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COVER STORY

Securing India's Maritime Edge

MESSAGE FROM THE EDITOR

Voyage into the Oceanic Future

Raksha Anirveda's (RA) endeavour since its launch in 2018 to promote the India Story, India Way continues to gain steady traction. The special print edition on the Indian Navy in 2024 was well received, and the encouraging feedback has motivated the *RA* team to carry forward this initiative with renewed commitment.

At a time when the convergence of technology, geopolitics, and demographics is reshaping security far beyond traditional borders, understanding the unpredictability of the future battlespace has become imperative. With its emphasis on agility, tech-fluency, and adaptability, the Indian Navy has emerged as a trailblazer, ensuring that the nation's maritime edge is retained despite multiple challenges. By accelerating innovation to safeguard the country against the unimaginable challenges of the future, the Navy today stands as a well-prepared, future-ready, and resilient maritime force.

India's naval build-up is gaining significant momentum as rising regional tensions reshape the shipbuilding landscape, creating a massive, multi-year opportunity. This special edition, themed "Securing the Nation's Maritime Edge," presents in-depth articles covering diverse facets of India's maritime evolution. It provides a comprehensive overview of the strides being made as the Indian Navy gears up for the next phase of maritime transformation — powered by the fusion of artificial intelligence, autonomous systems, and unmanned capabilities, alongside quieter enablers such as submarine support ships, amphibious aircraft, and light frigates. Capable of persistent presence, distributed lethality, and precision at scale, the Navy is rapidly evolving into a networked, data-driven force.

The cover story, aligned with this year's theme, underscores that India is no longer just a continental power with a coastline. Determined to secure its trade lifelines and claim its rightful place among the world's foremost oceanic powers by 2047, India's rise as a great maritime nation appears unstoppable. Another article explores the deeper strategic imperatives of safeguarding India's maritime advantage and argues for a unified mainland theatre that seamlessly connects with — and commands beyond — the Bay of Bengal and the Andaman Sea as one integrated operational space.

India's growing maritime ambition is backed by pragmatic investments in shipbuilding, naval modernisation, port expansion, coastal connectivity, and ocean research — all directed towards unlocking the full potential of its vast maritime sphere.

In the run-up to Navy Day 2025, the Indian Navy hosted the fourth edition of *Swavlamban 2025*, an event that showcased India's technological excellence and maritime vision for the future. Over the years, *Swavlamban* has evolved into a premier forum that brings together innovators, startups, industry, and the Armed Forces on a common platform. This year's edition highlighted the Navy's innovation and indigenisation efforts, focusing on collaborative, cutting-edge solutions for emerging operational challenges. It also underscored the vital role of the Indian industry and its technological advances in enhancing the nation's defence capabilities.

Observed annually on December 4, Navy Day commemorates the valiant 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 celebrations in Thiruvananthapuram, Kerala will feature an operational demonstration — offering civilians a rare opportunity to witness the Indian Navy's capabilities firsthand.

Team *Raksha Anirveda*, while acknowledging the invaluable guidance and active participation of Indian Navy veterans, expresses its heartfelt gratitude to the industry partners who have wholeheartedly collaborated and supported this initiative.

It is our hope that this special edition — reflecting upon the past, present, and future — amplifies the call to sustain India's momentum in navigating the challenges ahead. *Sam No Varunah.*

Jai Hind!

Ajit Kumar Thakur
Editor & Business Director

> "Indian Navy gears up for the next phase of maritime transformation — powered by the fusion of artificial intelligence, autonomous systems, and unmanned capabilities, alongside quieter enablers such as submarine support ships, amphibious aircraft, and light frigates"

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Indigenous Push for MARITIME Security

India, which is surrounded by the Arabian Sea to the west, the Bay of Bengal to the east, and the Indian Ocean to the south, has a coastline extending to 11,098.81 kms, and its territorial waters extend up to a distance of 12 nautical miles from the coast's baseline. Once a neglected sector, India's maritime industry is now at the heart of the government's defence and maritime strategy to secure an edge over other countries in the Indian Ocean Region

• **Asad Mirza**

Realising the potential of guarding India's sea borders and securing a maritime edge over its neighbours – both for defence and economic purposes the Indian Navy with full support from the government has embarked on an ambitious programme to develop indigenous platforms, systems, sensors, and weapons as part of the nation's modernisation and expansion of its maritime forces.

The support for the Indian navy from the government's side was evident during various events related to the Indian Navy. Defence Minister Rajnath Singh on October 23 highlighted changes in the Indian Ocean Region (IOR), which he said is "no longer passive." Addressing the top brass of the Indian Navy, the defence minister said, "IOR has become the centre of contemporary geopolitics. It is no longer passive; it has become an area of competition and cooperation."

He added that the Indian Navy, through its multidimensional capabilities, has played a leadership role in the region. "In the last six months, our ships, submarines, and naval aircraft have been deployed at an unprecedented scale. In addition, our Navy has provided safe passage to approximately 335 merchant vessels, equalling around 1.2 million metric tons of cargo and a trade value of 5.6 billion dollars. This is proof that India has now become a trusted and capable partner in the global maritime economy," Singh said while speaking at the Naval Commanders Conference.

The Defence Minister's statement follows his earlier emphasis on India's strategic location in the IOR and the increasing threats in the region. The Indian naval strategy currently focusses on the two-dimensional approach to the IOR, firstly it wants to secure its maritime defence and secondly it wants to enhance its maritime trade in the region.

As far as the naval defence strategy is concerned, due to the importance India attaches to potential threats to its maritime security, its diplomacy has increasingly focused on the IOR and it has increased cooperation with Indian Ocean states.

In the last five years India has also established security partnerships with major IOR strategic stakeholders such as France and the United States, India has increasingly invested in providing military training, weapons

support, and disaster relief assistance to "like-minded" states in the IOR.

The Indian Ocean has quietly become one of the most important regions in global geopolitics today. It is more than just a stretch of water - it is a strategic hub that carries over 80% of the world's maritime oil trade and connects major economies across Asia, Africa, and beyond. Key shipping lanes and chokepoints like the Strait of Hormuz, the Strait of Malacca, and the Bab el-Mandeb make this region vital not only for commerce but also for global energy security.

The IOR is rapidly becoming a complex and contested strategic space. It connects key trade routes, energy supplies, and economic centres. But this region also faces many security threats that affect not just India but many other countries. These threats come from rivalries between big powers, illegal activities at sea, natural risks, and India's own internal challenges.

One of the biggest concerns in the Indian Ocean is the growing competition between global powers-especially China and the United States. China has been developing ports and naval bases across the region in places like Djibouti, Gwadar (Pakistan), and Sri Lanka. These projects, often called the "String of Pearls," are part of China's plan to strengthen its presence in the region.

India is dealing with too many security demands at once - border tensions with China, managing relations in the Arabian Sea and Bay of Bengal, and helping with disaster response

While China claims these are for trade, they also help its Navy move and operate in the Indian Ocean. At the same time, the United States has a strong naval presence here, especially through its Fifth Fleet in Bahrain. The US has been working closely with countries like India, Australia, and Japan through the Quad group to balance China's growing power. For India, this strategic crowding raises concerns about losing initiative and space in its immediate neighbourhood, which it traditionally considered within its sphere of influence.

The Indian Ocean also has several choke points-narrow areas like the Straits of Hormuz and Malacca-that are extremely important for global shipping. If something goes wrong in these areas, like a conflict or blockage, it could affect oil prices and global trade.

Although India is building up its Navy and improving maritime infrastructure, it still faces many challenges. First, India has limited resources and technology gaps. Its naval ships, submarines, and surveillance systems are growing, but still not enough to cover the entire region effectively.

Second, India is dealing with too many security demands at once - border tensions with China, managing relations in the Arabian Sea and Bay of Bengal, and helping with disaster response. This puts a lot of pressure on its resources. Third, China's Maritime Silk Road-a part of its Belt and Road Initiative offers infrastructure loans to smaller Indian Ocean countries.

But many of these countries end up owing large debts to China. Sri Lanka, for example, had to hand over the Hambantota port to a Chinese company after failing to repay its loan. This kind of strategy allows China to gain long-term control over key maritime locations, which India finds deeply worrying.

Right now, the priority of the government is to allocate a Rs 70,000 crore plan to build ships, create jobs, and position the country among the world's top shipbuilders by 2047. This renewed focus was evident during the recently concluded India Maritime Week 2025, which opened in Mumbai with the Ministry of Ports, Shipping and Waterways (MoPSW) leading a series of landmark agreements and global collaborations focused on sustainability, innovation, and investment in the maritime sector.

The event, aimed at shaping India's maritime vision for Viksit Bharat 2047, saw the signing of memorandums of understanding (MoUs) worth Rs 10 trillion, of which Rs 1.55 trillion will be directed towards the shipbuilding segment.

The Union Minister of Ports, Shipping and Waterways

Sarbanand Sonowal noted that India's port capacity has doubled over the past decade from 1,350 million tonnes per annum (MTPA) to 2,700 MTPA and cargo handling has grown significantly.

Looking ahead to 2047, India aims to quadruple its port capacity to 10,000 MTPA, enable 10-fold growth in cruise tourism and increase the share of coastal and inland waterways cargo to 12 per cent in the modal mix, he said. The event also witnessed several high-profile announcements and partnerships.

Amit Shah, Union Home Minister, said the government has raised the maritime sector's budget sixfold and highlighted the $10 billion Vadhavan Port and $5 billion Great Nicobar project as pivotal to India's global maritime ambitions.

A major highlight was the Maritime Cooperation MoU between India and the Netherlands, including a Letter of Intent to establish a Green and Digital Sea Corridor connecting Indian ports with Rotterdam.

Multiple business MoUs were also signed with leading Indian and global firms including Adani Ports, JSW Infrastructure, Goa Shipyard and Abu Dhabi Ports Group covering green shipbuilding, financing, and port expansion.

In his inaugural address Admiral R Hari Kumar, Chief of the Naval Staff (CNS), emphasised the Navy's pivotal role in safeguarding national maritime interests amid changing global security dynamics. In his address, the CNS reiterated the Indian Navy's status as a 'Combat Ready, Credible, Cohesive, and

A growing and resilient industrial base with 'Make in India' impetus, and efforts to modernise, mechanise, and digitise ports along the busiest east–west trade route have provided India with a unique advantage. We have moved on from conjecturing whether our maritime sector can join the global green maritime transition meaningfully to asking if we can lead it decisively

Future-Ready Force'.

Admiral Kumar acknowledged the Navy's recent operational successes and capability upgrades, marking a significant step towards the goal of an Aatmanirbhar Navy by 2047. Through innovation, technological advancements, and the induction of indigenous defence systems, the Navy aims to ensure self-reliance and a robust maritime force.

The Chief of Defence Staff (CDS), General Anil Chauhan, also addressed the conference, emphasising the importance of jointness and integration across the Indian Armed Forces. The CDS reiterated the significance of resource optimisation and the need for improved coordination between the Navy, Army, and Air Force to bolster national security.

In addition to senior military leadership, Air Chief Marshal VR Chaudhari, Chief of the Air Staff, also participated in discussions, further strengthening the focus on cohesive and coordinated operational strategies.

On the sidelines of the conference, the Sagar Manthan event held on October 22 brought together Naval Commanders, subject matter experts, and thought leaders to discuss contemporary issues affecting maritime security. This event facilitated deeper engagement on emerging trends, challenges, and opportunities in naval warfare and regional security.

India Maritime Week 2025 demonstrates how global partnerships and state-level innovation together are shaping the maritime vision for Viksit Bharat 2047. India's ambition to lead global shipping sector's green transition is on a strong footing

The country's low renewable energy costs, engineering expertise, and skilled seafarers mean that it is ready to deliver at scale. India is ready to not just adapt to a changing world but shape it

A growing and resilient industrial base with 'Make in India' impetus, and efforts to modernise, mechanise, and digitise ports along the busiest east–west trade route have provided India with a unique advantage. We have moved on from conjecturing whether our maritime sector can join the global green maritime transition meaningfully to asking if we can lead it decisively.

According to Sonowal the leadership's intent is evident in the Modi government's recent approval of a Rs 69,725 crore ($8 billion) package to reimagine, revive, and rejuvenate India's shipbuilding and maritime ecosystem. This is not a routine budget line, but a signal of ambition.

He further said that this historic decision sets the stage for a maritime renaissance — a return to the spirit of seafaring enterprise that once defined India's trading heritage. It also aligns seamlessly with PM Narendra Modi's vision of an Aatmanirbhar Bharat and Viksit Bharat 2047 — a confident, capable nation that anchors global trade routes, not merely services them.

With strategic insights from the conference, the Indian Navy is set to continue strengthening its operational readiness, bolster regional engagements, and enhance its capabilities to remain a potent force in the Indo-Pacific region. The Indian Navy with its Vision 2047 seems poised to be a self-reliant, technologically advanced force ready for the challenges of the of the 21st century. ■

–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

Maritime POWER in Transition

The fusion of artificial intelligence, autonomous systems, and unmanned capabilities are turning the Indian Navy into a networked, data-driven force capable of persistent presence, distributed lethality, and precision at scale

• **Commander Rahul Verma (Retd)**

In the future, the fleet that senses first and strikes fastest will prevail — not the one that sails largest.

The Indian Navy's modernisation has entered a new epoch — one that transcends hulls and tonnage to focus on autonomous systems, artificial intelligence, and cognitive warfare. Operation Sindoor in May 2025 crystallised a stark reality: modern maritime conflict demands persistent surveillance, distributed lethality, and the ability to neutralise asymmetric threats while preserving the fleet's most valuable assets.

The Navy's emerging operational philosophy integrates Unmanned Aerial Vehicles (UAVs), Unmanned Surface Vessels (USVs), Unmanned Underwater Vehicles (UUVs), and autonomous weaponised swarms, which together extend India's maritime reach, reduce risk to personnel, and dramatically enhance response agility across the Indian Ocean Region (IOR).

Strategic Imperatives: The Underwater Challenge

The undersea domain of the Indian Ocean has become increasingly contested. China's Type 093 Shang-class nuclear attack submarines, capable of three-month patrols, and Pakistan's eight Hangor-class AIP-equipped submarines, armed with Babur-3 submarine-launched cruise missiles, have fundamentally altered the underwater balance of power. Each Hangor-class submarine, displacing nearly 2,800 tonnes, brings extended submerged endurance and a credible second-strike nuclear capability.

India's counter lies in building a formidable Underwater Domain Awareness (UDA) framework — a comprehensive subsurface monitoring architecture vital for protecting sea lines of communication (SLOCs). A significant leap in this direction is the High Endurance Autonomous Underwater Vehicle (HEAUV) developed by DRDO's Naval Science & Technological Laboratory — a six-ton platform capable of 15-day autonomous missions at depths of 300 metres, equipped with flank array sonar, side-scan sonar, front-looking sonar, and X-band radar. The system can perform anti-submarine warfare (ASW), intelligence gathering, and seabed mapping with minimal human intervention.

Building upon this, the Navy has initiated the procurement of Extra-Large Unmanned Underwater Vehicles (XLUUVs). Krishna Defence's 20-ton Jalkapi XLUUV — an 11-metre-long autonomous submarine operating at 300-metre depths for up

to 45 days — serves as a precursor to DRDO's planned 100-ton unmanned submarine, forming the backbone of India's future unmanned undersea fleet.

Complementing these are indigenous Underwater Remotely Operated Vehicles (UWROVs) procured from Coratia Technologies worth ₹66 crore. The Jalasimha UWROV provides AI-driven sonar mapping, seabed survey, and subsea inspection capabilities. To counter shallow-water threats, the Navy is inducting 16 Anti-Submarine Warfare Shallow Water Crafts (ASW-SWCs) — 78-metre vessels equipped with torpedoes, ASW rockets, and advanced sonar systems designed to secure coastal approaches where diesel-electric submarines operate.

Surface Autonomy and Aerial Dominance

One of the most striking developments in Indian naval innovation is the emergence of autonomous weaponised boat swarms. Under a contract with Sagar Defence Engineering, the Navy is inducting 12 Autonomous Weaponised Boat Swarm (AWBS) units — ten for naval operations and two for the Army at Pangong Lake. Each Mata Matangi-class vessel features 360° radar tracking, dual electro-optical cameras, remote-controlled 12.7 mm guns, and achieves 50 knots speed with a 2,000 kg payload for 48-hour continuous operation. Navigation integrates GPS and NaVIC, ensuring functionality in GPS-denied environments.

India's aerial maritime surveillance network has also evolved. Two leased MQ-9B SeaGuardian drones, operating from INS Rajali, have logged over 18,000 flight hours covering 14 million square miles. Following their success, India finalised a US$3 billion deal for 31 MQ-9B Sky/Sea Guardians, including 16 for the Navy. With 35+ hours endurance, a 450 kg payload, and Hellfire missiles, they deliver unmatched persistent ISR and precision strike capabilities. The SeaGuardians operate in tandem with MH-60R helicopters and P-8I maritime patrol aircraft, creating a layered surveillance grid.

The Navy's emerging operational philosophy integrates UAVs, USVs, UUVs, and autonomous weaponised swarms, which together extend India's maritime reach, reduce risk to personnel, and dramatically enhance response agility across the IOR

In parallel, Tardid Technologies is developing IMO Level 4 autonomous fast-attack craft, designed for manned-unmanned teaming with UAVs and UUVs. These surface and underwater swarms will detect mines, conduct reconnaissance, and execute strike missions with minimal cost and risk.

The Navy's adoption of indigenous loitering munitions from Bharat Forge, Economic Explosives, and Indian startups — 40 per cent cheaper than imported variants — further enhances its precision-strike portfolio. Each munition provides real-time electro-optical/infrared guidance, giving operators live visual control during terminal engagement.

As autonomy extends from the ocean depths to the skies above, the defining metric of power is no longer tonnage but cognition.

Artificial Intelligence and Lethal Integration

Artificial Intelligence forms the neural network of the Navy's future force structure. Over 30 AI projects are in progress, encompassing autonomous systems, predictive maintenance, maritime domain awareness, and combat decision-making. INS Valsura, the Navy's Centre of Excellence for Big Data and AI, drives this transformation with a dedicated AI and data analytics laboratory supporting operational and administrative decision-making.

A major step forward is the Collaborative Long-Range Target Saturation/Destruction System (CLRTS/D)

— an indigenous swarm-drone programme employing decentralised AI. Each drone in the swarm operates autonomously, enabling adaptive regrouping and retasking without central control. With a range exceeding 1,100 km, DSMAC navigation, INS/IRNSS integration, and encrypted datalinks, the system provides a resilient strike capability under GPS-denial or jamming conditions.

Comparable global efforts include the US Navy's "Ghost Fleet Overlord" unmanned surface vessels and the UK's Cetus XLUUV programme. India's indigenous, cost-effective approach offers a scalable alternative tailored to the Indo-Pacific — combining affordability, adaptability, and innovation.

Lethality Remains Paramount

Despite growing autonomy, firepower remains the ultimate currency of deterrence. The BRAHMOS supersonic cruise missile, with Mach 3 speed and a range of up to 400 km, has become the Navy's principal strike weapon. By 2025, 20 frontline warships are equipped with BRAHMOS systems, with the government approving procurement of over 220 BRAHMOS-ER missiles worth ₹19,518.65 crore. By 2030, more than 300 missiles will be deployed across destroyers and frigates.

The Project 18 Next Generation Destroyers (NGD) mark a quantum leap in capability. Each 13,000-tonne ship will feature 144 Vertical Launch Systems (VLS) — triple the capacity of existing destroyers — effectively bringing India into the cruiser-class league. The programme envisions an eventual fleet of up to 24 NGDs, dramatically expanding long-range strike capacity.

Operational Framework and Counter-Threats

Operation Sindoor demonstrated the Indian Navy's rapid-response capability. Within 96 hours of the Pahalgam terror attack, all major warships deployed with full munitions, submarines sailed, and MiG-29K fighters embarked on INS Vikrant. This posture effectively contained Pakistan's Navy within its territorial waters, underscoring the value of readiness and mobility.

However, the operation also revealed the proliferation of low-cost drones as a potent asymmetric threat. To counter this, the Navy has fielded Naval Anti-Drone Systems (NADS) developed jointly by DRDO and BEL — India's first indigenous anti-drone solution combining detection, jamming, and laser-based neutralisation. Integrated on ships by Hindustan Shipyard, NADS can detect and destroy hostile drones up to 30 km away, across 400 MHz to 6 GHz frequencies.

India's maritime doctrine has evolved from the concept of a "Net Security Provider" to a "Preferred Security Partner". The MAHASAGAR Vision, launched in 2025, expands this framework to encompass maritime trade security, capacity building, and regional cooperation across the Global South. The Quad's Indo-Pacific Partnership for Maritime Domain Awareness (IPMDA) further integrates India into real-time regional surveillance networks, enhancing transparency and deterrence.

The future Indian Navy is no longer just a fleet — it is a living network of machines, algorithms, and human command, engineered for maritime dominance in the Indo-Pacific

Beyond operational gains, India's rise as a hub for affordable autonomous maritime systems carries strategic and industrial implications. Exporting modular, cost-effective autonomy to friendly nations not only strengthens partnerships but also extends India's influence across the Indo-Pacific's strategic architecture.

The Autonomous Imperative

As the Indian Navy progresses toward its target of 175 warships by 2035, the integration of unmanned, autonomous, and intelligent systems will be decisive in maintaining

maritime superiority. Persistent ISR from MQ-9B drones, autonomous swarm boats conducting reconnaissance, and UUVs patrolling strategic chokepoints together establish a seamless surveillance web across the Indian Ocean.

Autonomous platforms allow India to project power across vast oceanic spaces without proportionally increasing manpower or cost. They neutralise threats at a fraction of missile expenditure, sustain prolonged deployments, and extend situational awareness. The future fleet will operate as a cohesive human-machine ecosystem — one that shifts from force concentration to distributed lethality, and from reactive operations to predictive presence.

From the ocean depths patrolled by XLUUVs, to littoral zones secured by weaponised swarms, to skies watched over by MQ-9Bs, the Indian Navy is building a truly multi-domain network of maritime intelligence and lethality. The fusion of underwater autonomy, surface swarms, aerial persistence, artificial intelligence, and supersonic strike power is redefining what maritime dominance means in the 21st century.

This transformation is no longer theoretical — it is operational. The question is not whether unmanned systems will define future maritime power, but how rapidly India can scale and integrate them to secure its interests against evolving threats.

The Indian Navy — unmanned, autonomous, and increasingly lethal — is charting a decisive course toward maritime supremacy in the Indian Ocean and beyond. ■

–The author is an Emerging Technology and Prioritisation Scout with one of India's leading conglomerates, driving modernisation through innovation in aerospace and defence. A decorated naval aviator with over two decades of service, he has flown the Sea King helicopter, commanded Remotely Piloted Aircraft (RPAS) missions, and served as a Flying Instructor, mentoring the next generation of naval aviators. The views expressed are personal.

Building INDIGENOUS Maritime Shield

For decades, India has relied on imported "eyes in the sky" like the American P-8I Poseidon to spot lurking enemy submarines. But as global tensions shift and technology hardens into diplomacy, New Delhi is rethinking this dependence. The call for an indigenous airborne Anti-Submarine Warfare (ASW) platform is growing louder — not just as a strategic necessity, but as a statement of sovereignty

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

The Indian Defence Acquisition Council approved the procurement of six additional P-8I aircraft in November 2019, which was later authorised by the US State Department in May 2021. However, after the initiation of the tariff war by the Trump administration, India's order for these six additional P-8I aircraft was put on hold due to a sharp price escalation. Nevertheless, negotiations are still ongoing between India, the United States, and Boeing for the acquisition of these aircraft. India already operates a fleet of 12 P-8I aircraft, deployed across two different squadrons of the Indian Navy.

Why ASW Is Important

Anti-Submarine Warfare (ASW) is a crucial capability for any nation's naval forces because enemy submarines can pose serious threats to maritime security. In today's strategic environment, submarines can attack surface ships, disrupt trade routes, and threaten vital sea lines of communication (SLOCs). An ASW infrastructure helps provide strategic defence by protecting SLOCs from underwater threats. It also supports joint operations with friendly nations, contributes to regional stability, and ensures a tactical edge over potential adversaries.

Airborne ASW Capabilities in India

Airborne ASW operations are vital because they reduce risks to own naval assets while providing enhanced detection and tracking capabilities over vast oceanic areas. ASW capabilities form a core part of the Indian Navy's defence strategy, especially in light of increasing submarine activity in the Indian Ocean Region (IOR).

Airborne ASW platforms act as the "Eye in the Sky" and serve as the first responders in the event of an underwater threat. The P-8I Poseidon aircraft, operated by the Indian Navy, provides long-range surveillance and is equipped with advanced radar systems and onboard ASW sensors. It carries a variety of sonobuoys, is fitted with magnetic anomaly detectors (MAD) for locating submarines, and is armed with lightweight torpedoes as its primary anti-submarine weapon. The aircraft can cover vast stretches of the Indian Ocean, making it one of the most effective maritime patrol aircraft in the world.

In the vast blue expanse of the Indian Ocean, an invisible war is already underway — a silent duel beneath the waves, where detection means survival and stealth decides supremacy. Airborne ASW platforms act as the 'Eye in the Sky' and serve as the first responders in the event of an underwater threat

Multi-Layered ASW Protection

Only a few nations globally possess strong airborne ASW capabilities, and India is among them. The Indian Navy operates a multi-layered ASW system that integrates submarines (for offensive ASW operations), surface ships, aircraft, helicopters, and unmanned systems.

This capability has expanded rapidly, with the Indian Navy

now operating over 150 warships, including 17 attack submarines. Within this layered defence network, the P-8I aircraft represents the first line of detection and deterrence.

These squadrons are manned around the clock by highly trained ASW specialists capable of analysing complex sonar data generated from multiple platforms and sensors. The now-decommissioned TU-142M aircraft, a Russian-origin predecessor of the P-8I, had superior ASW capabilities with a wide range of sonobuoys capable of detecting submarines at a greater depth and scanning over large areas of the ocean.

Need for an Indigenous ASW Aircraft

India has over four decades of experience in airborne ASW operations, but an indigenous design and development program for an advanced ASW aircraft similar to the P-8I or TU-142M has yet to begin.

This dependency on foreign platforms could pose a challenge if technical support for the P-8I is ever restricted due to geopolitical or sanction-related issues. The decision to procure the P-8I from Boeing rather than upgrading the existing TU-142M fleet was taken in 2008 to simplify maintenance, logistics, and operations.

However, because producing a small number of indigenous aircraft may not be commercially viable, the Government of India opted for foreign procurement. If India now moves toward indigenisation, it must focus on larger-scale production and export to friendly foreign nations (FFNs) to ensure economic feasibility and sustainability.

Bringing Back "Project Simhika"

DRDO's Project "Simhika" was an airborne ASW initiative developed in collaboration with the Indian Navy. Its primary goal was to establish an advanced, large-scale surveillance system in the Indian Ocean Region (IOR) to detect and track enemy submarines.

The current status of Project Simhika is not publicly known, but the project could be revived and modernised using India's DRDO expertise and growing defence startup ecosystem. In parallel, indigenous development of compatible sonobuoys can also be pursued.

While India is presently collaborating with the US to

develop Low-Frequency Dunking Sonar (LFDS) for ASW helicopters, the coverage and capabilities of airborne ASW systems remain far superior in scale and range.

Development of New-Generation Sonobuoys

Sonobuoys are the primary sensors of airborne ASW systems. Once deployed at sea, these floating sensors transmit underwater acoustic data to aircraft for analysis.

Developing indigenous sonobuoys tailored to the ASW platform is mandatory, since each ASW system requires its own compatible sensors. The DRDO could take the lead in developing state-of-the-art, autonomous, AI-enabled smart sonobuoys capable of intelligent data processing.

With recent advancements in long-endurance and low-cost battery technologies, it is now possible to replace traditional saltwater-activated batteries with rechargeable or renewable-energy-based systems. The use of solar or ocean-energy harvesting can be explored to extend operational life after deployment.

Additionally, the recovery and recycling of deployed sonobuoys would be both environmentally responsible and cost-effective, aligning with India's Sustainable Development Goals (SDGs).

Development of Air-Launched Supercavitation Torpedoes

Supercavitation is a cutting-edge propulsion technology that allows torpedoes to achieve extraordinarily high underwater speeds by creating a gas bubble (super-cavity) around the torpedo's nose, drastically reducing drag. The DRDO's Naval Science and Technological Laboratory (NSTL) is developing an ultra-high-speed supercavitation torpedo, known as "Varunastra," capable of achieving speeds exceeding 80 knots (148 km/h). However, the current version weighs around 1.5 tons, making it unsuitable for air-launch.

Hence, there is a pressing need to develop a lighter air-launched version of this torpedo, which would be a game-changer for India's ASW capabilities, allowing aircraft to engage submarines quickly and effectively.

Autonomous Surface Vessels for Airborne ASW Support

Autonomous Surface Vessels (ASVs), also known as Unmanned Surface Vehicles (USVs), are becoming increasingly critical components in ASW operations. They act as force multipliers by extending the reach and endurance of ASW aircraft and helicopters.

ASVs can assist in managing deployed sonobuoys, augmenting sensors, and even recovering or repositioning sonobuoys. With further advancements in autonomous technology and endurance, these vessels may eventually take over some of the functions of traditional sonobuoys, offering longer operational durations and improved coverage.

Reviving DRDO's long-shelved Project Simhika and harnessing AI-driven sonobuoys, lighter torpedoes, and autonomous surface vessels could turn India from a vigilant observer into a maritime power that builds — not buys — critical marine assets

Installation of Fixed Underwater Sensors

The deployment of fixed sonar sensors across the entry points of major ports and maritime straits can significantly strengthen India's underwater surveillance network.

Although the initial installation cost may be high, such a system would prove cost-effective over time and could be integrated with airborne ASW platforms for a comprehensive surveillance grid.

Building a Digital Repository of Sonar Signatures

The Indian Navy already maintains a valuable repository of sonar signature data—unique acoustic fingerprints that help identify and classify submarines.

Efforts should be made to ensure data portability and interoperability across different platforms. Generative AI and deep learning techniques, such as Generative Adversarial Networks (GANs), can be used to create synthetic sonar data for training and testing purposes. India should also consider forming a permanent task group for sonar signal processing, target classification, and data sharing to ensure continuity and institutional knowledge. Establishing a centralised digital sonar data repository would help future systems evolve more rapidly.

AI Algorithms for Airborne ASW Operations

AI plays a pivotal role in predicting enemy submarine positions using advanced mathematical models, optimisation techniques, and real-time data analysis.

Kinematic and dynamic modelling algorithms can estimate a submarine's speed, acceleration, and likely trajectory, while Random Finite Set (RFS) theory can manage uncertainty, false alarms, and unseen targets.

Bayesian inference and sequential Monte Carlo methods help assimilate data in real time to update the submarine's estimated position, and metaheuristic algorithms can optimise search and tracking efforts, improving accuracy and efficiency.

Tracking Enemy Submarines 24x7 Worldwide

Tracking enemy submarines continuously across global waters is a monumental challenge, given their stealth, speed, and unpredictable movement patterns.

Although no system can yet guarantee real-time, global submarine tracking, technological advances and multi-layered surveillance networks are narrowing detection gaps, especially around strategic chokepoints and high-value assets.

Digital twinning frameworks—which create virtual, real-time replicas of ocean environments and submarine positions—represent the next frontier in global underwater surveillance, although they remain technically demanding and resource-intensive.

Make in India, Make for the World

Any indigenous development in the defence sector becomes commercially viable only when production scales up or receives strong government support. For a limited number of aircraft, achieving cost efficiency is difficult.

Therefore, joint development programs, public-private partnerships, and export collaborations with friendly foreign nations can ensure economies of scale and global competitiveness. The DRDO and Indian Navy should take the lead in reviving the indigenous ASW initiative, leveraging current geopolitical opportunities that favour domestic defence innovation, particularly in the post–Operation Sindoor environment. ■

–The writer is a veteran aerospace engineer with over 25 years of service in the Indian Navy. He has led numerous defence technology projects and now serves as a consultant to global defence organisations. He is also the Founder and CEO of Defence Research and Studies (DRaS) and an Adjunct Professor at SASTRA University, focusing on emerging defence technologies. The views expressed are personal.

Beneath the Indian Ocean: INDIA IS BUILDING an Invisible NAVY

The Indian Navy's unmanned underwater fleet, the invisible guardians beneath the waters, will be essential in securing the nation's maritime edge as the nation's maritime frontier continues to expand

• **Joseph P Chacko**

As one of the world's preeminent maritime powers, India's naval strategy has long recognised the subsurface domain as the critical frontier in securing national maritime interests. With growing instability in the Indian Ocean Region (IOR), the proliferation of submarines by regional adversaries, and the strategic weight of sea-based deterrence, the Indian Navy has increasingly invested in unmanned underwater systems (UUS) to augment its surveillance, reconnaissance, and anti-submarine warfare (ASW) capabilities. The shift from a manpower-intensive to a technology-driven underwater presence symbolises India's transition toward network-centric warfare integration and maritime domain awareness at depth.

The Development of India's Unmanned Underwater Initiatives

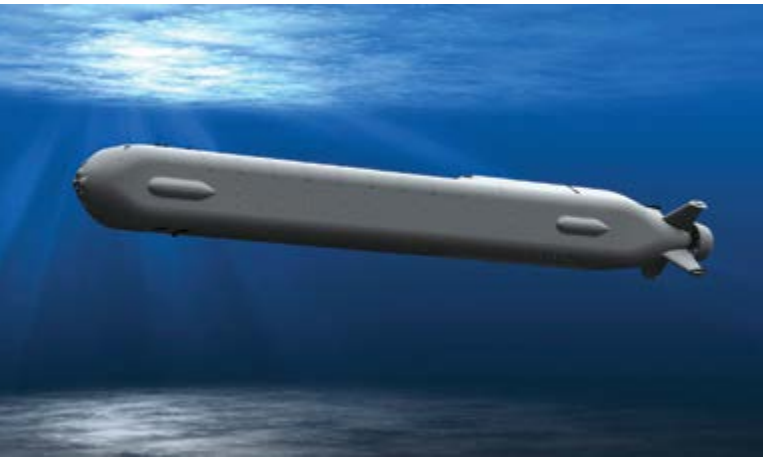
The roots of India's interest in autonomous underwater operations can be traced to early Naval Science and Technological Laboratory (NSTL) programmes in the 2000s that explored torpedo recovery vehicles and prototype remotely operated platforms. Over two decades, these efforts matured into indigenous Unmanned Underwater Vehicle (UUV) designs capable of executing seabed surveys, mine countermeasure (MCM) operations, and hydrographic data collection. The Defence Research and Development Organisation (DRDO) has collaborated with the Indian Navy to establish an incremental roadmap, emphasising both strategic autonomy and modular adaptability of systems.

Recent trials conducted off Visakhapatnam and Port Blair demonstrate how technologies from the Autonomous Underwater Vehicle (AUV) programme, such as "AUV-150" and "AUV-L," have transitioned from developmental phases to operational testing. These platforms are being tailored for extended endurance, high-resolution sonar imaging, and integration into the Navy's digital communication infrastructure. They represent a wider ambition: to establish a family of unmanned systems ranging from small inspection drones to

large-displacement AUVs operable alongside submarines and surface combatants.

Role of DRDO and Industry Collaboration

DRDO's NSTL, with support from institutions like NIOT (National Institute of Ocean Technology) and the private sector, has been central to advancing the boundaries of underwater autonomy. The development of underwater



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navigation algorithms, battery endurance enhancement, pressure-resistant hulls, and AI-enabled mission planning has been accelerated in recent years. Indigenous lithium battery solutions from Bharat Electronics Limited (BEL) and sophisticated control software from Indian startups have made these systems more deployable and less reliant on imported subcomponents.

Several Indian shipyards and defence companies are also working toward modular platforms with plug-and-play mission payloads. These could include synthetic aperture sonar (SAS) modules for mine detection, magnetic anomaly sensors for submarine tracking, or cameras for underwater intelligence gathering. This ecosystem synergy is consistent with the overarching Aatmanirbhar Bharat vision, as it promotes innovation in maritime robotics and systems integration while simultaneously reducing external dependencies.

Role of PSU's and Private Companies

Domestic industrial endeavours, notably those of Mazagon Dock Limited (MDL) and Larsen & Toubro (L&T), are increasingly influencing the unmanned underwater capabilities of the Indian Navy. MDL is spearheading the development of Extra Large Unmanned Underwater Vehicles (XLUUVs) that are specifically designed for deep-sea strategic missions, including surveillance, mine warfare, and anti-submarine operations. These vehicles are capable of operating for more than 45 days and can carry modular payloads, including torpedoes. L&T is developing smaller, tactical autonomous underwater vehicles such as AMOGH, ADAMYA, and MAYA, with a focus on mine countermeasures and reconnaissance. Additionally, the company is developing submarine-launched unmanned aerial vehicles to improve the capabilities of underwater and aerial ISR.

Strategic and Tactical Applications

The flexibility of unmanned underwater systems across mission categories is the source of their value. They offer continuous surveillance over critical sea lanes, underwater cables, and harbour approaches during routine operations without putting manned units at risk. In anti-submarine warfare, they function as silent scouts, either by probing for hostile signatures or operating as decoys. They facilitate the detailed mapping of seabeds that is essential for the coastal security infrastructure and submarine navigation in oceanographic and hydrographic missions.

The Indian Navy has demonstrated a particular interest in autonomous swarm concepts, which involve the operation of multiple small unmanned underwater vehicles (UUVs) in a coordinated formation with minimal human supervision. These vehicles can more effectively detect submarines or mines by operating in clusters, which allows them to cover vast volumes of water. The convergence of unmanned underwater vehicles with unmanned surface vessels (USVs) and satellite-

based command systems also creates opportunities for networked maritime defence, facilitating cross-domain data sharing.

The silent endurance of large AUVs could eventually support India's nuclear trinity by safeguarding sea-based deterrent assets through underwater perimeter surveillance, in addition to tactical missions. India's unmanned deterrent network could be instrumental in maintaining the integrity of its maritime deterrence posture and the survivability of ballistic missile submarines as adversaries in the Indo-Pacific experiment with subsea drones and gliders.

Future Prospects and Obstacles

Although advancements have been made, many obstacles continue to impede the full-scale deployment. The technical barrier of reliable underwater communication is the attenuation of signals in deep water, which requires the use of acoustic modems or surfacing intervals for data relay. Long-endurance operations over thousands of kilometres remain an aspiration, although advances in lithium-ion and silver-zinc batteries have extended the range of AUVs. Additionally, energy density limits the duration of missions. Robust artificial intelligence and fail-safe redundancy are necessary for autonomous decision-making in intricate underwater environments, where GPS and real-time supervision are unavailable.

Nevertheless, one can observe gradual enhancements. The Indian Navy has solicited expressions of interest for more advanced platforms and has initiated procurements under the Make-II category for indigenous UUVs that are capable of operating at a depth of 300–600 metres. Simultaneously, India's intention to enter a domain that is currently dominated by a handful of major navies, such as the United States and China, is indicated by the anticipated modular payload bays, extended range exceeding 1,500 kilometres, and potential torpedo-launch capabilities of DRDO's under-development Extra Large UUV (XLUUV).

A dedicated command structure for unmanned systems administration within the Navy, in conjunction with future integration with naval submarines and aircraft for coordinated ASW operations, has the potential to insti-tutionalise their operational role with the Navy

A dedicated command structure for unmanned systems administration within the Navy, in conjunction with future integration with naval submarines and aircraft for coordinated ASW operations, has the potential to institutionalise their operational role with the Navy. The digital backbone for such coordination is anticipated to be provided by the Indian Navy's Information Management and Analysis Centre (IMAC) and its integration with satellite surveillance networks.

In conclusion, the Indian Navy's perception of maritime security and undersea warfare is being consistently redefined by unmanned underwater systems. India's advancements in the management of the immense expanse of the Indian Ocean are indicative of both technological self-reliance and strategic foresight, as evidenced by the development of sophisticated autonomous platforms from humble R&D prototypes. The Navy's unmanned underwater fleet, the invisible guardians beneath the waters, will be essential in securing the nation's maritime edge as the nation's maritime frontier continues to expand. ■

–The writer is the publisher of Frontier India and the author of the book – Foxtrot to Arihant: The Story of Indian Navy's Submarine Arm. The views expressed are personal and do not necessarily reflect the views of Raksha Anirveda.

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One Joint Space
CRAFTING INDIA'S
Mainland Integrated Maritime Command

Each Navy Day, India glances seaward, yet the Andamans reveal how this once-a-year focus misses deeper strategic realities. For securing India's maritime edge, real security demands not a solitary forward A&N Command, but a unified mainland theatre that connects with—and commands beyond—the Bay of Bengal and Andaman Sea as one joint space

• **Rear Admiral Sudhir Pillai**

Over three and a half decades in uniform, I have served in the Andaman and Nicobar (A&N) Islands in almost every role the Services can offer and the islands demand. As a young aviator in the 1980s, I arrived to support early oil surveys, but we ended up doing everything the islands threw at us: search and rescue, medical evacuations, and flying into weather that punished hesitation. It was the kind of flying that teaches you distance, fragility, and respect long before you learn the vocabulary of strategy.

Later, as the Captain of a small Coast Guard patrol vessel, I saw how unforgiving these waters truly are. The ship was never built for monsoon seas, and the seas never cared. Every wave reminded me that this is a theatre that tests both man and machine.

As Commander Amphibious Task Force (CATF) when in command of a Destroyer, the view changed again. The islands offered many beaches but almost no depth, with little infrastructure. You could land troops, but sustaining them was another matter. That is when the idea of a theatre stopped being academic. It became something I could feel: thin, exposed, and dependent.

As Chief of Staff to CINCAN (Commander-in-Chief, Andaman & Nicobar Command), working with mainland forces during joint exercises, another truth became obvious. Everything depends on what comes from the mainland—ammunition, spares, fuel, reinforcements, communications, even confidence. The A&N Islands are only as strong as the mainland structures that support them.

These experiences shape my concerns and hopes. The islands matter not only for what they are, but for what they reveal about India's wider strategic posture.

The Great Nicobar trans-shipment project, to my mind, feels imagined in faraway Delhi by people who may never have walked the islands. It is not a 'Pearl Harbour' waiting to be built, nor a pearl waiting to be strung into a strategic necklace. History tells a different story: when the Japanese arrived here during the Second World War, the island's vulnerability was unmistakable. Geography has not changed since.

The islands draw their strength from the mainland; cut that link and they stand exposed. No single Service can secure this theatre; its geography demands jointness from the outset

A Country Beyond the Subcontinent

For decades, India has viewed security primarily through land borders and mountain frontiers. These habits—what I call continental reflexes—still shape our thinking. Even as Look East and Act East shifted our diplomacy eastward, a gentle fog settled at sea. The Bay of Bengal and the broader Indo-Pacific stayed in the background. Threats grew, partnerships deepened, yet our command structures kept their land-first mindset.

Long before A&N Command (ANC) existed, the Navy had carved out Fortress Andaman under a three-star commander. For those who lived and worked there, the islands clearly needed a larger structure to handle their vastness and isolation. Some even imagined a Far Eastern Command. But most decision-makers saw the islands as a remote LTC (Leave Travel Concession) destination. The idea faded.

Then Kargil arrived, reviving older continental reflexes. Maritime reform slipped out of focus.

When the government created the ANC based on the Kargil Review Committee and Group of Ministers (GoM) recommendations, it was a bold

step. It replaced Fortress Andaman and gave the islands a joint form. But it also created a paradox: we built a forward arm without the body behind it—a joint outpost without a joint mainland.

Each Navy Day, India Remembers the Sea

Every Navy Day, ships are lit up and the maritime world re-enters national memory. But the sea does not stop for ceremony. China's navy expands. Pakistan's military grows with Chinese support. Survey ships, submarines, and sensors push deeper into the Indian Ocean. The maritime stage stays active, whether we are mindful or not.

And nowhere does this stage stand clearer than in the Andaman and Nicobar Islands.

A Geography That Forces Clarity

The Andamans lie closer to Aceh in Sumatra (Indonesia) than to Chennai. They sit at the western gate of the Strait of Malacca, facing two different seas. They project India outward into Southeast Asia but depend inwardly on the mainland for every essential function.

True capability is sustained logistics, theatre-level protection, and the ability to reinforce quickly under pressure. The islands do not reveal India's power; they reveal our structural gaps

This duality is India's strategic paradox: outward-facing islands that rely entirely on inward strength.

This is why symbolic deployments mislead. A visiting submarine or temporary air detachment does not represent capability. True capability is sustained logistics, theatre-level protection, and the ability to reinforce quickly under pressure. The islands do not reveal India's power; they reveal our structural gaps.

Theatre Nuances: Shakespearean Folly or Strategic Reality

The word 'theatre' still unsettles parts of the defence establishment, especially the IAF (Indian Air Force), which worries about hierarchy and preserving air power's flexibility. These concerns are legitimate.

But theatre is not merely bureaucratic. Shakespeare used it for a living stage shaped by storms and shifting fortunes. Military thinkers like Milan Vego use it to describe vast operational spaces where unity of purpose and command are essential across land, sea, air, space, and cyber domains.

Seen through this lens, the Andaman region is a theatre not by choice but by geography. Action in one domain shapes the others. Geography insists on the word.

India's Joint Limitations

The ANC was meant to be India's first experiment in jointness. But jointness is not declared; it must be lived.

The islands are a limb stretched into the ocean. But limbs

matter only when the body behind them is coordinated. Every sortie, supply shipped, and deployment begins on the mainland, hundreds of miles away.

The islands are not the theatre. They are the visible extension of a theatre whose centre lies on the mainland, under a unitary, cohesive commander. India has not created that commander.

Two Seas, One Strategic Space

The Bay of Bengal is an 'open sea': wide, deep, and suited for long-range manoeuvre. The Andaman Sea is a 'narrow sea': confined, shallow in parts, and crowded with chokepoints. Operations in each sea differ, but in conflict their distinctions vanish. Forces will move across both. The weather will compress timelines. Decisions must treat them as one space before crisis forces them to. Dividing these seas between multiple mainland commands and a single ANC creates delay and confusion. Ships wait for orders from different headquarters. Aircraft respond without unified sequencing. Resupply lines become vulnerable because no one commander sees the whole picture.

Only a mainland theatre command can bind the Bay of Bengal and the Andaman Sea into one operational space. The ANC cannot shoulder that burden alone for several reasons.

Joint Operations Are Not Optional

Platforms are the surface of strategy. Logistics is its spine. In the A&N theatre, everything begins on the mainland: fuel, ammunition, spares, reinforcements, even building materials such as bricks and aggregate.

Resources must be layered. Surveillance must be continuous. Every element must reinforce the others. This only happens when one commander controls the entire logistics chain and its protection. Air power, carrier groups, submarines, satellites, cyber systems, and unmanned sensors all converge here. No Service can operate alone. Modern conflict demands integration from the start.

A mainland theatre command would give India faster reinforcement, coherent air–sea planning, unified decisions, and 'exterior lines' strengthened by resilient 'interior lines'.

A mainland theatre command would give India faster reinforce-ment, coherent air–sea planning, unified decisions, and 'exterior lines' strengthened by resilient 'interior lines. India cannot meet twenty-first-century maritime competition with twentieth-century command structures

Three Takeaways

The core message is clear. First, the islands draw their strength from the mainland; cut that link and they stand exposed. Second, no single Service can secure this theatre; its geography demands jointness from the outset. And third, India now needs a mainland theatre command that unifies responsibility, logistics, and decision-making, turning the islands from a vulnerable outpost into a true strategic asset.

Why Change Cannot Wait

China has positioned the Indian Ocean as an extension of its maritime strategy. Its deployments, port links, and intelligence networks extend into our neighbourhood. Pakistan benefits directly from this alignment. Together, they probe India's structural seams. India cannot meet twenty-first-century maritime competition with twentieth-century command structures.

Navy Day: Beyond the Celebration

Navy Day must be more than ceremonial lighting. The seas are where India's strengths and vulnerabilities meet.

The Andaman and Nicobar Islands show both potential and exposure. They show why a mainland theatre command is not optional. They show why India must move from individual acts to a single director who sees the eastern seaboard and the islands as one theatre. India's maritime strategy cannot be Navy-centric. It must unify the Army, Air Force, Navy, and Coast Guard under a single purpose. This is the next step in India's maritime evolution—and the step that will secure a lasting advantage in the Indo-Pacific. ■

–The writer is a former Flag Officer Naval Aviation, Chief of Staff at Headquarters, Andaman & Nicobar Command and Chief Instructor (Navy) at the Defence Services Staff College (DSSC), Wellington. The views expressed are of the writer and do not necessarily reflect the views of Raksha Anirveda

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Schiebel India's MRO OPERATIONAL Readiness Assured

Schiebel India has successfully operationalised its MRO in Hyderabad. The new unit apart from expanding Schiebel India's footprint, also ensures helping the Aatmanirbhar Bharat mission, by strengthening the domestic ecosystem and handholding and working together with smaller MSMEs

• **Asad Mirza**

Taking the ***Raksha Anirveda*** team around the Schiebel India's newly operationalised Maintenance, Repair and Overhaul (MRO) facility, ***Jajati Mohanty, CEO of Schiebel India*** said that for the first time in India all the technical requirements for maintaining a CAMCOPTER® S-100 are available under one roof. The facility in addition to regular MRO also includes three assembly lines, ESD rooms for electronic and software activities and area to manage / hold spares in environmentally controlled set up. And the facility can serve clients not just from India but from rest of the Asia too, particularly from South Asian countries like Malaysia, Indonesia, and Thailand, where Schiebel has already sold its S-100 systems.

Vienna, Austria-based Schiebel Group focuses on the development, design, and production of the revolutionary CAMCOPTER® S-100 and S-300 Unmanned Air Systems (UAS). Certified to meet AS/EN 9100 standards, Schiebel has built an international reputation for producing high-tech military, commercial and humanitarian products, which are backed by exceptional after-sales service and support. Schiebel has facilities in Vienna and several other countries.

Meanwhile, Schiebel's CAMCOPTER® S-100 Unmanned Air System (UAS) has proved its capability for military and civilian applications. The Vertical Take-off and Landing (VTOL) UAS needs no prepared area or supporting launch or recovery equipment. It operates day and night, under adverse weather conditions, with a range up to 200 km, both on land and at sea.

The S-100 navigates automatically via pre-programmed GPS waypoints or can be operated directly with a pilot control unit. Missions are planned and controlled via a simple point-and-click graphical user interface. High-definition payload imagery is transmitted to the control

Jajati Mohanty
CEO-Schiebel India

***Raksha Anirveda* team visits Schiebel India's facility**

station in real time. Using "fly-by-wire" technology controlled by redundant flight computers, the UAV can complete its mission automatically in the most complex of electromagnetic environments. Its carbon fibre and titanium fuselage provides capacity for a wide range of payload / endurance combinations.

Schiebel has also set up an experienced software team in Hyderabad to cater for all software updates, patches in addition to creating top of the line mission planning software for future upgraded S-100 design and the newly launched S-300 platform. With the creation of this software team and capability, Schiebel is now among the very few OEMs who are utilising the IT potential / work force of India to its fullest.

In the current year, Schiebel once again showcased the unrivalled versatility of its CAMCOPTER® S-100 at various global and Indian naval exercises, such as NATO's annual REPMUS (Robotic Experimentation and Prototyping using Maritime Uncrewed Systems) exercise, hosted by the Portuguese Navy, and the European Defence Agency's (EDA) first-ever Operational Experimentation (OPEX) campaign, showcasing its autonomous cross-domain logistics capabilities in a complex, simulated operational environment. In Portugal over the course of the large-scale multinational trials, the S-100 flew multiple missions with advanced LiDAR and ELINT payloads, underscoring its role as a maritime-proven solution, designed for naval combat system integration and as a proven multi-mission asset in complex maritime environments.

Schiebel's Hyderabad-based MRO, stands out for its modular and well planned design and exhibits meticulous resource utilisation. It has a dedicated mission planning software unit which is responsible for creating the new generation mission planning software for Schiebel

Schiebel's Hyderabad-based MRO, stands out for its modular and well planned design and exhibits meticulous resource utilisation. As already brought out, it has a dedicated mission planning software unit which is responsible for creating the new generation mission planning software for Schiebel. This team will thereafter manage this new generation software for the S-100 and S-300 towards customisation and technology obsolescence in terms of upward and back ward compatibility with the electronic modules / assemblies. Based on the requirement of the customer versions of software would be released and managed to ensure sustainability of the system.

The MRO has a dedicated area for overhauling activities which has all the necessary tools and fixtures for engine parts removal, micro-bacterial cleaning, measurement, balancing and replacement of new

parts prior to undertaking testing and replacement on the aircraft. Further, the setup also includes three assembly lines towards new programmes and orders from the Indian government. One of the major functions of any MRO is to test the engine after the process is finished.

For this requirement Schiebel has built a separate testing or cooling room, where the ambient temperature is maintained for temperatures at 10,000 feet. The complete design and assembly of the Engine Testing Room or the Cooling Tower has been carried out working collaboratively with the Indian companies. This ultimately promotes the Aatmanirbhar Bharat motto of the government, as Schiebel ensures that the expanded ecosystem for its MRO unit works together with Indian companies. Overall, the advanced facilities deployed at the MRO will also ensure a quick turnaround time for the range of CAMCOPTERS in

Top: Schiebel India CEO with his team

Below: MRO's Software unit, CAMCOPTER® S-100

"Along with defence domain the Indian government should also provide policy framework for use of UAS in civilian domain"

Schiebel India CEO

the stable of Schiebel.

Schiebel's CAMCOPTER® S-100 has been in deployment with the Indian Navy for the last one and half years with repeat orders expected based on the success of exploiting these platforms in the IOR. Commenting on the suitability of the S-100 for the navy, Schiebel India CEO said the S-100 uses heavy fuel, the same used by manned aviation, so there is complete compatibility in using a manned aviation asset and S-100 aerial vehicles from the twin hanger option. He is also optimistic that the Navy in future would utilise the MUM-T capability already existing with the S-100. After Navy's foray with S-100 a lot of other government organisations have also started the process of examining the suitability and procurement. The S-100 is a multi-role and dual use platform and hence provides cutting edge technology to both the military and the civilian sector.

Strengthening its India operation further, Schiebel India has agreement with Adani Defence and Matrix Smart Technologies to expand its outreach and cater to armed forces, coast guard, state governments and paramilitary requirements. Commenting on sales and birds fit for demands by the Indian tri-services, Schiebel India CEO said that talks are also on with the Indian Army, as S-100 and S-300 suits their requirements based on the topography and the endurance.

Commenting on the promotion of Aatmanirbhar Bharat mission of the government, Mohanty said that the facilities provided by the state and central governments at the Aerospace Park in Hyderabad, ensures that every unit here could be supported by other Micro, Small and Medium-sized Enterprises (MSMEs) and everyone can utilise the common facilities provided by the government, and this helps in building an ecosystem where the bigger players handhold the smaller units, and both progress together while ensuring that country's technological base also expands.

Schiebel India CEO further said that along with defence domain the Indian government should also provide policy framework for use of UAS in civilian domain, as its CAMCOPTER® S-100 also has successfully demonstrated its capacity in civilian domain. ■

Securing India's MARITIME EDGE

India is no longer just a continental power with a coastline — it is rising as a great maritime nation determined to secure its trade lifelines, and claim its place among the world's top oceanic powers by 2047

• **Rakesh Krishnan Simha**

The Indian Ocean may not be India's ocean, but it is certainly India's backyard. Although the majority of Indians are land-focused, it is undeniable that India is a maritime power. According to an Indian Navy report titled 'Ensuring Secure Seas: Indian Maritime Security Strategy', three significant developments have impacted India's maritime ecosystem in the past decade.

The first is the sweeping change that the global and regional geostrategic environment has seen during the period. The shift in worldview from a Euro-Atlantic to an Indo-Pacific focus, along with the repositioning of global economic and military power towards Asia, has resulted in significant political, economic, and social changes in the Indian Ocean Region, impacting India's maritime environment in tangible ways.

The second is a considerable change that India's security and threat calculus has seen during the period. In addition to persisting threats and challenges of the traditional nature, India's maritime security environment has become even more complex and unpredictable today, with the expansion in scale and presence of a variety of non-traditional threats such as terrorism.

The third is a national outlook towards the seas and the maritime domain, and a clearer recognition

of maritime security being a vital element of national progress and international engagement. Today, India interacts more actively with littoral states of the Indian Ocean Region and employs maritime security engagement as a cornerstone of its regional foreign policy initiatives.

Securing this maritime edge — a term evoking both littoral defence and blue-water projection — demands a holistic reinforcement of maritime identity, intertwining military prowess with economic vitality.

As articulated in the Maritime India Vision 2030 (MIV 2030), this identity must harmonise with India's continental imperatives, fostering a multipronged renaissance in maritime consciousness. Amid China's assertive maritime ascent, the Indian Navy's emergence as a premier first responder underscores a defensive posture evolving towards proactive deterrence. Complementing this are transformative initiatives like the Maritime Amrit Kaal Vision 2047 and the MAHASAGAR framework, which propel India towards self-reliance in shipbuilding, sustainable logistics and regional security architectures. Drawing on recent developments such as the India Maritime Week 2025, it can be argued that only through integrated economic-military synergies can India safeguard its oceanic capabilities against emerging threats.

As articulated in the Maritime India Vision 2030, the Indian Navy must harmonise with India's continental imperatives, fostering a multipronged renaissance in maritime consciousness

Maritime Identity in a Contested Domain

India's maritime edge hinges on cultivating a robust identity that bridges military strength and economic heft, transforming passive coastlines into active projectors of power. Militarily, this identity manifests in the Indian Navy's doctrinal evolution from coastal defence to expeditionary capabilities. The 2015 SAGAR (Security and Growth for All in the Region) policy marked a watershed, emphasising cooperative maritime security while subtly countering Beijing's expansionism. Yet, as China's People's Liberation Army Navy (PLAN) surges towards a 400-ship fleet by 2030 — bolstered by carriers like the Fujian and bases in Gwadar and Djibouti — India's response must transcend bilateral frictions.

The Navy's rising profile as a first responder, evident in operations such as the 2023 Houthi interdictions in the Red Sea and anti-piracy patrols off Somalia, positions it as a net security provider in the Indian Ocean Region (IOR). This posturing is not belligerent but calibrated: joint exercises such as Malabar with QUAD partners and Milan multilateral drills signal interoperability without overt alliance entrapment.

Economically, the stakes are existential. Nearly 95 per cent of India's trade by volume and 70 per cent by value traverses maritime routes, rendering ports like Mumbai, Chennai and Kandla conduits for $1.2 trillion in annual merchandise flows. Disruptions — be they chokepoint blockades in the Strait of Malacca or cyber vulnerabilities in shipping algorithms — could cascade into GDP contractions exceeding 5 per cent, as per World Bank models.

Thus, reinforcing maritime identity entails not just fleet augmentation but ecosystem resilience: from dredged channels to AI-optimised logistics. MIV 2030, launched in 2021, embodies this fusion, aligning oceanic ambitions with the highly successful Aatmanirbhar Bharat ethos. By harmonising maritime and continental outlooks — integrating coastal economic zones with Himalayan trade corridors — it reinvigorates national consciousness, urging policymakers to view the sea not as periphery but as core.

This multipronged effort cuts across various domains: regulatory reforms like the 2023 Major Port Authorities Act streamline governance, while skill infusion via the Maritime Training Institutes targets a 1.5 million-strong workforce by 2030. Yet, challenges persist — archaic labour laws and environmental pushback by paid 'Andolanjeevis' against mega-ports like Sagarmala's Vadhavan underscore the need for inclusive stakeholder engagement. In essence, securing the maritime edge demands a cultural shift: from a landlubber mindset to a Sagarmala-infused thinking where 'blue economy' rivals 'Make in India'.

Enter the MIV 2030, a 150-plus initiative compendium with ₹3-3.5 lakh crore in projected investments, catalysing port modernisation, shipping expansion and inland waterways

Economic Pillars: Charting a Resurgent Maritime Economy

The maritime sector's centrality is irrefutable: in the financial year 2024-25, major ports handled approximately 855 million tonnes of cargo, a 7 per cent year-on-year surge reflecting deepened integration into global value chains. From Siberian crude via the Northern Sea Route to ASEAN electronics through the Andaman Sea, these arteries sustain a $3.7 trillion economy projected to quintuple by 2047. Yet, inefficiencies — logistics costs at 14 per cent of GDP versus 8 per cent in peers like China — indicate the urgency of further reforms.

Enter the MIV 2030, a 150-plus initiative compendium with ₹3-3.5 lakh crore in projected investments, catalysing port modernisation, shipping expansion and inland waterways. At its heart lies sustainability: green corridors for low-emission shipping, methanol-fuelled vessels, and hydrogen bunkering at hubs like JNPT Mumbai. This green pivot

aligns with net-zero pledges, mitigating climate risks like rising sea levels that threaten 20 per cent of India's population in coastal belts. Complementing it is the Maritime Amrit Kaal Vision 2047, a centenary-aligned roadmap earmarking nearly ₹80 lakh crore for ports, coastal shipping, shipbuilding and eco-friendly innovations. Outlining over 300 actionable steps, it envisions India as a top-tier maritime and shipbuilding power, rivalling South Korea's yards and Singapore's transhipment prowess.

Financial instruments support this ambition. The ₹25,000 crore Maritime Development Fund (MDF) offers long-term debt for tonnage growth, targeting the tripling of India's 13 million gross tonnage fleet. The revamped Shipbuilding Financial Assistance Scheme (SBFAS), with ₹24,736 crore, offsets cost disadvantages via subsidies and incentivises eco-refits, while the ₹19,989 crore Shipbuilding Development Scheme (SbDS) promotes greenfield clusters and risk mitigation. In Visakhapatnam, the ₹305 crore Indian Ship Technology Centre (ISTC) emerges as an R&D hub, incubating designs for indigenous carriers and autonomous vessels.

Inland waterways amplify this mosaic. Over ₹1,000 crore has revitalised Northeast India's river networks, with ₹300 crore in completed projects unlocking Assam's tea exports and Arunachal's hydropower logistics. The Cruise Bharat Mission heralds luxury Brahmaputra cruises — two ₹250 crore 'Made in India' vessels launching in 2027 — heralding tourism as a $50 billion sector by decade's end.

The Indian Navy's rising profile as a first responder, evident in operations such as the 2023 Houthi interdictions in the Red Sea and anti-piracy patrols off Somalia, positions it as a net security provider in the Indian Ocean Region

The Sagarmala Programme, a linchpin of both MIV 2030 and Amrit Kaal, operationalises this vision through 840 projects worth ₹5.8 lakh crore by 2035. With 272 completions (₹1.41 lakh crore) and 217 underway (₹1.65 lakh crore), it slashes logistics costs by 10-15 per cent via integrated port-led development. Vizhinjam's deep-water transhipment hub, operationalised in 2024, exemplifies this: handling 1 million TEUs annually, it reduces Malacca dependency, enhancing energy security. A recent ₹69,725 crore shipbuilding package underscores commitment, blending defence indigenisation with commercial scalability.

At the same time, there are critical gaps. First, the overreliance on foreign FDI (60 per cent of port investments) risks technology leakage. Secondly, there is a gender disparity in seafaring, with under 2 per cent female officers. This needs to change to increase women's participation in the workforce.

Naval Ascendancy Amid the Dragon's Shadow

While economic currents propel the country forward, maritime military pressure has changed the mindset of India's war planners. The Indian Navy's trajectory — from a 1971 brown-water force to a 2025 blue-water contender — represents this transformation. With 150 warships, including the INS Vikrant carrier and destroyers armed with BrahMos supersonic cruise missiles, it postures as a counterweight to the PLA Navy, whose Indian Ocean Rim forays via its so-called Maritime Silk Road encroach on Andaman patrols and Lakshadweep chokepoints.

Sea power is not only about military projection. The Navy's first-responder mantle shines in humanitarian

assistance and disaster relief (HADR) missions: the 2024 Cyclone Remal evacuation of 50,000 people from Bengal and the Yemen evacuations in 2023 affirm its regional endorsement. This soft-power projection dovetails with hard deterrence — submarine-launched ballistic missiles (SLBMs) like K-4 ensure second-strike credibility, while P-8I surveillance aircraft monitor PLAN submarines in the Six Degree Channel.

China's rise, however, needs to be monitored closely. The Djibouti base and Pakistan's Gwadar concessions form an anti-access/area-denial (A2/AD) grid, threatening 80 per cent of India's oil imports. India's riposte includes theaterising commands under the 2021 Agnipath reforms and Quad-plus engagements, yet capability gaps persist — such as delayed Project 75I submarines and helicopter shortages. Maritime consciousness here demands doctrinal agility: the 2025 Naval Doctrine update integrates space-based ISR with hypersonic defences, linking continental airpower with oceanic reach.

Strategic Synergies: Sagarmala, MAHASAGAR and Beyond

Sagarmala's port-centric aspect intersects seamlessly with broader strategies, but the MAHASAGAR initiative elevates this to the geopolitical level. Evolving from SAGAR in March 2025, MAHASAGAR — Mutual and Holistic Advancement for Security and Growth Across Regions — expands India's maritime remit beyond the Indian subcontinent to the Western Indian Ocean and East African littorals. It deepens Global South ties through technology transfers (such as BrahMos exports to the Philippines) and joint patrols, countering China's debt-trap diplomacy. By linking security with growth — green shipping agreements and IOR counter-piracy — MAHASAGAR reframes the IOR as an 'Ocean of Collaboration', not confrontation.

This initiative aligns with Indo-Pacific visions, as External Affairs Minister S Jaishankar articulated at the 2025 G7, emphasising port-led development and multilateralism. It bolsters maritime identity by institutionalising the hybrid-threat mitigation, including cyber-maritime fusion centres at Kochi, while economically, it unlocks $100 billion in blue economy potential by 2030.

By 2047, when the tricolour completes a century over free India, the Indian Ocean must no longer be a contested moat around the subcontinent, but a secure highway under its watchful command. Securing India's maritime edge is not merely a policy choice — it is a decisive act of strategic survival

Momentum from the Maritime Week 2025

The recently concluded India Maritime Week 2025, inaugurated by Home Minister Amit Shah in Mumbai on October 27, crystallised this momentum. Shah heralded India's 'new maritime history', spotlighting Vizhinjam's commissioning and sustainable partnerships. Highlights included an India-Netherlands MoU on green shipping and forums on cruise tourism's $10 billion horizon. Discussions on workforce digitalisation and African collaborations echoed MAHASAGAR's ethos, underscoring a decisive decade ahead.

Towards an Unassailable Oceanic Frontier

India stands at the threshold of a maritime renaissance that will define its 21st-century destiny. The fusion of world-class ports, green shipping corridors, a battle-ready blue-water navy, and the bold diplomacy of MAHASAGAR is transforming a historically land-oriented civilisation into a confident ocean power. By 2047, when the tricolour completes a century over free India, the Indian Ocean must no longer be a contested moat around the subcontinent, but a secure highway under its watchful command. Securing India's maritime edge is not merely a policy choice — it is a decisive act of strategic survival. ■

– The writer is a globally cited defence analyst based in New Zealand. 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 that of Raksha Anirveda

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Maritime India: Sailing the Aatmanirbhar OCEAN

India is charting its course for greater maritime dominance. With historic investments in shipbuilding, naval modernisation, port expansion, coastal connectivity, and ocean research, India is unlocking the full potential of its vast maritime sphere

• **Cdr Sumit Ghosh**

India aspires to emerge as a leading global maritime power by 2047, driven by modern ports, world-class shipbuilding, and a secure, innovation-led maritime ecosystem. The vision focuses on strengthening naval capability, expanding commercial shipping, and developing efficient logistics corridors that connect India to key global trade routes. With an emphasis on sustainability, blue-economy growth, and strategic partnerships across the IOR and the Indo-Pacific, India aims to enhance its influence, protect vital sea lanes, and become a hub of maritime commerce and technology. This long-term ambition aligns with the broader goal of Viksit Bharat, positioning the nation as a resilient, self-reliant, and future-ready global naval leader.

The Strategic Drivers

- **Geopolitical & Security Calculus:** IOR being central to global trade and power dynamics, India must ensure that it has potent and robust naval capabilities & supporting infrastructure. This means not only modern fleets but also the logistics, repair, supply chains and ports to sustain them.
- **Economic/Trade Growth:** India's trade volumes (import + export + transshipment) are projected to continue rising, requiring ports with larger capacity, deep drafts, container terminals, better hinterland connectivity, and faster turnaround times.
- **Self-Reliance and Industrial Growth:** Shipbuilding, ship repair, and related maritime industries provide high-value jobs, technology diffusion, and industrial base enhancement. The government's policies (SBFAP 2.0, shipbuilding clusters, subsidies, maritime development funds) reflect this.
- **Sustainability and Green Technologies:** Green shipping corridors, use of green tugs, hydrogen bunkering hubs, eco-friendly vessels, etc., are increasingly factored into policy and port/shipyard planning.
- **Blue Economy and Maritime Domain Control:** Accurate maritime awareness is essential to thwart numerous threats to blue economy initiatives and for sustained maritime growth.

India's maritime strength will depend on how well several core elements of its maritime sector are strongly developed and integrated in the following areas:

- **Port Infrastructure:** Efficient, deep-draft ports with modern cargo-handling systems are essential for high-volume trade, seamless logistics, and global connectivity. Robust port infrastructure reduces turnaround time, lowers costs, and enhances competitiveness.

IOR being central to global trade and power dynamics, India must ensure that it has potent and robust naval capabilities and supporting infrastructure. This means not only modern fleets but also the logistics, repair, supply chains and ports to sustain them

- **Merchant Fleet and Shipbuilding Capacity:** A strong national fleet ensures reliable commercial transport, strategic autonomy during crises, and economic resilience. Alongside this, a capable shipbuilding and ship-repair ecosystem supports industrial growth, defence readiness, and technological advancement.
- **Maritime Security and Naval Power:** A highly potent navy and coastal security network protect trade routes, safeguard national waters, and deter threats. Strong maritime security is foundational for uninterrupted commerce and strategic influence.
- **Maritime Trade and Logistics Systems:** Efficient hinterland connectivity by rail, road, river highways or inland waterways ensures smooth movement of goods to and from ports. Digital logistics platforms, multimodal transport, and coastal shipping strengthen supply chains.
- **Blue Economy and Marine Resources Management:** Sustainable exploitation of fisheries, offshore energy, seabed minerals, and marine biotechnology contributes to long-term economic growth. Environmental protection is equally vital to preserving these resources.
- **Maritime Governance and Regulation:** A clear

policy framework, strong maritime laws, and efficient regulatory institutions enable investment, safety, and innovation across the sector.

- **Maritime Human Capital:** Skilled seafarers, engineers, logisticians, and maritime professionals ensure operational excellence and global competitiveness.
- **High Quality Maritime Research & Development Laboratories / Institutions / Organisations:** R&D organisations must have excellent equipment, skilled technicians, researchers and testing systems.

Together, these elements create a resilient, secure, and economically powerful maritime ecosystem for India.

Expansion of Maritime Facilities

The Sagarmala 2.0 initiative, backed by ₹40,000 crore investment, envisions modernising port infrastructure and building new shipbuilding clusters. A key pillar of this effort is the recently approved ₹69,725 crore Shipbuilding & Maritime Development Plan. This four-pronged strategy includes a Shipbuilding Financial Assistance Policy (SBFAP) extension, a ₹25,000 crore Maritime Development Fund (MDF) to lower financing costs, development of mega shipyards, and deep policy reforms. India plans to build 3 to 4 Mega Shipyards, each with a capacity of 1 to 1.2 million gross tonnage, to ramp up large-vessel production and economies of scale. It aims to capture about 5% of the global shipbuilding market by 2030, leveraging PPPs, automation, digital twin tech, and green shipbuilding.

Nearly 234 projects related to Port modernisation/ new ports are underway at a cost of ₹ 2,91,278 crores, and of which 104 (worth ₹32,653 crore) have been completed, and 55 projects (worth ₹74,725 crore) are under implementation. Cargo handling capacity is targeted to grow from about 2.7K MMT today to 10K MMT by 2047. Coastal economic clusters and maritime CEZs (Coastal Economic Zones) are being developed, with key clusters planned in Gujarat and Tamil Nadu. India is proactively building both physical research infrastructure (like deep-sea labs, submersibles, data portals) and institutional research capacity (think tanks, innovation hubs, start-ups) to drive a science-led blue economy.

Shipbuilding, ship repair, and related maritime industries create high-value jobs, technology diffusion, and an industrial base. The government's policies (SBFAP 2.0, shipbuilding clusters, subsidies, maritime development funds) reflect this

Boosting Naval Capabilities

The Indian Navy has placed a range of ambitious orders and contracts to dramatically expand and modernise its fleet and capabilities. In late 2024, the Ministry of Defence approved ₹2,867 crore for Air Independent Propulsion (AIP) submarine systems and Electronic Heavyweight Torpedoes (EHWT) for Kalvari class subs. 54 warships are currently under construction in Indian shipyards, ranging from destroyers and corvettes to patrol vessels, while there is Acceptance of Necessity (AoN) for another 74 platforms, representing an investment of around ₹2.35 lakh crore, covering nine diesel-electric submarines, next-gen stealth frigates, anti-submarine corvettes, mine-countermeasure vessels, etc. To support this surge, MDL is investing ₹4,000–5,000 crore to double its shipbuilding capacity by building two new basins, enabling the simultaneous construction and repair of large warships and submarines. IN is pushing ahead with three more Scorpene-class boats and the futuristic P75-India (P-75I) subs with stealth, AIP, and high indigenous content. It is also considering building its second aircraft carrier (90% indigenous content), eyeing additional next-gen destroyers under Project-18, potentially worth ₹70,000–80,000 crore, with MDL. India has already signed a ₹63,000 crore deal to acquire 26 Rafale M carrier-based

fighter jets from France.

Navy is going ahead with Unmanned Combat Aerial Vehicles (N-UCAV), developing its IN-CATS (Indian Naval Combat Air Teaming System), the ISR, EW and strike-capable N-CCAV (Naval Collaborative Combat Air Vehicle) for carrier operations. It is also pursuing Manned–Unmanned Teaming (MUM-T) to control and coordinate multiple autonomous UAVs for multiplying operational flexibility. The Maritime Patrol and Reconnaissance Aircraft, aerial refuelling capability through either Airbus A330 MRTT or converted commercial A330s/A320s are also on cards. Naval Aviation tech- roadmap 2047" outlines a fleet of almost 400 aircraft. Together, these orders reflect a sustained, strategic push to make India a self-reliant, blue-water maritime power by 2047.

Gaps and Challenges

For smoother, faster maritime growth, multiple strategic impediments must be addressed. Some are given below:

- Indian shipbuilders face higher costs in steel, labour, specific equipment and financing compared to South Korea, China, and Japan.
- Our shipyards still lack the capacity to build the largest ships/ submarines, so outputs have to keep pace with increasing demand.
- Ports must have strong road, rail, and inland waterway links, as congestion, delays, customs/ immigration, etc., reduce port competitiveness.
- Indigenous R&D, trained shipbuilders and systems integrators need strengthening.
- Obtaining land, environmental clearances, managing coastal zone regulations, dredging constraints, etc., can slow project execution. Also, ensuring ports and shipyards are resilient to climate change (rising sea levels, extreme weather) is important.
- While the government is providing major capital funds and subsidies, large projects must attract private and foreign investment too. Financial risk, delays, and return on investment need clarity.

Fifty-four warships are under construction in Indian shipyards, ranging from destroyers and corvettes to patrol vessels, and there is Acceptance of Necessity (AoN) for another 74 platforms, representing an investment of around ₹2.35 lakh crore

Conclusion

India is steadily charting its course for greater maritime dominance. With historic investments in shipbuilding, naval modernisation, port expansion, coastal connectivity, and ocean research, India is unlocking the full potential of its vast maritime sphere. The vision of Amrit Kaal 2047 places the seas at the heart of national growth, strengthening security, fuelling trade, empowering coastal communities, and driving innovation across the blue economy. The journey ahead promises a more secure, prosperous, and self-reliant maritime future where India sails forward as a true Aatmanirbhar Global Maritime Power. ■

–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.

Addressing Navy's Capacity Gaps

Behind every powerful navy lies a backbone of support systems that rarely make it to the front page. For the Indian Navy, the next phase of maritime transformation hinges not on carriers or nuclear submarines, but on the quieter enablers — the submarine support ships, amphibious aircraft, and light frigates. These un-glamourous force multiplier platforms can ensure the Indian Navy's sustained reach, endurance, and readiness across the Indo-Pacific

• **Commodore C P Srivastava**

In the recent past, several sea-based contingencies have required the Indian Navy to deploy assets to meet urgent operational needs. Among these, three operations stand out as both challenging and globally visible. The first was the 'out-of-area deployment' of a Scorpene-class submarine in the South China Sea. The second, the successful air-insertion of MARCOS teams using Indian Air Force C-130 Hercules and C-17 Globemaster aircraft. The third, a continuing long-term deployment of up to 12 Indian warships in the Arabian and Red Seas following the outbreak of hostilities involving Israel, Hamas, the Houthis, and Hezbollah.

These missions, while highlighting India's growing reach, also expose structural gaps in the Navy's inventory. A mature naval power must possess the right mix of platforms to deploy the most suitable asset for each mission, achieving results both effectively and efficiently. Let us identify key areas where the Navy's "un-glamorous" assets — those that seldom grab headlines — must be strengthened to secure the nation's maritime interests.

The Submarine's Silent Dependence

When INS Vagir, a Scorpene-class submarine, sailed 4,500 nautical miles to Fremantle, Australia, in 2023, the voyage sent a clear geostrategic message. It signalled that India could operate deep in the Indo-Pacific and that the Sunda and Lombok Straits — alternatives to the heavily monitored Malacca — were within its strategic range. Yet beneath the symbolism lay a crucial vulnerability: India lacks submarine tenders or support ships.

The Indian Navy's recent high-profile missions have revealed a silent truth — that success at sea often depends on unseen assets like submarine support ships and amphibious aircraft. These understated platforms form the logistical spine of naval endurance and operational flexibility

Submarine Support Ships are vital to any blue-water navy. They provide forward sustainment, ensuring submarines can stay on station longer, farther from home. These ships extend operational reach by offering:

- **Depot support:** alongside berthing, power supply, battery charging, crew accommodation, and medical facilities.
- **Logistic replenishment:** resupply of food, fuel, consumables, spares, and AIP-related hydrides.
- **Repair and maintenance:** technical support for repairs at sea or distant ports.
- **Weapon and armament reloads:** facilitating torpedo and missile replenishment, inspections, and system upgrades.

Globally, around 14 navies operate such vessels. India, however, decommissioned its only submarine tender, INS Amba — a Soviet-era Ugra-class ship — in July 2006, without replacement. Given today's dispersed areas of operation and expanding submarine fleet, at least three new tenders are needed — one each for the east and west coasts, and one in reserve for

maintenance rotation.

The Directorate of Naval Design (DND) has the expertise to develop these ships indigenously. Construction could take place at Hindustan Shipyard Limited (HSL), already tasked with building the 27,000-ton Fleet Support Ship. Submarine tenders may not command attention like nuclear submarines or carriers, but their absence is keenly felt in every forward patrol.

Air Insertion and the Case for Amphibious Seaplanes

In February and March 2024, the Indian Navy executed two exceptional special-forces missions in the Gulf of Aden — air-inserted MARCOS operations nearly 1,400 nautical miles from India's west coast and 260 nautical miles east of Somalia. Supported by IAF's strategic airlift fleet, these missions demonstrated India's ability to strike deep at sea. Yet they also highlighted a shortfall — the absence of integral naval amphibious aircraft.

During wartime, the Navy cannot depend indefinitely on Air Force assets. Amphibious aircraft are indispensable for maritime nations because of their flexibility, reach, and multi-mission utility.

The Role of Amphibious Aircraft

Amphibious seaplanes provide unmatched operational flexibility:

- Dual-domain operation: Able to take off and land on water or land, allowing deployment from naval bases, islands, or even rough sea conditions.
- Multi-mission versatility: Suitable for maritime patrol, reconnaissance, search and rescue (SAR and Combat SAR), casualty evacuation, and special operations.
- Enhanced maritime surveillance: Bridging the gap between shipborne radar and land-based aircraft, offering rapid situational updates.
- Crisis response: Delivering swift relief and rescue during natural disasters or emergencies.

The ShinMaywa US-2 Advantage

The ShinMaywa US-2 of Japan's Maritime Self-Defence Force stands as the benchmark in its class. Designed to operate in high sea states with waves up to three metres, it combines jet-powered performance with fuel efficiency and advanced fly-by-wire controls. With a range of 1,500 km, endurance for prolonged missions, and a payload capacity of 30 passengers or seven tonnes, the US-2 is ideal for India's needs.

It can perform SAR, medevac, and amphibious transport across distant island territories like the Andamans, Lakshadweep, and coastal fringes of the Arabian Sea. The US-2's capability to land in open seas makes it uniquely suited for inserting or

extracting special forces. In short, its induction is not a luxury — it's an operational necessity.

Heightened Tempo and the Light Frigate Gap

The outbreak of conflict in the Middle East since October 2022 has profoundly affected global shipping. Traffic through the Suez Canal and Bab el-Mandeb Strait dropped by 50 percent, forcing rerouting around the Cape of Good Hope and extending voyages by more than half. For India — dependent on the Gulf for 88 percent of its oil — this disruption has critical implications. Compounding the challenge, nearly 10 percent of the world's merchant mariners are Indian, a figure projected to double in a decade.

The Indian Navy has responded with sustained forward deployments — maintaining 10–12 warships and a large complement of aircraft and drones across 1.5 million square nautical miles. This constant vigilance, however, strains the fleet. Major destroyers and multi-role frigates are diverted for lower-intensity tasks like convoy escort, anti-piracy patrols, and area surveillance — roles better suited to smaller ships.

The Case for Light Frigates

By definition, the frigate is the smallest warship capable of sustained independent operations in open seas. A light frigate, displacing 2,500–3,000 tonnes, is ideal for missions such as ASW, anti-surface, or air defence in mid-intensity theatres. The absence

of this class forces the Navy to overcommit larger vessels, reducing strategic flexibility.

Light frigates would fill the tactical space between heavy destroyers and smaller corvettes, offering affordability, endurance, and adaptability. A fleet of at least 24 light frigates — 12 on each seaboard — would free larger combatants for critical missions such as carrier group operations and sea-control tasks.

Redesigning the Kamorta-Class Corvette

India's indigenously designed 3,300-ton Project 28 Kamorta-class ASW Corvette is a logical starting point for adaptation into a light frigate. Redesign can be guided by the following principles:

- Develop two variants: ASW and AAW (Air Defence).
- The ASW version can eliminate hull-mounted sonar in favour of active-passive towed arrays, ideal for tropical waters and reducing hull size.
- The AAW version should carry area-defence missiles, while the ASW variant retains point-defence systems.
- Both should mount 76 mm guns with DART ammunition, Close-In Weapon Systems (CIWS), ASW rocket launchers, and accommodate an ALH Dhruv helicopter.
- Bulk production would reduce costs and ensure standardisation in logistics, crew training, and maintenance.

Small ASW vessels, around 3,000 tonnes, are also tactically advantageous. They are often deemed 'non-torpedo-worthy' by submarines — engaging them risks exposing a submarine's position. Thus, their size is an asset rather than a limitation.

Since decommissioning INS Amba in 2006, the Navy has operated without a single submarine tender, leaving a void in forward sustainment capability. New tenders would restore endurance and resilience to India's expanding undersea flota

Sustaining Presence Through Force Multipliers

The Indian Navy's most formidable achievements — carrier groups, nuclear submarines, and advanced destroyers — rely heavily on the invisible backbone of sustainment. Submarine support ships, amphibious seaplanes, and light frigates may not command attention, but they enable persistent presence, flexibility, and rapid response.

Each of these platforms addresses a distinct capability gap. Together, they form a triad of endurance: undersea sustainment through tenders, aerial reach through amphibious aircraft, and surface presence through light frigates. Their induction would ensure the Navy's ability to maintain steady presence and influence from the Gulf of Aden to the South China Sea.

Building a Truly Balanced Fleet

The media often celebrates the induction of headline platforms — aircraft carriers, nuclear submarines, and stealth destroyers. These are essential, but they alone do not make a balanced fleet. A truly capable navy must also invest in support systems that ensure sustained and flexible operations.

It is time to address the Navy's silent needs — the submarine support ships that sustain endurance, the amphibious seaplanes that extend reach, and the light frigates that preserve presence. These are the platforms that turn power into persistence, presence into protection, and ambition into capability. It is essential that we address these capacity gaps and initiate acquisition of these 'Un-Glamorous Force Multipliers' at the earliest. Only then can the Indian Navy be considered a truly balanced and rounded force at sea. ■

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Extending India's Maritime Reach: The MQ-9B SeaGuardian®

The MQ-9B programme exemplifies the deepening defence ties between India and the United States. This partnership is built on shared values, mutual interests, and a commitment to maintaining peace and stability in the Indo-Pacific region. A highly promising investment for India and a partnership that will continue paying dividends for many years to come

• **Dr Vivek Lall**

On Navy Day, Indians honour the service of their fleet and sailors. It also serves as an opportune moment to reflect on the importance of India's defence partnerships, particularly its collaboration with the United States, which has significantly bolstered India's maritime security.

Among the crown jewels of this partnership is the MQ-9B SeaGuardian® programme, a cutting-edge uncrewed aerial system (UAS) that has transformed the operational capabilities of the Indian Navy.

The MQ-9B SeaGuardian, developed by General Atomics Aeronautical Systems, Inc. (GA-ASI), represents a major leap forward. The MQ-9B's advanced onboard systems enable it to act as an extended sensor node—flying on its own, with other uncrewed aircraft, or complementing human-crewed platforms like maritime patrol aircraft and theater airborne early warning (AEW) systems.

By operating in tandem with these other assets, the SeaGuardian enhances the range, coverage, and responsiveness of India's naval operations. The aircraft can remain airborne for 30 hours or more, in some configurations, giving it range and time on station that nothing else can match. Moreover, in high-threat environments, the MQ-9B can be deployed forward into contested airspace, reducing risks to pilots by undertaking missions deemed too dangerous for manned aircraft.

This capability underscores the MQ-9B's role as a force multiplier, enabling India to extend its defence capabilities without overstretching its resources.

Accomplishments of the MQ-9B in Indian Navy Operations

Since its induction into the Indian Navy's arsenal, the MQ-9B SeaGuardian has demonstrated its versatility and operational effectiveness. While some specific mission details remain classified, the aircraft has been instrumental in enhancing maritime domain awareness, monitoring critical chokepoints, and providing real-time intelligence to naval commanders.

General Atomics Aeronautical Systems, Inc. (GA-ASI)'s MQ-9B SeaGuardian is the longest-endurance and most versatile uncrewed aircraft in its class.

The SeaGuardian programme is poised to enter an exciting new phase in India, marked by increased industrial collaboration and indigenous contributions. As part of its defence partnership with the United States, India is set to play a significant role in the assembly and production of the MQ-9B aircraft

Other operations are public, including the role played by the MQ-9B in supporting the rescue of vessels freed by Indian Navy special operators that had been captured by pirates. Commanders monitored these raids live, in real time, thanks to the full-motion video and other intelligence provided by the MQ-9B.

The SeaGuardian programme is poised to enter an exciting new phase in India, marked by increased industrial collaboration and indigenous contributions. As part of its defence partnership with the United States, India is set to play a significant role in the assembly and production of the MQ-9B aircraft. This development aligns with India's broader "Make in India" initiative, which seeks to enhance domestic defence manufacturing capabilities and reduce reliance on imports.

The integration of Indian industrial inputs into the MQ-9B programme is expected to yield several benefits.

Firstly, it will foster the transfer of advanced technologies, enabling Indian companies to develop expertise in areas like aeronautics, sensors, and secure communications.

and global security. Additionally, the aircraft's rapid deployability makes it ideal for crisis response, border security, and strategic deterrence—a necessity given the evolving security challenges in the Indian Ocean Region (IOR).

The MQ-9B programme exemplifies the deepening defence ties between India and the United States. This partnership is built on shared values, mutual interests, and a commitment to maintaining peace and stability in the Indo-Pacific region. Through collaborative programmes like the MQ-9B, the two nations have demonstrated their ability to leverage cutting-edge technology to address common security challenges.

GA-ASI's fleet of aircraft has recorded more than 9 million flight hours in service around the world and many individual machines have flown tens of thousands of hours over that time. These platforms have the highest operational availability of any military aircraft. Notably, India is joining a growing community of international MQ-9B operators that already includes Japan Coast Guard, Japan Maritime Self-Defense Force, Taiwan, Belgium, Canada, Poland, and the United Kingdom. This global adoption reflects both the maturity of the MQ-9B programme and the confidence that leading maritime and defence forces place in the platform. All of this adds up to a highly promising investment for India and a partnership that will continue paying dividends for many Navy Days to come. ■

SeaGuardian shown in its anti-submarine warfare (ASW) configuration equipped with sonobuoy dispensers and monitoring / control systems.

Secondly, it will create high-skilled jobs and contribute to the growth of India's defence ecosystem. Finally, the involvement of Indian industry will ensure that the MQ-9B aircraft are tailored to meet the specific operational requirements of the Indian Navy and other armed services.

In the coming years, the MQ-9B SeaGuardian is likely to become a cornerstone of India's maritime security strategy. Its ability to operate seamlessly within NATO-compliant frameworks ensures interoperability with allied forces, further strengthening India's position as a key player in regional

–The writer is Chief Executive at General Atomics Global Corporation. The views expressed are of the writer and do not necessarily reflect the views of Raksha Anirveda

The Son of KORA

As India's maritime responsibilities expand, a proposed 108 metre missile corvette of a 2,250-ton stealth combatant sophistication offers a future ready solution: compact enough to be procured in numbers, powerful enough to deter peer threats, and flexible enough to adapt to emerging technologies. It stands as a compelling blueprint for the next generation of Indian naval combatants

• **Rahul Vatsayan**

The Indian Navy's evolving maritime doctrine increasingly emphasizes distributed lethality, persistent presence, and rapid response across the Indo Pacific. As the operational environment becomes more contested—with adversaries fielding long range sensors, precision weapons, and dense littoral defences—the need for compact yet heavily armed surface combatants has grown significantly. In this context, a 108 metre, 2650 ton missile corvette equipped with advanced sensors, a robust vertical launch missile suite, and a stealth optimized superstructure represents a compelling addition to the Navy's future force structure. This concept blends the firepower of a frigate with the agility and cost efficiency of a corvette, creating a platform tailored for high intensity missions in both littoral and blue water theatres.

Hull Form, Stealth Architecture, and Structural Philosophy

The proposed corvette's 108 metre length and 2650 ton displacement place it at the upper end of the corvette category, allowing for a balanced integration of propulsion, sensors, weapons, and crew accommodations without compromising stability or endurance. The hull adopts a modern raked line geometry, characterized by a sharply angled bow, faceted surfaces, and a continuous sheer that reduces hydrodynamic drag and improves seakeeping in high sea states.

Stealth is a defining feature of the design. The superstructure is fully enclosed, with sloped panels and minimized right angles to reduce radar cross section (RCS). The mast is integrated into a single low observable block housing the primary radar arrays, communication antennas, and electronic warfare systems. Exhausts are trunked through the superstructure and cooled to suppress infrared signatures. Deck fittings are recessed, and the lifelines, mooring equipment, and RHIB bays are concealed behind flush panels. These measures collectively reduce detectability, especially against long range maritime patrol aircraft and shipborne AESA radars.

The hull is constructed from high strength naval steel, while the superstructure employs composite materials to reduce topweight and improve stability margins. This hybrid approach allows the vessel to carry a substantial missile loadout without compromising roll characteristics or structural integrity.

A 108 metre, 2,250-ton missile corvette equipped with advanced sensors, a robust vertical launch missile suite, and a stealth optimised super-structure represents a compelling addition to the Navy's future force structure

Propulsion, Endurance, and Seakeeping

A vessel of this size is well suited to a CODAD (Combined Diesel and Diesel) propulsion architecture. CODAD offers fuel efficiency and simplicity. This configuration would enable a top speed of 28–30 knots and a cruising range of 4,000–5,000 nautical miles, allowing the corvette to operate independently or as part of a task group.

The raked bow and optimized hull form improve seakeeping, reducing slamming and enhancing sensor stability in rough seas. This is particularly important for the EL/M 2248 MF STAR, which performs best when platform motion is minimized.

Primary Armament and Close Range Defence

76 mm OTO Melara Super Rapid Gun Mount

The forward mounted 76 mm SRGM serves as the ship's main gun, providing a versatile, rapid fire capability against surface targets, aircraft, and incoming missiles. Its compatibility with guided ammunition such as DART enhances lethality against manoeuvring threats. The gun's compact footprint and high rate of fire make it ideal for a corvette class vessel where deck space is at a premium.

Two AK 630 CIWS

Close in defence is handled by two

AK 630 systems, typically positioned port and starboard aft to provide overlapping arcs of fire. Their 30 mm Gatling cannons deliver a dense stream of projectiles capable of intercepting sea skimming missiles, UAVs, and fast attack craft. The AK 630s form the last line of defence in a layered protection scheme.

Vertical Launch Systems: Air Defence and Strike Capability

The corvette's most defining feature is its dual role VLS architecture, which gives it firepower comparable to much larger combatants.

2 × 8 Cell VLS for Barak 8

With 16 Barak 8 Missiles, the ship gains a medium range area air defence capability rarely seen on vessels of this displacement. Barak 8's active radar seeker, high manoeuvrability, and network centric guidance allow it to counter aircraft, UAVs, and anti ship missiles. Integrated with MF STAR, the system provides rapid reaction times and multi target engagement capability.

2 × 8 Cell VLS for BrahMos AShM

The inclusion of 16 BrahMos Supersonic Anti Ship Missiles transforms the corvette into a formidable strike platform. This loadout allows the vessel to engage high value surface targets at long ranges with precision and overwhelming kinetic energy. Few ships in the world under 3,000 tons carry such a potent offensive suite, giving the Indian Navy a significant asymmetric advantage.

The VLS modules are placed amidships to maintain centre of gravity balance and ensure structural reinforcement around the launch zones.

Airborne Surveillance and Attack

This ship will carry a Deck-Based Multi-Role Helicopter (DBMRH). It is a critical part of India's Aatmanirbhar Bharat initiative in the defence and aerospace sector. and was developed specifically for the Indian Navy's maritime requirements.

The proposed corvette's hull adopts a modern raked line geometry, characterised by a sharply angled bow, faceted surfaces, and a continuous sheer that reduces hydrodynamic drag and improves seakeeping in high sea states

This will fulfil a pressing need for a modern, medium-lift, multi-role helicopter fleet capable of operating from its surface ships including frigates, destroyers and aircraft carriers. The need has been accentuated by the phase out of the older helicopters such as the Sea King. The DBMRH will fill critical capability gaps in Anti-Submarine Warfare (ASW) and Anti-Surface Warfare (ASuW).

Sensor Suite and Combat Systems

EL/M 2248 MF STAR AESA Radar

The MF STAR is the ship's primary sensor, providing 360 degree coverage for air and surface surveillance. Its multi function AESA architecture enables simultaneous tracking, fire control, and guidance for Barak 8 missiles. The radar's high refresh rate and resistance to jamming make it ideal for modern electronic warfare environments.

BEL Lynx U1 Fire Control Radar

The Lynx U1 provides dedicated fire control support for the 76 mm gun and AK 630 CIWS. Its indigenous design ensures seamless integration with Indian combat management systems and reduces logistical dependency on foreign suppliers.

BEL HUMSA Hull Mounted Sonar

The HUMSA sonar suite offers reliable detection of submarines and torpedoes in both littoral and deep water environments. While the corvette is not primarily an ASW platform, HUMSA provides essential situational awareness and cueing for decoys or supporting ASW assets.

Mission Profile and Operational Roles

This missile corvette is designed to excel in a wide range of missions:

- Anti Surface Warfare (ASuW): With 16 BrahMos missiles, the ship can neutralize enemy surface groups, logistics vessels, and high value units.

- **Area Air Defence:** The Barak 8 and MF STAR combination enables fleet escort, convoy protection, and independent operations in contested airspace.
- **Littoral Dominance:** Stealth shaping, compact dimensions, and high manoeuvrability make it ideal for coastal strike missions and choke point control.
- **Maritime Security and Patrol:** Its endurance and sensor suite support EEZ patrols, anti piracy missions, and maritime interdiction.
- **Task Group Integration:** The corvette can operate alongside destroyers and frigates, adding distributed firepower and expanding the fleet's engagement envelope.

Strategic Value and Future Growth

The proposed 108 metre missile corvette represents a shift toward high lethality, low signature combatants that can be produced in numbers. Its modular architecture allows future upgrades, including:

- Directed energy CIWS
- Next generation anti ship missiles
- Towed array sonar
- UAV launch and recovery systems

This ensures relevance well into the 2040s.

In Conclusion the Author would like to state that this proposal for the Indian Navy's future missile corvette represents a decisive step forward in the Indian Navy's pursuit of compact, high lethality surface combatants tailored for the evolving Indo Pacific battlespace. By integrating a stealth optimized superstructure, advanced AESA surveillance through MF STAR, indigenous fire control and sonar systems, and a formidable dual VLS architecture for both Barak 8 and BrahMos, the design achieves a rare balance of offensive reach, defensive resilience, and operational flexibility. Its refined hull form, raked lines, and disciplined shaping philosophy ensure reduced signatures without compromising seakeeping or structural integrity.

The corvette's most defining feature is its dual role VLS architecture, which gives it firepower comparable to much larger combatants

This vessel is not merely an incremental improvement over existing platforms—it is a deliberate shift toward distributed firepower, rapid reaction capability, and survivability in contested littoral and open ocean environments. It embodies the Navy's strategic need for platforms that can operate independently, support task groups, and impose costs on adversaries through credible, long range strike options.

As India's maritime responsibilities expand, a corvette of this sophistication offers a future ready solution: compact enough to be procured in numbers, powerful enough to deter peer threats, and flexible enough to adapt to emerging technologies. It stands as a compelling blueprint for the next generation of Indian naval combatants. ■

–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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EyeROV: Redefining INDIGENOUS EDGE

The next battlespace isn't in the sky—it's under the sea. EyeROV's Aatmanirbhar underwater robots are redefining how India protects its maritime lifelines

• **Neeraj Mahajan**

India's maritime security is undergoing a quiet but decisive transformation. For most of modern history, the deep ocean remained a mysterious, uncharted realm—far beyond the reach of human capability. Even the world's most advanced navies could only partially observe what lay beneath. The seabed was Earth's last unexplored frontier.

Today, that frontier has become a battlespace.

Modern conflict is no longer limited to land, air, cyber, or space. Increasingly, it is unfolding beneath the surface—where pipelines, communication cables, offshore energy fields, naval jetties and strategic sensors sit vulnerably on the seabed. For a country like India, with over 7,500 kilometres of coastline, island territories from Lakshadweep to Andaman & Nicobar, and critical naval hubs from Karwar to Port Blair, underwater security is no longer optional—it is foundational.

Why Underwater Robots Now Matter More Than Ever

India's dependence on subsea infrastructure has grown dramatically. Offshore gas pipelines, power cables, port foundations, and deep-sea communication lines form the backbone of the nation's economy and defence posture. A single sabotage attempt hundreds of metres below the surface can disrupt power grids, cut communications, compromise naval readiness, or cripple shipping lanes.

These risks are no longer theoretical. Globally, seabed warfare, underwater sabotage and UUV (Unmanned Underwater Vehicle) incursions have risen sharply. Chinese submarines and survey vessels operate deeper and more frequently in the Indian Ocean. Hybrid warfare has extended below the surface, targeting assets that were never designed to withstand deliberate interference.

To secure this domain, India cannot rely on divers alone. The underwater terrain is too vast, too deep, and increasingly too hostile. What the country needs is persistent visibility—machines that can observe, inspect and analyse environments where human presence is dangerous, slow, or impossible.

This is where indigenous underwater robotics becomes indispensable.

Breaking the Dependency: The Need for Indian Solutions

For decades, India's underwater capability was constrained by dependence on foreign remotely operated vehicles (ROVs) and specialised sensors. These systems were expensive, bulky, difficult to maintain and often unsuited to the warm, turbid, silt-heavy waters around the subcontinent. Export controls added another layer of delay and uncertainty—hardly ideal for urgent defence or disaster-response

situations. India needed its own underwater robotics ecosystem—not imported machines retrofitted for Indian conditions, but technology engineered from the ground up for Indian realities.

The shift began in 2016 with a small but ambitious Kerala-based startup: EyeROV, founded by IIT engineers Johns T. Mathai and Kannappa Palaniappan. Their approach was simple but radical: Make underwater robotics accessible, modular, affordable and mission-specific—without compromising capability.

The EyeROV Approach: Built in India, Built for Indian Waters

India's coastline presents a uniquely challenging operating environment. Visibility is often murky. Sediment loads are high. Monsoon-driven currents are unpredictable. Harbour geometry is complex. Corrosion is rapid. Western ROVs, designed for clear and cold waters, struggled.

EyeROV flipped the design philosophy. Every product was developed not for ideal conditions, but for the real India—brown waters, strong currents, tropical corrosion, and challenging depth profiles.

Its systems focus on stability in turbulent zones, precision in low-visibility environments, high-intensity lighting for murky conditions, and rugged, easily repairable designs that can withstand tropical deployment. This approach allowed EyeROV's robots to be deployed across naval jetty inspections, offshore platforms, bridge pillar surveys, harbour scans, cyclone damage assessments and industrial projects. Instead of adapting foreign designs to India, EyeROV built India-first engineering.

From TUNA to TROUT: Building a New Capability Layer

EyeROV's first product, TUNA, was a compact micro-ROV for basic underwater inspections. It was soon followed by TROUT, a far more robust and capable system.

To secure this domain, India cannot rely on divers alone. The underwater terrain is too vast, too deep, and increasingly too hostile. What the country needs is persistent visibility—machines that can observe, inspect and analyse environments where human presence is dangerous, slow, or impossible. This is where indigenous underwater robotics become indispensable

TROUT represents India's quiet leap into deep-sea operations. Built with dual HD/4K cameras, a 300-metre depth rating, six degrees of freedom manoeuvrability and advanced imaging, TROUT can perform extended missions in conditions where earlier systems could not operate reliably.

Its true value lies in versatility. TROUT can assess submarine anchorage zones, inspect offshore installations, survey underwater archaeological sites, or support naval engineering teams in complex harbour environments. By adding a deep-water tool to the nation's underwater toolkit, EyeROV is helping India transition from shallow-water capability to comprehensive subsea coverage.

Every indigenous deep-sea platform also strengthens data sovereignty—keeping sensitive underwater imagery and mission data securely within national systems.

A Growing Defence Partner in Aatmanirbhar Bharat

EyeROV's evolution mirrors India's broader push toward defence indigenisation. The company has grown from a startup solving inspection problems to a significant partner in India's maritime ecosystem. It is now one of the country's top defence-aligned deep-tech firms, contributing directly to naval and DRDO missions.

A major milestone came with EyeROV securing a ₹47 crore contract from the Indian Navy—a clear signal that the Navy increasingly trusts indigenous underwater systems for mission-critical operations. EyeROV's clients today include DRDO, the Indian Coast Guard, GAIL and major ports, reflecting a dual-use capability across defence and industry.

Alongside its underwater systems, EyeROV has also developed iBoat Alpha, an autonomous surface vehicle (USV) designed to complement ROV operations—further strengthening India's unmanned maritime capability.

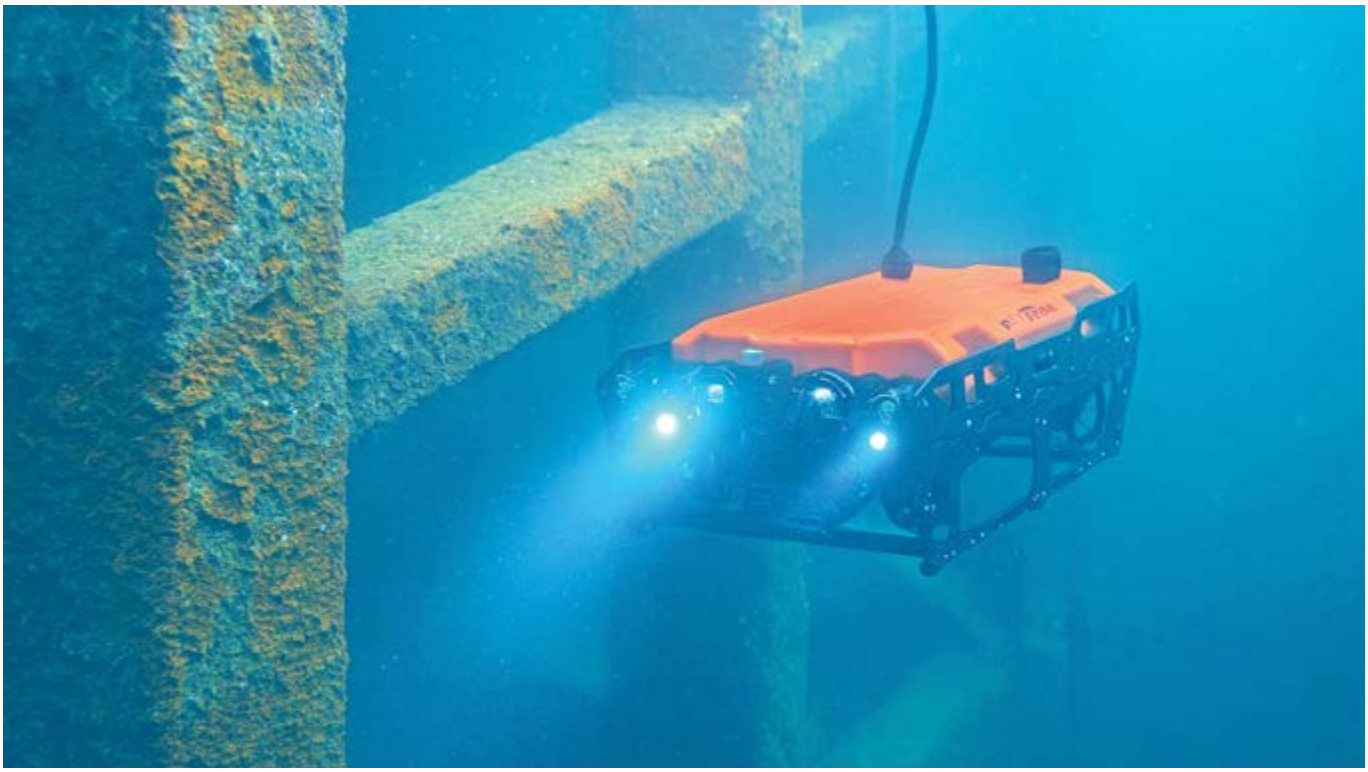
Human–Machine Teaming: Reducing Risk, Enhancing Readiness

A major advantage of underwater robotics is the protection it offers to divers. Naval divers often operate in hazardous conditions—limited visibility, structural debris, strong currents or entanglement risks.

By taking over repetitive, dangerous or prolonged underwater tasks, ROVs allow divers to focus on specialised operations where human skill is indispensable. This synergy—human judgement supported by robotic precision—is rapidly becoming the global norm in naval operations. EyeROV's systems position India firmly on this trajectory.

Completing the Underwater Picture: Strengthening MDA

India has built a sophisticated maritime domain awareness network over the years—radars,



satellites, coastal surveillance chains, automatic identification systems and digital fusion centres. Yet one layer remained incomplete: underwater awareness.

EyeROV's ROVs fill this gap. Whether scanning harbour floors for anomalies, monitoring underwater activity around naval installations, or inspecting seabed features, these systems provide a continuous stream of high-quality underwater intelligence. As underwater threats become more complex, this capability will be essential for naval planners and harbour security teams.

A Future Shaped by Indigenous Innovation

India's underwater robotics sector is still young, but its trajectory is clear. The coming decade will demand long-endurance autonomous underwater vehicles, AI-enabled ROVs with automated navigation, swarm UUVs, mine-countermeasure robots, deep-sea survey platforms and locally built subsea thrusters and batteries.

EyeROV—and startups like it—will be central to building this future. Working alongside DRDO, the Indian Navy and energy-sector industries, they will shape an underwater industrial base that India urgently needs as seabed competition intensifies across the Indo-Pacific.

Indigenous innovation is no longer a choice. It is a strategic necessity.

Securing the Nation's Hidden Frontier

Navy Day celebrates the courage and professionalism of the Indian Navy. But maritime superiority rests not only on ships, submarines and aircraft—it also depends on the invisible technologies safeguarding them from below.

The silent revolution beneath the waves has begun, and it is poised to become one of the defining contributors to India's maritime power in the decades ahead

The underwater battlespace is now real and immediate. And as companies like EyeROV build advanced indigenous platforms—from the first TUNA to the deep-sea TROUT—India is gaining the tools to secure its most hidden frontier with confidence.

This is the new face of Aatmanirbhar Bharat: quiet, strategic and unfolding far beneath the surface. The silent revolution beneath the waves has begun, and it is poised to become one of the defining contributors to India's maritime power in the decades ahead. ■

–The writer is a seasoned media professional with over three decades of experience in print, electronic, and web media. He is presently Editor of Taazakhabar News. The views expressed are of the writer and do not necessarily reflect the views of Raksha Anirveda

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Building India's Maritime Defence Ecosystem

As India's maritime security architecture undergoes a transformation driven by indigenous capability development across surveillance, autonomy, electronic warfare, materials engineering, and AI-enabled systems, Big Bang Boom Solutions makes a significant contribution

• **Dr R Shivaraman**

India's maritime frontier spans 11,098.81 km of coastline and over 2 million sq km of Exclusive Economic Zone. These waters are not mere boundaries but vital arteries of national security and economic prosperity. As we advance towards becoming a developed nation, securing our maritime edge through indigenous capabilities has become both a strategic necessity and an operational imperative.

The Indian Ocean Region faces an evolving threat landscape. Traditional naval warfare concerns now coexist with asymmetric challenges, including unmanned systems, swarm attacks from non-state actors, underwater drones, and hybrid tactics that exploit gaps in domain awareness. The 26/11 Mumbai attacks demonstrated how coastal vulnerabilities can be exploited when surveillance gaps exist.

The Multi-Domain Maritime Threat

Naval forces today must defend against threats spanning multiple domains simultaneously. Surface vessels, submarines, aircraft, and increasingly, unmanned systems operate in coordinated patterns designed to overwhelm defences. Small boats loaded with explosives, drone swarms launched from fishing trawlers, and autonomous underwater vehicles mapping sensitive installations, each represents a distinct challenge requiring specialised countermeasures.

What makes this threat environment particularly complex is the sheer scale of India's maritime domain. Monitoring every fishing harbour, commercial port, offshore installation, and naval facility requires capabilities that are both comprehensive and economically sustainable. Relying on imported systems for such large-scale coverage is neither viable nor strategically prudent.

The answer lies in indigenous innovation aligned with operational realities. Through platforms like iDEX, Indian startups and research institutions now collaborate closely with the Navy to develop solutions suited to regional climates, maritime patterns, and evolving threats.

Naval forces today must defend against threats spanning multiple domains simul-taneously. Surface vessels, submarines, aircraft, and increasingly, unmanned systems operate in coordinated patterns designed to overwhelm defences

Autonomous Systems Extending Naval Reach

Unmanned systems have become essential in extending naval capability. Autonomous surface vessels can conduct persistent surveillance, mine countermeasure support, and anti-submarine operations across large ocean expanses without risk to personnel. Underwater autonomous vehicles enable harbour security, seabed mapping, offshore infrastructure inspection, and covert reconnaissance.

The value of autonomy increases significantly when systems can be deployed at a meaningful scale. A few expensive imported platforms cannot ensure persistent surveillance across India's maritime spread, but cost-effective indigenous systems can enable distributed coverage.

Indian technology developers are now creating platforms optimised for Indian Ocean realities, including shallow waters, monsoon-driven sea states, and indigenous communication frameworks. This ensures operational relevance and cyber assurance.

At Big Bang Boom Solutions, the development focus has been on ensuring unmanned platforms remain practical for sustained naval deployment. Systems are tested to withstand maritime environmental stress, operate within existing Indian Navy maintenance capacity, and integrate with command and control networks already in service. Indigenous development allows system design to evolve from operational needs rather than fit imported architectures.

Maritime Domain Awareness Through Multi-Sensor Fusion

The foundation of maritime defence is real-time domain awareness. Traditional reliance on ship radar

and aerial patrols cannot often detect low-signature threats such as small craft, semi-submersibles, or surface-skimming drones.

A layered surveillance ecosystem is required. Networked coastal systems integrating radar, RF monitoring, electro-optical surveillance, and AIS-based maritime data create a composite picture. When fused using AI-based analytics, such systems can differentiate routine civilian activity from anomalous or suspicious activity with improved accuracy.

Artificial intelligence is essential in processing multidimensional data at operational speed. Systems trained on Indian maritime data can recognise patterns unique to local shipping, fishing cycles, and seasonal variations. This ensures a higher degree of relevance and reduces operator fatigue.

These systems improve further through iterative learning from deployment feedback, ensuring adaptability against evolving tactics.

Counter Swarm Defence for Naval Assets

Commercial drone proliferation has expanded the threat environment. Drones can be used for reconnaissance, targeting, or swarm-style offensive missions. Naval operations introduce additional complexity due to sensor interference, saltwater exposure, and the constant motion of platforms.

Effective maritime counter-drone capability requires a combined architecture including radar-based tracking, RF denial mechanisms, and precision neutralisation tools. These systems must integrate with naval command systems and adapt to shipboard deployments as well as coastal security installations.

The Vajra family of systems was introduced during indigenous development programmes to address these challenges using a modular approach. The system structure demonstrates how layered defence can be adapted across vessel sizes, shore infrastructure, and mobile rapid deployment units.

The value of autonomy increases significantly when systems can be deployed at a meaningful scale. A few expensive imported platforms cannot ensure persistent surveillance across India's maritime spread, but cost-effective indigenous systems can enable distributed coverage

Non-Lethal Deterrence and Graduated Response

Modern maritime operations often require the precision application of force. In many missions, particularly in anti-piracy or smuggling interdiction, escalation control is critical.

Developing indigenous non-lethal deterrence capabilities provides naval commanders with intermediate response options before kinetic measures become necessary. These technologies support lawful engagement frameworks and reduce risk to civilian maritime traffic.

AI-Driven Predictive Maintenance and Logistics

AI-enabled maintenance analytics are transforming fleet sustainment. Predictive systems analyse equipment performance data to forecast failure points and recommend maintenance cycles. This improves availability and reduces unexpected downtime.

Indian Navy-specific platforms and deployment rhythms differ from international configurations. Indigenous AI models trained on Indian operational datasets provide stronger predictive outcomes than generic imported maintenance platforms.

Economic Sustainability and Strategic Autonomy

Capability building in naval technology requires sustained investment and long-term viability. Indigenous equipment provides lifecycle benefits, including local spares, ease of upgrade, secure data handling, and domestic training capacity.

Strategic autonomy is strengthened when critical defence technologies are developed, supported, and modernised within national capability. Operational readiness no longer depends on global supply chains or external policy constraints. In addition, successful indigenous systems create potential export opportunities among nations facing similar maritime challenges. This forms strategic partnerships and positions India as a maritime security contributor.

Building Through Collaboration

Innovation efforts in the Indian defence ecosystem have been accelerated by programmes like iDEX, which enable startups, MSMEs, and private sector innovators to work alongside the armed forces.

This model shortens development timelines by enabling early operational evaluation, refining solutions through continuous feedback, and avoiding isolated development pipelines.

Big Bang Boom Solutions has contributed to such programmes since 2018 through projects in electronic warfare, AI-based systems, and autonomous platforms. In 2025, an indigenous solution developed within this ecosystem entered international deployment, signalling the model's readiness and maturity.

Advanced Materials and Stealth Technologies

Materials innovation is increasingly shaping naval capability. Lightweight and corrosion-resistant materials increase the endurance of unmanned platforms, while stealth materials reduce detectability and enhance survivability.

Developing such material systems domestically ensures optimisation for Indian Ocean environmental conditions and protects sensitive technology from reliance on foreign suppliers.

At Big Bang Boom Solutions, the development focus has been on ensuring unmanned platforms remain practical for sustained naval deployment. Systems are tested to withstand maritime environmental stress and operate within the existing Indian Navy maintenance capacity

Training and Human Machine Teaming

As autonomy and AI become integral to naval operations, training must prepare personnel for interaction with intelligent systems. This includes understanding system logic, managing exceptions, and maintaining mission-level decision authority.

Indigenous training systems can incorporate Navy-specific doctrines, procedures, and operational workflows, improving effectiveness and reducing reliance on imported simulation ecosystems.

The Path Forward

While progress has been significant, continued scaling of infrastructure, funding continuity, and expanded test environments will accelerate capability maturity. Collaborative naval innovation hubs would further streamline certification, testing, and operational deployment.

Summing Up

India's maritime security architecture is undergoing a transformation driven by indigenous capability development across surveillance, autonomy, electronic warfare, materials engineering, and AI-enabled systems. These advancements are not theoretical, but increasingly visible across active deployments and operational trials.

As India celebrates Navy Day 2025, it is clear that the foundation of maritime security rests not only on naval presence but also on technological self-reliance. The Indian Ocean will remain secure when operational capability aligns with indigenous innovation, ensuring readiness, resilience, and national autonomy. ■

–The writer is Co-Founder of Big Bang Boom Solutions. The views expressed are of the writer and do not necessarily reflect the views of Raksha Anirveda

Powering Maritime SELF-RELIANCE

Paras Defence and Space Technologies stands at the forefront is pioneering indigenous innovations across optronics, EMP protection, and counter-drone systems. From advanced submarine periscopes to command consoles and multi-domain defence engineering, Paras Defence is reinforcing India's resolve for an Aatmanirbhar, combat-ready Navy

• **RA Editorial Desk**

For centuries, our seas have shaped our trade, strategy, technology, and national identity. Today, India's maritime imperatives are shaped by a complex security landscape and evolving national security priorities. With over 11,098.81 km of coastline, vital sea lanes, expanding trade volumes, and a rapidly evolving geopolitical environment, the Indian Navy stands as the principal instrument of India's maritime power. It remains a cohesive, combat-ready and increasingly Aatmanirbhar force.

Within this framework, Paras Defence and Space Technologies is privileged to contribute to indigenous technologies that help preserve and project national influence across borders. As a trusted pioneer in India's defence ecosystem, Paras Defence has consistently advanced core indigenous capability across optics, optronics, strategic electronics, EMP solutions, space systems, and emerging drone and counter-drone technologies, all aligned with the vision of mission readiness and operational dominance.

The Optronic Mast for Submarine Applications

The Submarine Periscope

The indigenisation of the optronic submarine periscope system, a complex integration of high-precision optical, optronic and mechanical systems, stands as the flagship technological advancement for Paras Defence, being the first to indigenise such technology on its home ground. The submarine periscope, traditionally imported and developed by only a few nations, is now being manufactured in India with world-class performance and quality.

This capability, developed over years of specialised engineering, has enabled the Indian Navy to reduce its dependence on foreign suppliers while ensuring lifecycle support within the country. This shift in India's defence ecosystem has not only brought

us responsibility but also the opportunity for the nation's technological ownership to contribute to the Indian Navy's strategic transformation.

The Command and Control System

Equally critical to maritime operations is the architecture of command itself. Modern warships and submarines rely on command consoles that can withstand vibrations, shock cycles, fluctuating electromagnetic conditions and extended operational deployments.

Paras Defence has developed specialised expertise in the design and manufacturing of Military Standard (MIL-STD) command and control systems. These command-and-control consoles are equipped with ruggedised displays and embedded software, in-house designed and developed by Paras Defence to meet stringent operational requirements.

New Age Threats to the Maritime Domain

Beyond the underwater operations, the Navy's operational landscape continues to expand through the air and coastal domains. Maritime operations demand persistent surveillance, precision targeting, and real-time data to respond to new and emerging threats.

Anti-Drone Solutions

The proliferation of unmanned aerial systems has introduced a new dimension of risk. While traditionally associated with land warfare, drone-based threats now extend into naval infrastructure, coastal regions, and shore-based installations.

The indigenisation of the optronic submarine periscope system stands as a flagship technological advancement for Paras Defence, making it the first to indigenise such technology domestically

The company's counter-drone solutions through its subsidiary Paras-Anti Drone Technologies represent the early foundation for addressing the new-age threats. Its cutting-edge solutions include multi-sensor drone detection and wide-band drone jamming technology. All of these are indigenously designed, developed and manufactured by the company.

Electromagnetic Pulse Protection Solutions (EMP)

Electromagnetic pulse is a new-age threat to all operational electronic systems. In the advent of electronic warfare, EMP becomes the most potent and destructive threat, capable of neutralising electronic and electrical infrastructure across a large area. Paras Defence is proud to be the only Indian company offering turnkey EMP protection solutions for critical defence and non-defence infrastructure.

EMP Protection Solutions by Paras Defence are completely designed, developed and manufactured in India and meet global MIL-STD in performance and quality and include 100 per cent Indian content.

Areas of Expertise

Paras Defence and Space Technologies Ltd is a premier Indian defence engineering company, delivering a comprehensive suite of indigenously designed, developed, and manufactured (IDDM) products and solutions for the defence and space sectors. With over 40 years of sustained business growth, Paras has evolved into a pivotal player supporting India's strategic interests across land, naval, air, and space domains.

The company's operations span two core verticals: Optics & Optronic Systems and Defence Engineering, which includes Defence Electronics,

Electromagnetic Pulse (EMP) Protection Solutions, and Heavy Engineering. Paras is the only Indian company developing and manufacturing Optronic Periscopes in the Asia-Pacific region for submarine applications.

Its technological footprint covers a wide spectrum of strategic applications — from rockets and missiles to naval platforms, land and armoured systems, space research, electronic warfare, surveillance, and electromagnetic shielding. Through its subsidiaries, Paras also drives innovation in areas such as anti-drone technologies, RF and microwave systems, EO/IR systems for avionic platforms, thermal solutions for space, and quantum communication.

Paras Defence is proud to be India's only company offering turnkey EMP protection solutions for critical defence and non-defence infrastructure

While maintaining a global outlook, Paras Defence remains firmly focused on advancing India's self-reliance in defence technology, powered by strong in-house R&D, integrated engineering capabilities, and turnkey system delivery.

Safeguarding the Seas for a Developed and Secure India

As we commemorate Indian Navy Day, the shift from traditional sea-based missions to multi-domain security and the increasing need for resilient, indigenous technologies become even more pivotal.

Paras Defence and Space Technologies remains committed to enabling this transition. Its contributions across optronic submarine periscopes and other emerging technologies are aligned with the effort to safeguard India's maritime interests with strength, coherence, and self-reliance. Paras Defence is proud to stand with the Indian Navy in this national endeavour, supporting its mission to secure the seas for a Viksit Samriddha Bharat. ■

Seeing the Seas CLEARLY

In a world defined by maritime interdependence, SAR is becoming the backbone of how nations safeguard their waters, protect their economies, and ensure security at sea. Moreover, with the emergence of New Space, maritime awareness and intelligence is transforming

• **RA Editorial Desk**

Maritime domains today are more contested, more congested, and more consequential than ever. Global supply chains depend on uninterrupted sea lanes. Nations rely on maritime trade for economic stability. Illegal fishing, sanctions evasion, smuggling, and grey-zone manoeuvres increasingly shape geopolitical tensions. In this high-stakes environment, what countries need most is the one element they have historically struggled to maintain: persistent, all-weather visibility across the oceans.

For decades, maritime surveillance relied on a patchwork of tools—coastal radar, patrol aircraft, shipborne sensors, AIS transmissions, and optical satellites. Each has played an important role, yet each has significant limitations. Weather, darkness, signal manipulation, and vast geographic distances routinely create dangerous blind spots.

The emergence of New Space has changed this equation. Agile constellations, rapid image delivery, and high-resolution sensors have ushered in a new era of maritime awareness—one where oceans can be monitored continuously, not occasionally. At the centre of this transformation is Synthetic Aperture Radar (SAR), the technology redefining how nations understand and secure their maritime environments.

SAR: The Most Reliable Eyes over the Oceans

Unlike optical imagery, SAR is immune to cloud, haze, rain, or darkness—conditions that dominate much of the world's oceans. This alone makes it indispensable for maritime operations, where storms, monsoons, nightfall, and sea spray often diminish optical and radar performance.

ICEYE, the global leader in SAR constellation technology, has built its system precisely around this need for maritime persistence. With imaging resolution up to 16 centimetres and the world's most expansive synthetic aperture radar fleet, ICEYE delivers the ability to track vessels, observe ports, monitor chokepoints, and detect anomalies with unmatched reliability.

Sea-faring nations are increasingly prioritising sovereign maritime intelligence capabilities. ICEYE's mission systems model enables countries to deploy their own SAR satellites, integrate them into national ecosystems, and develop long-term operational independence

This persistent maritime visibility fills critical gaps left by traditional systems and enables stakeholders—from naval commands and coast guards to insurers and disaster authorities—to maintain situational awareness even in the most challenging conditions.

Revisiting the Oceans at Operational Speed

Timeliness is everything in maritime security. Vessels can change course within minutes, illegal transfers can occur within hours, and storms evolve rapidly. ICEYE runs the largest operational SAR satellite constellation in the world with the

largest number of satellites designed for rapid revisit cycles—capturing the same area multiple times a day.

In an operational context, revisit speed directly translates into decision speed—ensuring maritime authorities act based on current reality, not outdated imagery.

Unmasking Dark Vessels: A Global Challenge

One of the most significant maritime risks today is the proliferation of "dark vessels"—ships that switch off AIS or manipulate their identity to conceal movement. These vessels are linked to illegal fishing, contraband transport, human trafficking, and sanctions evasion. Many operate under cover of night or in poor weather, where conventional sensors falter.

SAR detects vessels based solely on their physical signatures, revealing their location regardless of whether AIS is present, spoofed, or disabled. When combined with advanced analytics, SAR enables authorities to identify irregular behaviour, investigate vessel clusters, and expose suspicious maritime patterns in near real time.

Agile constellations, rapid image delivery, and high-resolution sensors have ushered in a new era of maritime awareness—one where oceans can be monitored continuously, not occasionally

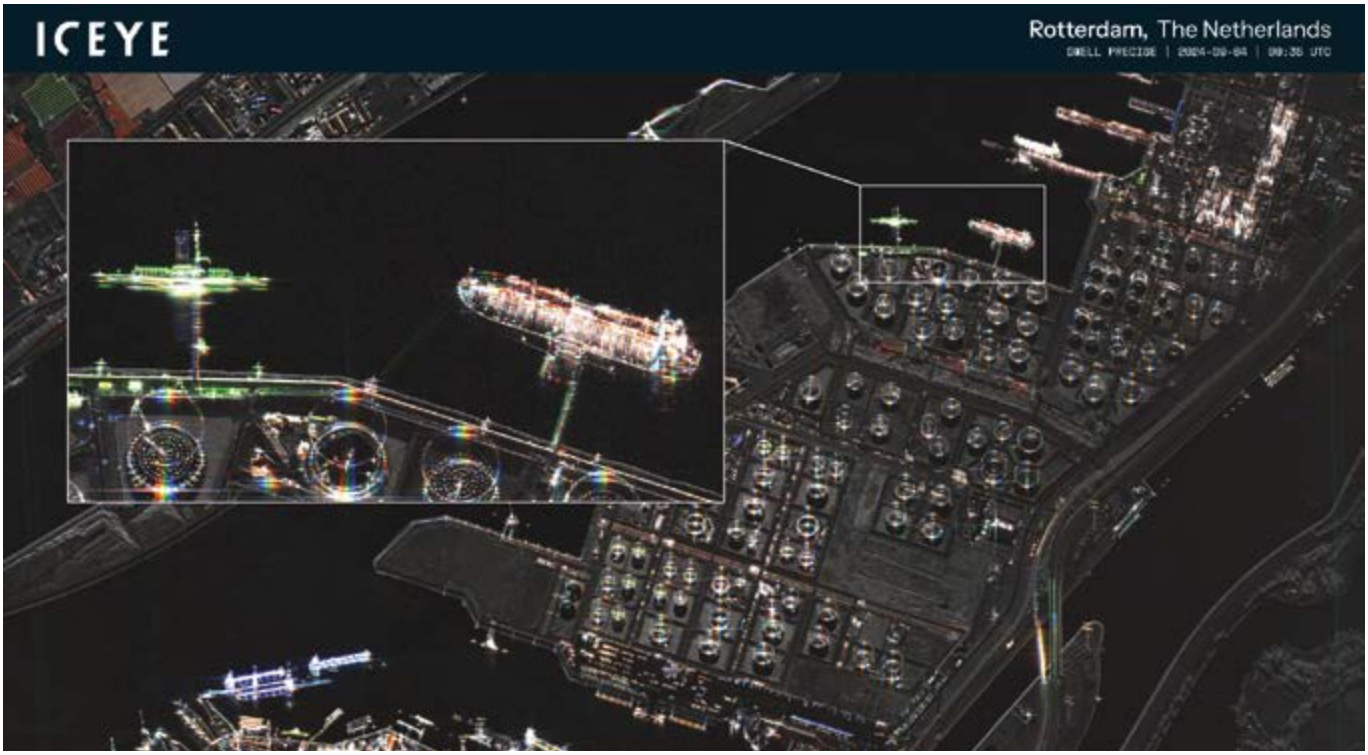
ICEYE's SAR modes are designed specifically with maritime operational flexibility in mind. Scan Wide mode captures up to 60,000 square kilometres in a single scene, enabling broad-area surveillance of sea lanes, archipelagos, and EEZs. Multi-frame tasking doubles this footprint—critical for monitoring wide swaths of ocean quickly.

Once an anomaly is identified—an unexpected vessel, a cluster of ships, or unusual coastal activity—the constellation can zoom into the same area to collect high-resolution imagery for detailed analysis.

This wide-to-narrow workflow is essential for maritime authorities who must both monitor the big picture and investigate specific targets.

From Ocean Imagery to Operational Intelligence

The next breakthrough in maritime surveillance is happening at the intersection of SAR and artificial



intelligence. In partnership with SATIM, ICEYE's Detect & Classify product uses AI to automatically detect and classify vessels, aircraft, and vehicles with over 90 percent accuracy. This shift—from imagery to intelligence—ensures maritime operations are guided by insights, not just pixels.

Sea-faring nations are increasingly prioritising sovereign maritime intelligence capabilities. ICEYE's mission systems model enables countries to deploy their own SAR satellites, integrate them into national ecosystems, and develop long-term operational independence.

Partnerships with the Polish Armed Forces, Portuguese Air Force, Royal Netherlands Air Force, and Finnish Defence Forces demonstrate how SAR satellites can anchor national maritime ISR capability.

Complementing this, Tactical Access provides guaranteed tasking availability—ensuring that during crises or dynamic maritime operations, imagery can be obtained on short notice, without waiting in global queues.

Resilience in an Era of Climate and Geopolitical Stress

From cyclones to coastal flooding, maritime disasters often unfold under heavy cloud cover. SAR's ability to deliver clear imagery during extreme weather makes it essential for:

- Flood mapping and storm surge assessment
- Port and coastal infrastructure monitoring
- Damage assessment for insurers and utilities
- Tracking inland water movement and coastal erosion

In an era where climate events increasingly shape maritime safety and economic security, SAR provides a dependable foundation for response and resilience planning.

ICEYE's constellation and analytics ecosystem represent the next frontier of maritime awareness—one where nations can detect, understand, and respond to activity across their seas with unprecedented clarity and confidence

The Future: Real-Time Maritime Intelligence from Space

As miniaturised satellites, AI-based analytics, and rapid manufacturing advance, Earth Observation is evolving into a system of real-time maritime intelligence. Stop-start visibility is giving way to continuous coverage; periodic snapshots are transforming into persistent monitoring; and manual analysis is being replaced by automated decision support.

ICEYE's constellation and analytics ecosystem represent the next frontier of maritime awareness—one where nations can detect, understand, and respond to activity across their seas with unprecedented clarity and confidence.

In a world defined by maritime interdependence, SAR is becoming the backbone of how nations safeguard their waters, protect their economies, and ensure security at sea. ■

HINDUSTAN SHIPYARD LIMITED

(GoI Undertaking, Ministry of Defence) A MINIRATNA COMPANY

Celebrating 85 years of Shipbuilding Excellence

DRIVING GROWTH @ HSL

HSL has transformed from negative to positive net worth after 40 years and is progressing towards achieving Mini Ratna status. HSLs future vision including development of Green Tugs(Electric & Hydrogen powered) is aimed at reducing carbon emissions. HSL is striving to promote self-reliance, innovation & maritime development contributing to Swarna Andhra & Viksit Bharat. HSL is also playing a key role in developing Vizag as a maritime Hub.

India's largest Defence shipbuilding yard Hindustan Shipyard Limited, recently celebrated 85 years of maritime excellence on June 21st 2025. HSL has come a long way, having started way back in 1941 by the legendary Seth Walchand Hirachand

HSL has faced testing times over the years, from being India's first greenfield shipyard to experiencing dismal orders and mounting losses. However today HSL is a rejuvenated shipyard, one that is buzzing with enthusiasm, energetic & motivated employees coupled with a thriving and rapidly growing order book.

Timely delivery, customer satisfaction and customer is King attitude is today widely witnessed and felt at this landmark shipyard on the east coast of India.

POSITIVE NETWORTH @ HSL

HSL AT WORK

Powering the Green Vessel Revolution with Hydrogen Fuel Cells

Driving Aatmanirbharta through Fleet Support Ships Mega Project

Hub for thriving Ship & Submarine Refit Ecosystem on the East Coast

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Swavlamban-2025 Showcases INDIGENOUS Tech and Innovations

The *Swavlamban 2025* besides showcasing the SMEs, MSMEs and startups contribution to the Indian Navy's modernisation and *Aatmanirbharta* programmes, also challenged the young minds with its Innovathon Challenge, which include the Development of a Swarm Algorithm, a Scalable cross-platform network traffic encryption solution, and the Design and Development of a satellite-aware maritime route intelligence system to encourage SMEs, MSMEs and entrepreneurs to submit bids across three disciplines: Cybersecurity, Autonomous Operations, and Artificial Intelligence

• **Cmde Ranjit B Rai**

"India is entering a golden era of defence innovation; our young entrepreneurs are helping the nation become builders, creators and leaders, and we must remain proactive, ahead of the curve and future-ready in today's rapidly evolving world", Defence Minister Rajnath Singh said on November 25 at the Indian Navy'sevent *Swavlamban 2025* ahead of India's Navy Day Celebrations on December 4 at Thiruvananthapuram's Shangumugham beach with an Operational Demo.

Swavlamban is an annual event of the Naval Innovation and Indigenisation Organisation (NIIO), conducted in collaboration with the Society of Indian Defence Manufacturers (SIDM) that provides a unique platform to showcase indigenous maritime technologies and foster cooperation between the Indian Navy and the nation's innovation ecosystem in the pursuit of *Aatmanirbharta*. This edition featured tangible products that have matured over time and will soon be deployed for operational use. Defence Minister visited the exhibition and was apprised of the equipment on display.

Defence Minister Rajnath Singh in a group photograph at 4th edition of the Indian Navy's Swavlamban-2025 seminar

The word *Swavlamban* stands for self-reliance and the Indian Navy has since India's Independence lived with a desire to Make in India' as some few thousand officers and sailors were deputed to British shipyards

to bring back INS Delhi (HMS Achilles 1948), Mysore (HMS Gambia 1954), Vikrant (HMS Hercules 1961) and eleven new frigates in the 1960s. This gave them hands-on experience in maintaining and building ships. Spares and machinery were shipped out from Yarrow Shipyard at Glasgow for the Leander class of ships to Mazagon Docks Ltd in Bombay, and the first major frigate, INS Nilgiri, was commissioned by Prime Minister Indira Gandhi in Bombay in 1973. The Indian Navy has not looked back since.

The Navy set up a Design Directorate at a hired building in Delhi and an in-house R&D Organisation called the Weapons Electronics Engineering Systems Establishment (WEESE), and, thanks to this background, India's Navy became a Builder's Navy by the early 2000s. As of writing, no ships or submarines are being imported. Exports of small platforms have begun, and over sixty-five warships are under construction and on order in Indian yards, and over twenty-five have been approved by the Defence Acquisition Council (DAC). This could not have been achieved without the Small and Medium Enterprises (SMEs) supplying sub-assemblies, small and soft hardware, and ship systems. The Navy established the NIIO and launched its first *Swavlamban* at the Bharat Mandapam in 2022.

Swavlamban is an annual event that provides a unique platform to showcase indigenous maritime technologies and foster cooperation between the Indian Navy and the nation's innovation ecosystem

For the Navy's 4th *Swavlamban 2025*, from November 25-26, 2025 at the Manekshaw Centre, Delhi the theme was '*Strength and Power through Innovation and Indigenisation'*. Over 80 MSMEs and start-ups presented their prototypes & solutions designed to meet operational and strategic requirements of the Navy. It highlighted the Indian Navy's innovation and indigenisation efforts, and the contributions of the Indian industry's SME, many headed by young start-up innovators and investors, with a focus on technological advances that have already been inducted and could significantly enhance not only the Navy's but also the nation's defence capabilities.

This year's *Swavlamban* focused on emerging and disruptive technologies to keep pace with the country's changing security needs, such as drones, autonomous

navigation systems, quantum communications, which have proved successful in trials, hydraulics for ships and submarines, cyber options, and predictive technologies to reduce maintenance costs. Some exhibits focused on collaborative, cutting-edge solutions to operational challenges, including dedicated exhibit zones highlighting products that have emerged as success stories and those realised through the 'ideation to induction' cycle.

In his address, the Chief of the Naval Staff, Admiral Dinesh K Tripathi, stated that with each successive edition *Swavlamban* has grown in scope, scale, and participation – evolving from 800 participants in its maiden edition to an impressive gathering of 3,000 last year with iDEX which is Ministry of Defence's 'India Startup Challenge' in partnership with Atal Innovation Mission to create an ecosystem to foster innovation and technology development in Defence and Aerospace by engaging Industries. Of the 565 iDEX challenges announced so far, the Indian Navy holds a significant 35% share, and *Swavlamban* has been central to achieving this he added. Defence Minister felicitated 10 iDEX winners and released key documents.

Rajnath Singh recalled the rapidly evolving geopolitical landscape in the world, which is constantly shifting. He credited the innovators for coming forth with path-breaking solutions and helping the nation emerge as a builder, creator, and leader and not merely a buyer. He complemented the hard work of all stakeholders, who have made giant strides towards becoming a technology exporter rather than an importer. "If India is rising as a maritime power today, it is due to the contribution of our innovators along with the Navy," he said, sharing insights on the emergence of new technologies. Rajnath Singh also exhorted the private sector to adopt a profit-plus approach and develop platforms and systems that become symbols of the world's trust in India.

The Navy set up a Design Directorate at a hired building in Delhi and an in-house R&D Organisation called the WEESE, and, thanks to this background, India's Navy became a Builder's Navy by the early 2000s. As of writing, no ships or submarines are being imported

Naval shipbuilding and production, technology, design, and innovation have grown, bearing national maritime interests in mind. Every dollar saved in imports has had a 2.5 multiplier effect in India's economy. India's private defence shipyards and industry's ecosystem has expanded to supply all small platforms and large OPVs to the Navy and Coast Guard, and Larsen and Toubro Ltd (L&T) is set to provide three large training and five large multipurpose ships. The Navy's strategic submarine programme is a large Public-Private Partnership led by INS Arihant, and Defence Secretary Rajesh Kumar Singh has stated that all future bids will be equally opened to private shipyards. *Swavlamban* is another attempt to increase the private sector's contribution to defence manufacturing to 50% or more in the coming years, and this year the private sector provided Rs 1.27 lakh crores.

MoU signed by IIT Madras and Apollo Micro Systems to integrate the R&D capabilities of IIT Madras, Navy's expertise and Apollo Micro Systems for production of armament systems.

Defence minister releasing the Compendium of Naval Technological Challenges & Problem Statements, Armament Indigenisation




All three services spend heavily on maintenance, repair, overhaul, and spare parts for defence facilities, which are imported from foreign countries, especially aircraft. The Defence Minister emphasised the need to minimise import dependency and create a strong and self-reliant domestic supply chain. "If we strengthen local manufacturing of components and subsystems, our indigenous content will increase rapidly. This will not only enhance capability but also ensure cost efficiency, reliability, and strategic independence. This is possible only when the private sector, start-ups, R&D labs, and government institutions move forward with a shared vision," he said, underlining that in future, defence innovation, indigenous design, advanced manufacturing, and strategic autonomy will all become core strengths of development.

While Rajnath Singh endorsed enhanced collaboration for a robust defence ecosystem, he also called upon the private industry to identify and apprise the Government of the following big platforms, disruptive technologies, or path-breaking innovations they can provide. He extended full support of the Government and defence institutions in collectively finding solutions to any challenge.

This year's edition included a wide range of activities, such as the launch of the 'Innovathon', a Naval hackathon for students, researchers, technologists, and developers to contribute their intellect and creativity towards addressing real operational challenges of the maritime domain. The challenges include the Development of a Swarm Algorithm, a Scalable cross-platform network traffic encryption solution, and the Design and Development of a satellite-aware maritime route intelligence system to encourage SMEs and entrepreneurs to submit bids by January 4, 2026, across three disciplines: Cybersecurity, Autonomous Operations, and Artificial Intelligence.

The Navy's strategic submarine programme is a large Public-Private Partnership led by INS Arihant, and Defence Secretary Rajesh Kumar Singh has stated that all future bids will be equally opened to private shipyards

Earlier, they were called 'Challenges', and selected bids were funded and nurtured by the Navy. Defence Minister also released the Compendium of Technology 'Challenges and Problem Statements', and the Armament Indigenisation Compendium. He also launched the System for Armament Review, Analysis, Tracking, Handling, and Indigenisation (SARATHI), an analytical and knowledge management tool developed as a one-stop solution for all Naval Armament Inspection/ QA related issues. The application covers the entire gamut of activities during the life cycle of ammunition through stages of development, production, in-service exploitation, and finally, disposal. It has been completely designed and developed by the Centre for Development of Advanced Computing, Chennai.

On day two, interactive sessions were held, one led by Admiral Karambir Singh, former Chief of Naval Staff, who steered the Navy through increased Internet connectivity during COVID which was complemented and drew on his experience with experts from academia, industry, and partners in startups. Lt Gen VG Khandare led the second session. Both featured discussions on cutting-edge innovations in AI, autonomous systems, communication technologies, quantum computing, stealth solutions, and smart ordinances. ■

–The writer is Vice President of Indian Maritime Foundation and curates a Maritime Museum at Defence Colony, New Delhi. The views expressed are of the writer and do not necessarily reflect the views of Raksha Anirveda

India's Quantum SECURE EDGE

QNu Labs has established India as one of the world leaders in quantum-secure communication. Extending a five-year lead in Global Military Communication and expanding India's Quantum-Secure Defence network, the company is currently working with the Indian Navy to build quantum-secure communication capabilities to enable secure exchange of emails, voice, and chat over the existing satellite

• **Sunil Gupta**

How an Indian Deep-Tech Firm Built the World's Leading Quantum Communication Systems

India's progress in quantum-secure communication has accelerated in recent years, and a major share of that momentum comes from QNu Labs — a Bengaluru-based deep-tech company working at the intersection of physics, cybersecurity, and national defence. QNu Labs began its Quantum Key Distribution (QKD) R&D programme in 2016 and achieved India's first successful QKD implementation by 2018.

This early success set the stage for a larger ambition: creating a battle-ready and military-grade quantum communication network that could operate across India's vast geography and meet the stringent requirements of the armed forces. Few nations have progressed this far, this fast.

Extending the Boundaries of Quantum Key Distribution (QKD)

India's QKD Reaches 200 km — Far Ahead of Global Benchmarks

One of the biggest challenges in QKD is distance. Photons lose energy as they travel over longer distances, making the generation of quantum-secure keys a tough scientific and engineering challenge. Most international QKD systems operate between 80 and 120 km. Through sustained research and engineering, QNu Labs has extended this reach to 200 km with its patented QKD, nearly doubling global standards.

The global standard for creating a 500 km QKD Network needs 8 to 10 nodes, whereas QNu has developed it with 4 nodes, showcasing 50-60% cost savings while not compromising security and quality

Prime Minister Narendra Modi unveils QRNG SIP powered by QNu Labs at ESTIC 2025

This breakthrough not only demonstrates technical capability but also significantly reduces deployment costs per kilometre. The global standard for creating a 500 km QKD Network needs 8 to 10 nodes, whereas QNu has developed it with 4 nodes, showcasing 50-60% cost savings while not compromising security and quality.

Why Quantum Communication is Becoming Essential for National Security

Classical Encryption Will Not Survive the Quantum Era

Current communication, whether voice, email, or messaging, all rely on mathematical encryption. With the arrival of quantum computers, the traditional security protocols will eventually collapse. Research shows that future quantum systems will be able to break today's encryption "in a matter of minutes."

QKD Uses Quantum Physics, Not Mathematics

QKD derives its security from quantum physics. Instead of bits, it uses Qubits, which can exist at both 0 and 1 simultaneously. Any attempt to intercept the signal collapses the quantum state, immediately revealing

the intrusion and initiating a decision to prevent a man-in-the-middle attack.

This makes QKD one of the strongest available defences against interception. It is ideal for the armed forces, intelligence agencies, strategic industries, critical sectors, and national networks.

Trusted Node Technology for a Country of India's Scale

Meeting the Demands of Distance and Terrain

India's terrain and distances pose unique challenges. While optical fibre networks exist, they cannot always guarantee absolute security. QNu Labs' Trusted Node Technology solves this by enabling the generation of quantum-secure keys between network nodes located as far as 200 km. This approach is especially relevant for armed forces where the military nodes are deployed across long, remote routes from the plains to high-altitude regions.

Moving Towards Chip-Scale Quantum Security

Quantum communication technology, like most cutting-edge technologies, has large form factors and is meant to be deployed in data centres. With time, it has become important that the form factor reduces significantly to enable mass adoption of QKD and QRNG technologies. QNu Labs is shrinking it. QNu's quantum-security chip can be integrated into mobile phones, drones, laptops, and satellites, enabling secure communication across multiple platforms.

Supporting the Indian Navy and Tri-Services with Next-Generation Capabilities

Satellite-Based Quantum Secure Communications for Maritime Operations

QNu Labs is currently working with the Indian Navy to build quantum-secure communication capabilities to enable secure exchange of emails, voice, and chat over the existing satellite. The Indian Armed Forces have been the earliest adopters of quantum communication technologies, and discussions are in progress with other mission-critical national bodies.

Dr Jitendra Singh, Minister for Science and Technology, Prof Ajay K. Sood, Principal Scientific Adviser to the Government of India, Prof Abhay Karandikar, Secretary Department of Science and Technology, and other officials interact with Sunil Gupta, Founder and CEO – QNu Labs at ESTIC 2025

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A Strong Network of National and Global Collaborations

Partnerships that Strengthened India's Quantum Ecosystem

QNu Labs' journey includes collaborations with key national critical bodies and organisations: The Indian Armed Forces, DRDO, iDEX, DST, TDB, C-DOT, NASSCOM and DSCI.

On the global front, companies such as Cisco, Intel, NetApp and Amazon supported integration and validation of QNu's products through their accelerator and innovation programmes.

Alignment with the National Quantum Mission (NQM)

QNu Labs is one of the first private companies in which the government has taken equity under the National Quantum Mission. This support played a significant role in accelerating India's quantum capability and demonstrated the government's confidence in private deep-tech innovation.

The Road Ahead —India Steps Into a Quantum-Secure Future

QKD across 2,000 km by Next Year

QNu Labs aims to deploy a long-distance intercity QKD network by 2026 and a satellite-based QKD network by 2027.

Achieving this will make India one of the world's most secure digital and defence communication ecosystems.

A New Era for Naval and Defence Communication

On the Navy Day, it is worth noting how rapidly India is advancing in quantum communication technology. QNu Labs has not only delivered early breakthroughs but established India as one of the world leaders in quantum-secure communication, as per the guidance from our honourable Prime Minister Narendra Modi, DST and National Quantum Mission. From long-range QKD to Trusted Nodes to quantum-secure QRNG SiP, drone and satellite communications, QNu Labs is shaping a future where India's armed forces, including the Navy, operate with secure, tamper-proof communication channels across land, sea and space.

This progress marks a significant shift in India's defence readiness: a transition to an era where security is governed by physics or nature itself, not by computational strength. ■

–The writer is CEO and Co-founder of QNu Labs Pvt Ltd. The views expressed are of the writer and do not necessarily reflect the views of Raksha Anirveda

'An Agile Indian Navy Will ACQUIRE MORE ASSETS'

Chief of Naval Staff Admiral Dinesh K. Tripathi addressed the Navy's annual press conference in New Delhi, ahead of the Navy Day 2025. He confirmed the signing of the contract for 26 Rafale Marine aircraft, with the first batch expected in 2029. The Navy Chief highlighted the success of Operation Sindoor and the Swavlamban 4.0 seminar held in November earlier. He also noted the induction of Agniveers from 673 districts and the commissioning of the National Maritime Domain Awareness (NMDA) project

• **RA Editorial Desk**

Two days before Russian President Vladimir Putin embarks on an official visit to India—his first to New Delhi ever since the Ukraine conflict broke out in February 2022—India's Navy chief Admiral DK Tripathi has said that there is no 'conflict' in the Indian military having logistics agreements with both the US and Russian militaries.

The Navy chief's statement acquires significance in the backdrop of the fact that India and Russia are expected to ink the Reciprocal Exchange of Logistics Agreement (RELOS) during the presidential visit for easier logistics access between the navies of the two countries

At the Navy's annual press conference, the Navy Chief further detailed recent operations and future plans, highlighting heavy deployment at sea, anti-piracy, and anti-drug missions, along with upcoming assets such as Rafale fighter jets and new submarines. Admiral Dinesh K Tripathi shared these updates during the Navy Day press conference, stressing activity since the last Navy Day and cooperation with other national agencies.

Admiral Tripathi explained that sustained missions in the Gulf of Aden and nearby waters have continued without a break since 2008. According to Admiral Tripathi, warships, aircraft, and helicopters remain active across key sea lanes, with a sharp focus on piracy around the Red Sea, while parallel efforts target narcotics smuggling in the wider Indian Ocean region.

"Cumulatively, we have clocked almost 11,000 ship days and 50,000 flying hours since the last Navy Day and counting. We have maintained one ship in the Gulf of Aden continuously since 2008. The ship is relieved on station for anti-piracy duties. To date, 138 ships have been deployed for that, and they have successfully escorted more than 3,700 merchant vessels of all nationalities and crew. Since November 23, when the Red Sea crisis began, which led to an increase in piracy incidents, we have apprehended 62 pirates... Since November 23, due to heightened activity, especially by non-state actors like the Houthis, our 40 capital ships, along with their integral assets (helicopters, etc.) and capabilities, have been deployed," he said.

Admiral Tripathi also described modernisation steps for the Indian Navy. He said the force is projected to receive the first batch of four Rafale fighter jets by 2029

These figures underline how wide the Indian Navy's security role has become across busy trade routes. The focus on merchant vessel safety covers ships of many flags, while capital ships and aircraft increase presence where threats from pirates and non-state groups are reported.

Admiral Tripathi also described modernisation steps for the Indian Navy. He said the force is projected to receive the first batch of four Rafale fighter jets by 2029, adding that Project 75 India, which covers six advanced submarines, has reached an advanced stage, with a formal contract expected soon.

He further said India will soon commission its third indigenous nuclear-powered and ballistic missile-carrying submarine named 'Aridaman'. This is India's third ship submersible ballistic nuclear (SSBN) after INS Arihant and INS Arighat.

Speaking about combat readiness, Admiral Tripathi recalled the Indian

Navy's posture during Operation Sindoor against Pakistan. Apprising media about the Navy's role during the Operation Sindoor, Admiral Tripathi said the aggressive stance and deployment of battle ships forced Pakistan to remain at their ports.

Admiral Tripathi then quoted how the carrier group's movement limited Pakistan Navy activity. "The aggressive posturing and immediate action during Op Sindoor, of deployment of the carrier battle group forced the Pakistan Navy to remain close to their ports or near the Makran coast," he said.

Admiral Tripathi linked this example with current deployments, saying visible presence and quick decisions are central to the Indian Navy's approach in regional waters. Admiral Tripathi also highlighted the Navy's role in anti-narcotic operations. "As far as the anti-narcotic operations are concerned, our units on deployment in concerned with other national agencies have seized contraband worth Rs 43,300 crores last year," he said.

On the occasion Admiral Tripathi also released the Indian Maritime Doctrine 2025.

Significance of the Naval Doctrine. The Indian Maritime Doctrine is the apex guidance document of the Indian Navy. Initially published in 2004 and revised in 2009, with minor amendments in 2015, the 2025 edition reflects the major transformations in India's maritime environment and strategic outlook. The Indian Maritime Doctrine 2025 lays the foundation for the Navy's strategy and operations, providing a shared understanding of the principles that guide employment across the spectrum of conflict. It clearly defines the Navy's roles, answering the central question: "Why we do what we do."

The 2025 edition reflects the transformation in India's maritime environment over the last decade and incorporates India's broader vision of harnessing the oceans as a key pillar of Viksit Bharat 2047. This outlook is reinforced through major Government of India initiatives, such as Sagarmala, PM Gati Shakti, Maritime India Vision 2030, Maritime Amrit Kaal Vision 2047, and MAHASAGAR. It also recognises the growing maritime security challenges characterised by multi-domain threats, a diverse set of actors, and rapid advancements in technology.

The Indian Maritime Doctrine 2025 lays the foundation for the Navy's strategy and operations, providing a shared understanding of the principles that guide employment across the spectrum of conflict. It clearly defines the Navy's roles, answering the central question: "Why we do what we do"

The latest edition also formalises 'No-War No-Peace' as a distinct category between peace and conflict, establishing it as an important facet of the conflict spectrum. It integrates an enhanced understanding of tactics employed by adversaries, including grey-zone, hybrid, and irregular warfare. The revised doctrine also acknowledges the growing importance of the space, cyber, and cognitive domains, while emphasising on the integration of uncrewed systems, autonomous platforms, and emerging technologies. Additionally, it prioritises jointmanship by aligning with tri-service joint doctrines, towards ensuring interoperability across the Armed Forces.

The Indian Maritime Doctrine 2025 is intended to advance India's regional role and maritime influence while fostering a maritime-conscious nation that recognises the centrality of maritime power to national security. It seeks to strengthen jointness and integration across services and guide the translation of doctrine into strategy, operational directives, tactical publications, and naval capability development.

The Indian Navy will mark Navy Day 2025 with a grand Operational Demonstration on December 4 at Shangumugham Beach in Thiruvananthapuram, Kerala.

Continuing its tradition of hosting Navy Day celebrations beyond major naval stations, the event follows similar commemorations held in Puri, Odisha, and Sindhudurg, Maharashtra, in recent years. The mega demonstration will offer citizens a rare opportunity to witness the Navy's multi-domain operations and technological prowess up close.

According to the Navy, the event will showcase its state-of-the-art platforms and operational capabilities, reaffirming India's position as the "Preferred Security Partner" in the Indian Ocean Region under the broader vision of MAHASAGAR (Mutual and Holistic Advancement for Security and Growth Across Regions).

HSL: Indian Navy's BACKEND FORCE

Hindustan Shipyard Limited is the yard that never sleeps and keeps the Indian fleet smoothly sailing at sea, powered by decades of experience, skill and a record of over 2,000 ship repairs. HSL is the backbone of India's maritime operational readiness, shipbuilding self-reliance and naval power projection

• **RA Editorial Desk**

On Navy Day, as the nation turns its attention towards India's frontline warships slicing through the waters of the Indian Ocean, it's time to recognise the institution –Hindustan Shipyard Limited (HSL) India's most dependable naval maintenance and refit hub that keeps these ships seaworthy, mission-ready, and technologically relevant.

Located in Visakhapatnam, the headquarters of the Eastern Naval Command, HSL is the virtual back bone or lifeline that operates silently behind the scenes to ensure that the Indian Navy can sail, fight, and respond at a moment's notice.

Over the past more than eighty years, HSL has built over 200 vessels and repaired more than 2,000 ships, including frontline Indian naval vessels, scientific research platforms, offshore support ships and coast guard crafts. Few other institutions can boast of such a rich, varied and long history of uninterrupted service and maritime experience.

HSL- Eastern Seaboard's Strategic Gatekeeper

The Eastern Naval Command is home to a battle-ready fleet that patrols the Bay of Bengal, safeguards key sea lines of communication, and monitors maritime activity all the way to the Malacca Strait. HSL's location here gives it unparalleled strategic importance.

Every time a warship prepares for deployment, every time a tanker needs to return to sea ahead of schedule, every time a submarine requires a complex repair before a strategic patrol—HSL is the yard that commanders call upon.

This proximity enables:

- Rapid repair cycles for operational ships
- Emergency docking when unforeseen defects threaten deployments
- Overhauls and upgrades before joint exercises and patrol missions
- Fast turnarounds that maximise fleet availability

The ability to respond swiftly is not a luxury; it is a national security imperative. In the eastern Indian Ocean—now subject to increased Chinese submarine presence, grey-zone activities, and strategic posturing—fleet readiness is a decisive advantage. HSL ensures that India's naval assets spend more time at sea than in dock.

Mastering the Underwater Realm: HSL's Submarine Expertise

If there is one domain that elevates HSL from a capable shipyard to a strategic

jewel in India's maritime architecture, it is submarine refitting.

A submarine is among the most complex machines ever built—an airtight world of high-pressure steel, precision welding, sensitive sonar, weapon systems, propulsion machinery, and hundreds of interdependent systems. Even a minor defect can endanger lives. To refit a submarine is to dismantle and rebuild an entire ecosystem under exacting safety standards. Very few shipyards in the world have mastered this craft. HSL is one of them.

Over the years, HSL has successfully undertaken:

- Normal and medium refits of the Kilo-class (Sindhughosh-class) submarines
- Midlife-extension upgrades of the weapon systems to keep pace with technological advancements
- Comprehensive hull strengthening and corrosion control
- Integration of modern weapons and sensors
- Shafting system and propulsion motor overhaul
- Survivability and safety enhancements

The recent refit of INS Sindhuvir and INS Sindhuvijay undertaken in last five years involved some of the most intricate underwater repairs ever attempted in India—became a landmark achievement. Subsequent refits, including the refit MRLC of INS Sindhuvijay which is in advanced contractual stage, further demonstrate the Navy's growing confidence in HSL.

Each submarine that returns to sea after an HSL refit is not merely a repaired vessel; it is an enhanced underwater warrior, capable of adding stealth, deterrence, and strategic depth to India's maritime posture.

Ship Repair: 24×7 Readiness

While submarine refits are important, the true measure of a fleet's availability lies in everyday ship repair. This is where HSL has engineered a remarkable transformation. The once-underutilised Ship Repair Complex (SRC) has become a round-the-clock hive of activity.

Key improvements include:

HSL is the lifeline that operates silently behind the scenes to ensure that the Indian Navy can sail, fight, and respond at a moment's notice. Over the past eighty years, HSL has built over 200 vessels, and repaired more than 2,000 ships, including frontline Indian naval vessels, scientific research platforms, offshore support ships and coast guard crafts

- Strict adherence to timelines
- Process re-engineering to eliminate delays
- Real-time client coordination with Navy and commercial owners
- Lean project management practices
- Simultaneous multi-ship operations

Ships line up at HSL because it delivers. A week saved in dock is a week added to surveillance patrols, humanitarian operations, or anti-submarine missions. This reliability is why Coast Guard ships, naval auxiliaries, scientific research vessels, and merchant ships now actively seek HSL's dry-docks.

To manage rising demand, HSL has even collaborated with the Visakhapatnam Port Authority for additional berths—ensuring repair flow never breaks.

These are not just commercial efficiencies; they are strategic outcomes. When a replenishment tanker returns to sea early, the entire fleet gains additional reach and endurance.

A Legacy Forged in War, Sustained in Peace

HSL's origins go back to 1941, when the world was engulfed in the chaos of the Second World War. Born as a wartime facility to support Allied naval operations in the Indian Ocean, it quickly gained a reputation for reliability, sturdy workmanship, and technical finesse. After Independence, the Government of India took charge of the yard in 1952, recognising its immense strategic utility and transforming it into a critical national asset.

But HSL's true significance lies not just in shipbuilding numbers. It lies in the role it plays in sustaining the Indian fleet and enabling India's maritime ambitions in an increasingly contested Indo-Pacific.

The Human Backbone: India's Quiet Maritime Warriors

Behind every successful repair, every flawless weld, and every on-time refit stands a workforce of exceptional skill and devotion. HSL's engineers, planners, welders, pipe-fitters, machinists, electricians, naval architects, and safety specialists have built a culture where the yard is not just a workplace—it is a heritage. Many families have worked here for generations, passing down craftsmanship that no textbook can teach.

These unsung warriors work late nights during cyclone emergencies, overhaul propulsion systems at short notice, and solve engineering challenges under demanding timelines. They form the backbone of an ecosystem that sustains India's frontline naval capability.

Financial Revival and a New Culture of Performance

HSL has undergone a remarkable financial and operational turnaround in recent years.

- Turnover has crossed ₹1,400 crore, a historic high.
- Profit after tax has risen steadily.
- Legacy liabilities have been resolved.
- New efficiencies have been institutionalised.

This revival stems from disciplined contract execution, infrastructure upgrades, adoption of Industry 4.0 tools, and a performance-driven culture. The result is a shipyard that is not only reliable but also competitive—ready for the next generation of naval and commercial orders.

Green, Smart and Future-Ready: Preparing for Maritime Amrit Kaal

HSL is reinventing itself for a future defined by digital engineering, green propulsion, and sustainable maritime operations. Its new initiatives include:

- Hydrogen-powered tug development under the Green Tug Transition Programme
- AI-enabled diagnostics
- Robotics and smart fabrication systems
- Energy-efficient hull design
- Automated blasting and painting bays
- Upgraded cranes, workshops and testing facilities

Such modernisation is essential as shipping transitions toward carbon neutrality and as navies demand quieter, more efficient propulsion systems for next-generation vessels.

HSL's strategic vision extends beyond Visakhapatnam. Plans for a satellite shipbuilding centre in Andhra Pradesh, complete with a floating dry dock, will expand capacity, reduce congestion, and create a regional maritime manufacturing ecosystem.

A Regional Hub with Global Potential

HSL's capabilities are now drawing interest beyond India's borders. Discussions with countries such as Vietnam for submarine refits indicate the yard's emergence as a potential regional centre for underwater engineering—a development aligned with India's broader Indo-Pacific outreach.

Closer partnerships with the Eastern Naval Command, the Coast Guard, research institutions, MSME networks, and offshore industry players continue to strengthen HSL's ecosystem.

Navies fight at sea but win on shore. A navy's power is measured not just in the ships it builds, but in the ships it can keep ready. HSL ensures India's fleet is never caught unprepared. On this Navy Day, as India salutes the courage of its sailors, it must also acknowledge the institutions that empower them

Why HSL Matters More Than Ever

India stands at a maritime crossroads. Strategic competition in the Indian Ocean is intensifying. Chinese submarines are making more frequent forays. The security of sea lanes—carrying over 90% of India's trade—cannot be taken for granted.

In this environment, HSL's significance is profound:

1. Maximises fleet availability
2. Enhances submarine readiness
3. Strengthens maritime deterrence
4. Reduces dependence on foreign refit yards
5. Supports humanitarian and disaster missions
6. Builds indigenous technical skillsets
7. Drives India's blue economy and green shipping transition

A navy's power is measured not just in the ships it builds, but in the ships it can keep ready. HSL ensures India's fleet is never caught unprepared.

A Navy Day Tribute to India's Silent Maritime Strength

Navies fight at sea but win on shore. India's maritime power rests not only on its ships, but on the shipyards that sustain them. As India builds more warships for keeping sea lanes of communication open, the importance of such "never-sleeping" yards will only grow.

Hindustan Shipyard Limited is the critical backbone—

- that works around the clock,
- that treats every refit as a mission,
- that is steadily reinventing itself for a greener, smarter future.

The next time an Indian warship sails out of Visakhapatnam or a submarine quietly slips beneath the waves, chances are that somewhere in its recent history lies a chapter written in the workshops, docks and design offices of HSL—the yard that keeps India's fleet always ready and always at sea. ■

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