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Abstract

Over the past few decades, rapid advances in autonomous systems have begun to transform the character of warfare. Their impact has been unambiguously demonstrated in recent conflicts, including the Russia-Ukraine conflict, the Red Sea campaign and Op Sindoor 2025. For the Indian Navy, the implications are stark and clear. Integrating these potent platforms alongside major service combatants is an imperative. This article aims to derive key policy takeaways for integrating the USVs into the Indian Navy. It examines *'where we want to be'* by deriving lessons learnt from recent conflicts and analysing global trends. It further attempts to assess *'where we are'* by evaluating the various challenges and then proposing specific policy and doctrinal recommendations to address *'how to get there'*. The underlying vision is that the Indian Navy's

Unmanned Surface Fleet becomes not only a technological addition but a force multiplier firmly embedded in the Indian Navy's DNA.

Key Words: Unmanned Surface Vessel (USV), Swarms, Atmanirbhar Bharat, Unified Platform Management System

Introduction

In contemporary naval warfare, the character of maritime operations is increasingly shaped by autonomy. Unmanned surface vessels, once confined to experimental trials and simulations, are now being employed by navies and non-state actors alike for high-risk missions such as maritime surveillance, mine countermeasures, anti-submarine warfare and surface security tasks.[1] Their strategic relevance has been established not by theoretical promise, but by operational experience. Ukrainian attacks on the Russian Black Sea Fleet and naval infrastructure at *Sevastopol*[2], as well as Houthi employment of unmanned systems in the Red Sea, illustrate a broader trend in which access to affordable autonomous platforms is reshaping traditional assumptions of naval power, survivability and deterrence.

In this environment, maritime advantage cannot be measured solely by the number of manned platforms. Instead, it increasingly relies on integrating unmanned systems that provide persistence, expendability and deniability while preserving high-value assets. Properly integrated, USVs offer political and military leaders additional options across the spectrum of conflict. Their value, however, lies not in standalone employment but in their integration into naval concepts of operations, force design and command structures to enhance lethality, resilience and deterrence.

What We Need to Learn

The following key lessons emerge from the recent conflicts:

Economics Favour the Asymmetric. During the Ukraine conflict, Ukraine, a nation without a navy, managed to keep the Great Russian Fleet at Bay. USVs worth only $250,000 from Ukraine Group 13 special drone unit executed a coordinated attack, swarming the well-defended Ivanovets (Project 12411 Molniya Class), causing damage worth more than $750 million.[3] A handful of inexpensive autonomous boats forced a vastly superior fleet to absorb losses a hundred times greater. The lesson learnt that when asymmetry meets scale, economics tilt decisively against traditional power.

Harbours are Future Battlefields. During the start of the Russia–Ukraine conflict, the Ukrainian objective was to prevent a Russian amphibious landing and mines were used for anti-access/ area denial. In May 2022, Russia occupied Snake Island, after which Ukraine mounted an all-domain effort to remove the Russians from the Island.[4] USVs were also successful in tying down the Russian Fleet in its home ports at Sevastopol and Novorossiysk throughout the war. Harbours can no longer be considered safe sanctuaries but are contested frontlines where denial and deterrence can be decided long before the Fleet ever puts to sea.

Effects vs Platforms. Ukraine's civil sector led the rapid technological transformation that produced Magura V and Sea Baby USVs, which were critical to Ukraine's success in the early days of the war. The Ukrainians focused on the mass production of USVs and follow-on innovation was ad hoc, conducted through multiple civil entities. However, despite early losses, Russia opted for a far more robust R&D program and conducted detailed trials before producing thousands of USVs in 2024–25.[5] Counter Innovation by the Ukrainian forces saw the installation of SSMs and SAMs onto the USV, which were engaged in combat situations.

Cadence beats Perfection. Ukraine's strategy embraced cadence over perfection. It produced approximately 7–12 Magura/Sea Baby USVs per month during the peak of the conflict, from January to March 2024.[6] This was followed by constant innovation and realignment in response to the perceived threat.[7] The requirements for mass production, testing, trials, maintenance, spares, fitting-out and defect rectification were hampered by ad hoc output in Ukraine.

Intelligent and Networked. A 2024 industry survey underscores the extent to which AI is transforming USV operations, enabling autonomous navigation, formation control and multi-level vessel coordination. Advanced navies, such as the US Navy and the PLA Navy, are working to integrate unmanned systems into joint/multi-domain operations. For example, the US Navy has introduced its OCDSS (Optimised Cross-Domain Swarm Sensing), which utilises AI to model and coordinate combinations of unmanned aerial, surface and subsurface platforms for diverse mission objectives.[8]

Surprise is Difficult. Recent conflicts have demonstrated the elusiveness of surprise with the advent of technology. Pervasive satellite coverage, radar stations, AIS tracking and credible OSINT have ensured increasing transparency in the maritime domain. In the black sea, Ukraine relied on precise targeting from allied naval patrol aircraft, whilst in the Red Sea, Houthis continuously tracked merchant ships and escorts using shore-based sensors and drones.

Eco System of Participative Warfare. Ukraine's defence resilience has hinged on a participatory warfare ecosystem. A dynamic network of innovative startups, volunteer groups, industry clusters and global partners collaborate in the fight against Russia. Volunteer engineers and startups, such as Brave1, Hornets and Swarmers – supported by groups like Come Back Alive- designed and fielded low-cost explosive USVs, including Sea Baby and Magura V5.[9] This participatory ecosystem blurred the line between the state and civil society, building resilience in Ukraine's war-fighting efforts.

Collusion is Inevitable. Op Sindoor underscored the strategic reality that collusion is a given certainty. Open-source assessments and strategic commentary suggest that regional actors may have used the episode to observe and test surveillance and electronic capabilities. At the same time, Turkey's footprint was unmistakable, with Ankara providing significant quantities, as reported in open sources and training pilots to assist Pakistani forces in coordinated unmanned strikes.[10] The lesson is clear: India needs to be prepared to fight an adversary that intelligence, armaments and technology will well support.

Where We Want to Be

United States. The United States strives to maintain regional stability and safeguard the sovereign rights of all nations in the Indo-Pacific.[11] In 2024, to bolster lagging unmanned systems and robotic programmes across the USN, CNO Admiral Lisa Franchetti implemented NAVPLAN and Project 33, with a vision of integrating all joint and unmanned forces. Through the Project 33, USN, aims to increase readiness by enhancing the capability for rapid combat surge, operationalising robotic and autonomous systems (UxSs), redoubling efforts to recruit and retain the right talent, improving flexible training to build sailors' tactical proficiency and restoring critical infrastructure to generate and sustain the ready forces required.[12] Task Force 59, comprising US Navy unmanned assets based in Bahrain, plays a pivotal role in enhancing maritime security by deploying unmanned systems alongside manned platforms in the Arabian Sea.[13] In 2024, the US Navy commissioned a new Task Group 59.1, a branch of TF 59, explicitly designed for the operational integration of unmanned technologies and manned-unmanned teaming concepts in real-world missions, and for exploring novel operational concepts.[14] USVs such as those which form part of the Ghost Fleet Overlord expand the TF 59's fleet's horizon and maintain the operational tempo without placing sailors in harm's way.[15]

TF 59 Crest

TF 59 and TF 59.1 trials

Source: SailDrone[16]

PLA Navy. PLAN has also steadily advanced its USV capabilities, fielding platforms such as the amphibious Maritime Lizard and the modular JARI USV, designed for ISR, anti-ship, anti-submarine and air-defense missions.[17] Doctrines such as the *Science of Strategy 2019* emphasize the use of unmanned systems for reconnaissance, mine-laying and strike tasks. Looking into the future, PLAN has planned the induction of drone mother ships, such as the Type 076 assault ship, which would be capable of launching both USVs and UAVs, reflecting its shift towards an 'intelligentized' war at sea. [18] It is also understood that rigorous trials and testing are underway, and that the PLAN is already deploying unmanned vessels in various minor roles, such as ISR.

JARI USV

Source: Covertshores[19]

Houthi USVs. According to a United Nations Panel of Experts, the Houthis have transformed from a localized armed group into a powerful military organization primarily due to material support, training and technology transferred by Iran's IRGC, Hezbollah and Iraqi specialists.[20] According to the IISS, most of the Houthis' USVs are assembled in Yemen, but key parts such as computerized guidance systems are from Iran. It is also understood that key IRGC commanders have been trained and positioned in Yemen to impart training and coordinate targeting directly. It is opined that a similar model could be attractive to other regional actors if it pursued offensive USV ops in Indian waters.

Where We Are

To guide industry partners in synchronising their development efforts with the requirements of the Indian Navy, the Swavlamban 2.0 was released by the Hon'ble PM on 4 Oct 2023 at the NIIO seminar.[21] The document has served as a tool for industry partners to bolster the overall GoI initiative of '*Atmanirbhar Bharat'*. By the end of 2023, approvals of MoD had been obtained for the following Unmanned systems under 'Make' category:

- SAVIOR (Semi-submersible Autonomous Vessel for Intelligence, Operations & Reconnaissance).
- CASCADE-ASW (Compact Autonomous Surface Craft All Domain Effect - ASW). Autonomous Surface Vessel – ASV.
- ASW – Wavegliders.

- High Endurance Autonomous Underwater Vehicles (HEAUVs).
- Autonomous Surface Vessel- Mine Countermeasure (ASV_MCM).
- Buoyancy Gliders.

Technology Maturity and Viability Assessment

Following the GoI push, there has been a surge in investment in the R&D and development of USVs in India. *Sagar Defence* USV '*Matangi'* completed a 1,000-mile autonomous journey in 2024 from Karwar to Thoothukudi.[22] GRSE delivered the '*Jaldoot'* USV to NSTL in Dec 24. BEL has developed a solar-powered, zero-emission USV designed for hydrographic surveying, coastal surveillance and potentially logistics and kamikaze roles.[23] Various other stakeholders are independently developing USVs in line with requirements projected by NHQ.

Misc Issues. However, on the ground, a large number of miscellaneous issues exist, as follows:

- **Suitability and Survivability**. The geographical conditions of the Russia–Ukraine conflict differ fundamentally from India's western seaboard. The former involves confined littoral waters, ports and semi-enclosed waters, which inherently favoured the use of small, expendable unmanned surface vessels. By contrast, the western coast of India is characterised by long, open coastlines and expansive sea areas, where USVs operating in open waters would face significantly higher risks of detection, tracking and neutralisation. The Arabian Sea experiences comparatively rougher sea states, higher swell patterns and severe monsoonal conditions for extended periods each year. These conditions impose demanding requirements on hull design, propulsion reliability, sensor stability and command-and-control links. Achieving acceptable endurance while simultaneously preserving low observability and stealth in such conditions remains a non-trivial design and operational problem, particularly for smaller USV classes.
- **Bandwidth and Networking**. Operating USVs would require high bandwidth to ensure no data latency with the control station. A typical architecture, a high-

throughput mesh topology and satellite relays would need to be developed, along with data automation and analysis.

- **Shape, Size and Modularity**. There is a need to standardise the basic shape, size and modular configuration of a USV. Once the prototype is finalised, modifications can be implemented as the field's technology matures.
- **Unified Platform Management System**. With the increasing number of unmanned systems, there is a pressing need for a Unified Platform Management System that provides a single console for the operation of all unmanned systems within the local area.
- **Interface with Existing Platforms**. All USVs must communicate with one another and interface with surface platforms; aerial platforms should also be considered if there is total centricity in naval operations.

Matangi USV (Sagar Defence)

Source: https://botsanddrones.in/news/f/india%E2%80%99s-first-autonomous-vessel-completes-milestone-1500-km-voya

Jaldoot USV

Source: https://botsanddrones.in/news/f/grse-hands-over-jaldoot-unmanned-surface-vessel-usv-to-nstl

Strategic/ Operational Issues

- **Doctrinal Lag**. The lack of a dedicated doctrine may have long-term consequences for the envisaged operational philosophy. The USN revealed its Unmanned Roadmap in 2007, followed by the Unmanned Campaign Framework in 2021. The doctrines clearly lay out the doctrinal '*why*' and '*how*' of Unmanned Systems in the future USN. Similarly, the PLA Navy has integrated USVs into its far-seas strategy under its '*intelligentisation*' construct, experimenting with swarming operations, autonomous patrol craft and unmanned logistics.[24] Similarly, there is an urgent need to promulgate an Unmanned Systems Doctrine that integrates all aspects of Unmanned Systems across the entire spectrum of conflict.

- **Organisational Structure**. There needs to be a single organization responsible for planning, induction, testing, trials and integration to provide attention to all aspects of integration.
- **Operational Command and Control**. Operationally, the future USVs would be deployed across the IN's vast AOR, often in close support of surface forces, UAVs and UUVs. There needs to be very clear lines of operational command and control.
- **Training**. A dedicated unmanned school for a Center of Excellence (CoE) may be established.
- **Legal and Ethical**. Legal and ethical frameworks would be crucial to the integration of USVs. The fundamental question remains: what is the legal status of the USV under international law? The seizing of two US naval UUVs in Chinese waters highlights the vulnerability of these systems.[25] At present, there is no such legal or ethical framework.

Recommendations and Way Ahead

Roles. The integration of Unmanned Surface Vessels into the Indian Navy will be an institutional and doctrinal challenge. While recent trials have demonstrated the growing capabilities of USVs, there is a need for a clearly articulated framework to integrate these systems into the broader Indian Navy's CONOPS. Defensive Roles such as harbour surveillance, perimeter security and force protection align intuitively to the strengths of USVs. However, integration with the Fleet for offensive employment merits further study. Consequently, higher degrees of autonomy can be introduced as trust and technological maturity converge.

Organisational Fragmentation. The responsibility for induction, testing, proving and operationalisation of the USVs is presently dispersed across multiple directorates and agencies, diluting accountability and slowing integration. It is recommended that the

Directorate of Unmanned Systems be formed within NHQ. The Directorate would be the single point of contact for experimentation, induction, integration and doctrinal development.

Command and Control. USVs are inherently networked platforms whose effectiveness depends on resilient, clearly defined control architectures. USVs in defensive roles, positioned near harbours, may be placed under the NOICs/Station Commanders. USVs in fleet support and offensive roles are recommended to be controlled from shore, with the option of handing over control to the Commander at sea. Without such arrangements, USVs risk being under-employed or misaligned with operational intent.

Human Resource Development. Unmanned platforms necessitate a dedicated training and experimentation ecosystem. Beyond basic operator training, there is a requirement to establish an Institutional Centre of Excellence that integrates training, experimentation and counter-innovation. It is recommended that such an ecosystem would institutionalise learning, accelerate adaptation, and spur innovation to counter technological development.

Civil Ecosystem. India's expanding defence innovation ecosystem has demonstrated considerable ingenuity towards the USV program. However, embedding industry participation within operational feedback, ensuring that systems evolve in response to real operational demands rather than isolated demonstrations, is a necessity.

Legal and Regulatory Frameworks. Autonomous and semi-autonomous systems raise complex questions of authority, accountability and escalation control. In the absence of clearly articulated rules of engagement, commanders may hesitate at critical moments or risk unintended escalation. Developing USV-specific rules of engagement aligned with national legal frameworks and international obligations is essential to enable confident employment while preserving political oversight and strategic stability.

Cyber Resilience. USVs are vulnerable to cyber intrusion, data manipulation and electronic interference. Existing naval cyber frameworks, while robust for crewed platforms, require adaptation for autonomous fleets. Enhanced encryption, anomaly detection and the ability to revert to safe autonomous modes under attack are critical to ensuring survivability and mission assurance in contested environments.

Conclusion

The integration of USVs into the Indian Naval CONOPs represents a structural shift in maritime warfare. We need not only to acquire USVs in large numbers but also to integrate them coherently into our existing force structure to complement our major surface combatants. If pursued in isolation, USVs may become peripheral assets with limited strategic effect. If integrated coherently, they can enhance maritime domain awareness, strengthen deterrence and provide decision-makers with a wider spectrum of calibrated options. The question, therefore, is not whether USVs matter, but whether institutional adaptation can keep pace with technological change.

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