heavily on efficient logistics. While the adoption of IoT-based smart supply chain management (SCM) is underway, its implementation is far from complete. By upgrading existing systems to include Enterprise Resource Planning (ERP) and Just-in-Time (JIT) logistics, the Navy could minimise inventory costs and improve operational efficiency.

Healthcare Innovations for Naval Personnel

Ensuring the health and safety of personnel in remote and challenging environments is a persistent concern. Emerging technologies such as Internet of Battlefield Things (IoBT) can enable real-time health monitoring through smart wearables, potentially reducing fatalities during missions. Additionally, telemedicine platforms, combined with robotic surgery capabilities, could revolutionise medical care on board ships and in isolated locations.

Advancements in Weapon Systems

The Navy's focus on developing advanced weapon systems reflects its ambitions for modernisation. Laser-based technologies, such as Directed Energy Weapons (DEWs), hold promise for applications ranging from target disorientation to drone neutralisation. However, these systems are still in experimental stages, with formidable hurdles in operationalising them for naval missions.

Takeaways

The Navy's commitment to fostering collaborations with academia and industry is a step in the right direction. Initiatives like the Naval Innovation and Indigenisation Organisation (NIIO) aim to bridge the gap between users and manufacturers. Partnerships with institutions such as IIT Madras and startups specialising in advanced technologies have yielded some results, but scalability remains a challenge.

The Indian Navy's technological evolution is a long-term endeavour requiring a realistic assessment of its strengths and weaknesses. As India seeks to secure its maritime interests in an increasingly contested region, the Navy must adopt a pragmatic approach, focusing on achievable goals and sustainable innovation. Only through sustained efforts can it transition from a dependent force to a self-reliant, combat-ready maritime powerhouse, capable of addressing contemporary maritime challenges while safeguarding the nation's security. ■

From developing indigenous warships and submarines to adopting cutting-edge systems like AI and laser-guided weaponry, the Indian Navy's modernisation plans reflect ambition. Yet, resource constraints and technological gaps require sustained efforts to meet future maritime challenges

–The writer, an Aerospace Engineer, has served in the Indian Navy for 25 years. He is the founder and CEO of Defence Research and Studies [DRaS], a Fellow of the Institution of Engineers, and a Defence Research and Development Organisation – Technology Development Fund Expert. The views expressed are of the writer and do not necessarily reflect the views of Raksha Anirveda

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