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NAVAL DRONES: FORCE MULTIPLIERS IN MARITIME OPERATIONS

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INTRODUCTION

It is a well-known dictum that "*there are no runners up in war*." The nature of warfare in the context of this unforgiving truism has per-force, been transformative; wherein the singular aim has been to win at all costs. Therefore, the warring parties often resorted to innovative means and out-of-box innovations to surprise the adversary with regard to their Force's strength and intent. The advent of the industrial revolution and the consequent development of technology changed the nature of warfare forever. As technology matured and its benefits in gaining asymmetrical advantage over the adversary became apparent, technology started becoming the main driver for formulating the strategy of warfare.

Various technological applications of warfare did surprise the adversary when they progressively appeared on the scene for the first time. Two centuries down the line, the nature of warfare has now evolved into an era of high-technology enabled disruptive weapon systems and platforms, where in vigorous technological innovations to ensure surprise to the adversary – and consequently ensure victory – is the norm. The multi-domain unmanned systems – in air, land, sea-surface and underwater – are one among many such high-technology means of warfare.

This article covers unmanned systems in the maritime surface and under-sea domain only. Thus, the envisaged operational roles of unmanned surface vessels (USVs) and the unmanned underwater vehicles (UUVs) in pre-conflict, and conflict scenarios have been discussed in detail. Their potential as force-multiplier during warfare when they are used in innovative ways, has also been investigated. The status of their development and operational usage in India has also been dwelt upon, followed by the recommended roadmap for their optimalutilisation to engender effective maritime security in the proximate Indian Ocean region, in future.

ENVISAGED OPERATIONAL ROLE OF NAVAL UNMANNED SYSTEMS

The use of naval unmanned systems – which includes USVs and UUVs/ submersibles – has seen accelerated expansion since the start of the new millennium, wherein these systems are progressively becoming an integral part of modern-day warfare, both, in traditional and non-traditional domains. In fact, unmanned systems have become the preferred option for many missions which may either be highly repetitive, requiring longer sustenance or pose unacceptable risks to the attendant crew. Their use in a hostile environment – besides being cost effective – is also seen as less escalatory when compared to usage of other conventional military hardware or platforms.

The preference of policymakers and operational commanders to utilise unmanned systems has increased steadily with the growing capabilities of these systems to augment or supplant human beings in conduct of various operations. In areas protected by mines or threatened by integrated air defense systems (IADS) where operational planners would like to minimize the risk to human lives, unmanned systems will certainly provide a viable alternative.

Such unmanned systems would be particularly useful for conducting operations in environments containing nuclear, biological, chemical, or radiological contamination. For instance, after the 2011 Fukushima nuclear disaster in Japan, robots were used to conduct on-site survey of the facility after the calamity when it was reckoned to be too dangerous for human exposure.[1] Subsequently, if such unmanned systems become irreversibly contaminated, and the cost/effort involved in decontaminating them is considered to be too high/unacceptable, then they can be easily abandoned without significant losses.

Some other scenarios which have not been fully explored yet, may pose significant physical and mental problems to the human body during sustained operations. Unmanned systems can greatly mitigate many of them. Some obvious examples relate to undertaking high gravity force maneuvers, operating at very high altitudes, sustaining great pressures at depth, or remaining submerged for long periods of time. Humans require life sustaining systems in these environments, which add size, weight, and complexity to current manned vehicles. The unmanned systems will clearly obviate the need for all these requirements.

Besides the risk to human lives, unmanned systems also offer advantages of consistent performance and effectiveness for monotonous missions such as long-term, persistent surveillance. It is challenging for humans to spend hours conducting surveillance and maintain the same level of awareness and attention to detail. The algorithms in associated computers/processing systems can be programmed to detect patterns and unexpected anomalies, and present them for further review by human analysts, thus aiding in informed decision-making.

As the diversity of tasks has increased, types of unmanned systems have also proliferated. These systems come in all shapes, sizes, forms and configurations, and are generally built as per role and mission specifications. They can either be configured for standalone single mission or a combination of one or more roles. The specific operational missions of the USVs and UUVs will be covered separately in undermentioned sections – though there are certain commonalities in these roles because of their inherently unmanned nature and the associated advantages and limitations.

UNMANNED SURFACE VEHICLES (USVS) – OPERATIONAL MISSIONS AND ROLES

Some missions and roles in conventional warfare where USVs can prove to be great force-multipliers – and which have been listed as per role priority accorded by the UN Navy's USV Master Plan of 2007 – are mentioned below:[2]

- Mine Countermeasures (MCM)
- Anti-Submarine Warfare (ASW)
- Maritime Security (MS)
- Surface Warfare (SUW)
- Special Operations Forces (SOF) Support
- Electronic Warfare (EW)
- Maritime Interdiction Operations (MIO) Support

Mine Countermeasure Role

The main aim of MCM is to provide a safe transit passage for a large number of fleet ships, including high-value assets like aircraft carrier formations and amphibious forces. This requirement consequently translates into sanitisation of a large sea area, particularly at entry/exit routes to the harbours and in restricted navigation areas and narrow channels/choke points. In order to fulfil this objective without damage to one's own assets and crew, the USVs – as also the UUVs working separately or in tandem – will play a vital role as MCM entails the conduct of these 'dirty, dull and dangerous'[3] tasks. They provide long time-on-task, which allows sustained mine hunting and sweeping cover at huge cost saving and risk reduction; thus increasing the effectiveness of dedicated MCM ships.

The MCM USVs will be provide the Force Commander with the capability to conduct comprehensive MCM ranging from intelligence collection about mined waters to first response MCM at safe stand-off ranges, thus enabling effective conduct of subsequent fleet operations. The intelligence about mined waters also provides the option to the Force Commander to bypass the dangerous area altogether, if there is a chance to do so. MCM operations by USVs will open transit lanes for forced entry missions, clear operating areas for naval forces, and enable protection for amphibious forces, keeping manned forces clear of danger,all the while. In addition to the above advantages, actual force multiplication effect generated by the use of USVs in MCM role comes by the way of lesser time taken for safe passage and access to the contested area; as also confident execution of the operational plan.

Anti-Submarine Warfare (ASW) Role

Increasing submarine threat from potential adversaries – particularly in tropical waters – calls for establishing and maintaining an effective and credible ASW capability. It is also a given that there will never be enough manned assets to cover a large area associated with either defending approaches to harbours and other shallow waters; or sanitising the carrier strike group/expeditionary amphibious forces operating and transiting areas against submarine threat.

USVs offer significant force multiplication for ASW operations because they can perform the ASW mission at some level of autonomy. This enables the manned combatants to become free of this task and thus be employed for other more pressing operational tasks. USVs in ASW role also provide an additional layer of defense-in-depth for the manned surface group; as also reduce risks to the manned platforms that would otherwise have been conducting the ASW mission themselves. In any case, USVs can serve as off board sensors, thereby extending the range of detection and sanitization effect without increasing risk. The manned mother ship functions as the control and coordination centre for numerous USVs, thus providing the economy of effort while enhancing decision-making inputs. The US Navy envisages the undermentioned concept of operations for exploitation of USVs in ASW role:[4]

- employment of non-lethal weaponry by USVs
- employment of lethal weaponry by USVs
- accumulation of intelligence information on threat submarines by USVs

- USVs engaging in diversionary maneuvers to create a deterrent or distracting effect against threat enemy submarines

Maritime Security Role

Maritime Security role consists of securing ports, harbour approaches and navigational channels;and protecting ship and maritime infrastructure (piers, docks, anchorages, warehouses) from a wide spectrum of threats ranging from conventional attack to special operations to specifically targeted terrorist attacks. Generation of comprehensive Maritime domain awareness (MDA) plays a major part in implementation of effective maritime security. A list of maritime security tasks for which the USVs can be employed is as follows:[5]

- Strategic and tactical intelligence collection: Signal, Electronic, Imagery (SIGINT, ELINT, IMINT)
- Chemical, Biological, Nuclear, Radiological, and Explosive (CBNRE) detection and localisation
- Harbour and Near-shore monitoring
- Deployment and monitoring of expendable surveillance sensors/ arrays
- Specialised mapping and object detection and localisation
- Non-lethal and lethal threat deterrence
- Monitoring boat traffic in rivers/inland waterways for personnel, contraband or weapons smuggling, and other illegal activities

Surface Warfare Role

Surface Warfare capability for USVs is quite similar to some aspects of maritime security role mentioned earlier, but also incorporates the engagement of more difficult threats further offshore as well as in high seas. Such USVs have to have a larger hull, be capable of doing higher speeds (30-40 knots), be equipped with MDA and ‘identification friend or foe’ (IFF) wherewithal, and be armed with role-specific armament payload. These USVs can carry out Coastal/Homeland Security/Port Security Patrol, support special force operations and also engage hostile targets – in modes either remotely controlled by an operator, or semi-autonomously, or fully autonomously.

Special Operations Forces (SOF) Support Role

The aim of SOF is to achieve disruption by 'hit and run' to achieve asymmetrical advantage using surprise as the main element, rather than traditional 'force on force' kind of warfare. SOF units require support for conducting missions involving unconventional warfare, counter-terrorism, reconnaissance, and direct action, clandestine missions in enemy held territory etc. The USVs can support such SOF activities by way of Intelligence, Surveillance and Reconnaissance (ISR)[6] using standard or non-standard sensors, and by providing transportation and material support. Innovativeness to enhance stealth and ensure non-attributability of blame would play a great role in form, size, design and features of such USVs.

Electronic Warfare Role

USVs have broad role in application of naval and joint campaigns to support conventional warfare, irregular warfare and internal security through strategic use of electronic warfare and Information Operations. This capability is used in synergy with the Maritime Security (MS)mission. The best part is that the USVs can be programmed to always engage in this activity in a secondary role also, while they continue to perform their primary tasks. The USVs, suitably equipped with an Electro-Optical/ Infrared(EO/IR) sensor on a retractable/extendable mast,can be used as picket ships ahead of, or on flanks of the carrier formation or expeditionary group, to conduct passive signal detection and threat warning for the battle group. Provision of chaff launchers or jammers on such USVs or even additional dedicated ones, will enable them to be used for anti-missile defence as well.

Maritime Interdiction Operations (MIO) Support Role

Activities by naval forces to divert, disrupt, delay, or destroy the enemy's military potential before it can be effectively brought to bear against own forces, generally fall under the ambit of MIO. This implies that MIO by default, is a manned mission. The intended role of USVs is to support this manned mission by way of increased domain awareness in the area of relevance. This requirement would entail the deployment of a small USV that can precede a boarding party by investigating the target vessel above and below the waterline. For this role, its payload would likely include ISR, EO/IR, CBRNE and Weapons of Mass Destruction (WMD) detectors, and possibly even, remotely operated vehicles (ROVs), UUVs, and UAVs.

UNMANNED UNDERWATER VEHICLES (UUVS) – OPERATIONAL MISSIONS AND ROLES

The US Navy defines an unmanned underwater vehicle as "*a Self-propelled submersible whose operation is either fully autonomous (pre-programmed or real-time adaptive mission control) or under minimal supervisory control; and is untethered except, possibly, for data links such as a fiber optic cable*."[7] By this definition, the UUVs are expected to possess certain unique operational advantages related to autonomy, risk reduction, low profile, flexibility of deployment, adaptability, and persistence. These features would enable them to deploy or retrieve devices at/from the seabed and water column; gather, transmit, or act on all types of information in the undersea realm; and engage targets lying above and below sea surface, at sea bottom; orin the air, and even on land.

While the operational roles envisaged for the USVs have been explained above, there are certain commonalities with those stipulated for the UUVs too, the minor difference being in the operating realm – the former operating on the sea surface, and the latter, underwater. The US Navy's UUV Master Plan of 2004 lists the following roles for its UUVs in the order of priority:[8]

- Intelligence, Surveillance, and Reconnaissance
- Mine Countermeasures

- Anti-Submarine Warfare
- Inspection/Identification
- Oceanography
- Communication/Navigation Network Node
- Payload Delivery
- Information Operations
- Time Critical Strikes

Intelligence, Surveillance, and Reconnaissance (ISR) Role

The envisaged ISR roles for UUVs are generally consistent with the 'maritime security' role in respect of the USVs,[9] the only difference being in their domains of operation. Their unique features enable them to undertake these activities at long standoff distances, operate in shallow waters, work autonomously, and provide a level of clandestine capability which is not available on other systems. UUVs can increase the intelligence collection extent of manned platforms into inaccessible or disputed areas without endangering high value assets and their crew; and achieve force-multiplication effect by raising the number and density of sensors in the undersea battle space.

Mine Countermeasure Role

There is great similarity between the MCM roles of USVs explained in the earlier section, as well as those of UUVs. In fact, the UUVs in many cases, can be used by the USVs as supporting equipment to carry out underwater reconnaissance of mined areas (detection, classification, identification, localisation), sweeping/clearance of floating, moored and seabed mines (neutralization, breaching) and protection operations against mines (Spoofing, jamming). The real utility of UUVs however, lies in time-stamped collection of oceanographic data in peace time, wherein collated data on currents, waves, bathymetry, water visibility, seabed physical parameters, seaweed density, sand bars, etc. can be used to highlight pattern inconsistencies and facilitate change detection to determine mineable areas; and mine-like objects.

Anti-Submarine Warfare Role

The role similarity between USVs – as mentioned in earlier section – and UUVs extends to the ASW realm also. The added advantage is in their clandestine modus-operandi, which can be best leveraged when they operate close to enemy harbours, narrow channels and choke points. They can also act as mobile mines if required and so tasked; wherein they can independently detect a target, navigate towards it, and collide with it below the waterline in self-destruct mode.

Inspection/ Identification Role

As part of port defence and Force protection architecture, the infrastructure like jetties, moorings, piers, drydock gates, as also the hulls of docked ships and 'port operations support' vessels are required to be regularly inspected against terrorist and sabotage threats. Since the areas in question are large, substantial amount of manpower and effort would be required to achieve their foolproof sanitisation. Instead, these tasks – including identification of dangerous objects like depth charges, limpet mines and other underwater ordnance and their disposal – can be carried out from safe standoff ranges by deploying UUVs. The UUVs thus provide an alternate option to conduct multiple, rapid hull and other underwater structures in a cost-effective fashion; thereby sparing the divers and support staff for more complex tasks requiring real-time human intervention.

Oceanography

UUVs are the best suited equipment for carrying out critical tasks like collection of hydrographic, oceanographic, and meteorological data in all sea states and conditions. By implication, they become a great force multiplier to manned platforms in provision of near real time data to the tactical commander at sea at required frequency and locational comprehensiveness, as aid to decision making. When used in conjunction with remote sensors, other ocean data, and models; UUV-acquired data provides combat units with critically required advance knowledge of environmental parameters such as bathymetry, tides, waves, currents, acoustic propagation characteristics, locations of navigational hazards, and other objects of interest.

Undersea Communication/ Navigation Networking Role

The UUVs can provide undersea communication and navigation relay function for a wide variety of platforms. As a communications relay, the primary task would involve the provision of connectivity to static underwater sensors, chains or systems. UUVs, because of their mobility, can establish links with underwater stations and other surface platforms and even space-based systems. The obvious advantages of using UUVs in submerged communications role include extended standoff distances and greater accessibility to remote areas. Potential users of this facility would include other UUVs, submarines, Special Forces units, and other recipients where clandestine communication is desirable.

Payload Delivery Role

Payload delivery is not a task per-se; but is required in support of many underwater missions like MCM, ASW, Oceanography, Support for special operations, and time critical strikes. The UUVs in this role, would simply become a means of underwater transportation; and will provide the energy, navigation, autonomy, and payload deployment systems which may be needed to accomplish those missions. The size and endurance of such UUVs will naturally depend on the weight of the payload and the distance to which it is required to be transported.

Information Operations (IO) Role

The UUVs' capability to operate clandestinely in shallow waters and areas too hazardous for a manned platform to operate in, makes them the ideal platform for IO missions – aimed at deceiving, deterring and disrupting the adversary. The UUVs appear to be most suitable for two IO roles, viz., as communications/computer node jammers, and as submarine decoys.

Time Critical Strikes (TCS)

The US Navy considers the TCS as one of the lowest priority missions for UUVs, because an autonomous weapon launch capability is still regarded as unethical and controversial. Till such time, human control of weapon launch will be the norm, this capability will probably be kept on hold in foreseeable future. However, there is no denying that UUVs can provide low-risk, high-payoff strike mission results, providing an ability to clandestinely deliver weapons closest to the adversary's vital assets/vital points, in extremely compressed time frame.

INNOVATIVE EMPLOYMENT OF USVS AND UUVS IN SUPPORT OF NAVAL OPERATIONS

The different roles and methods in which the USVs and UUVs can be operationally utilised, have been discussed in the earlier section. The combination of one or more features or roles of these unmanned systems in innovative ways can deliver asymmetrically high outcomes in the most cost-effective manner with minimum economy of effort. Certain advanced applications of these unmanned systems are also being conceptualised. Though some such applications are being tested at demonstration or 'proof of concept' stage in the US, the Chinese technologists are also working on these ideas. While there is no limit to the innovative usage potential of unmanned systems, some known applications currently under preliminary development are discussed in brief in the succeeding paragraphs.

Innovative Usage of USVs

The USVs can be utilised in many innovative ways. Armed mini- or micro-USVs can be used to swarm a large warship or a target of interest. The two known ways in which China intends to use the USVs to gain tactical advantage over the adversary relate to their use as swarms around the high-value assets of the opposing force; and for coastal assault by incorporating amphibious characteristics to the USVs for use, both at sea and on land.[10]

In an innovative display of USV employment, a Chinese company demonstrated coordinated formation manoeuvres by 56 mini USVs – called 'shark swarm' – sometime in 2018, a video of which was released by *Global Times* on 31 May 2018.[11] The mini USVs, moving at high speeds, formed various patterns, shapes and Chinese characters, without colliding with each other. They also formed the shape of an aircraft carrier, while another larger unmanned boat waded directly into the formation, imitating the take-off of a fighter aircraft from the notional carrier's flight deck.[12] The military potential of such USVs moving in large numbers at high speed to overwhelm the adversary warship's defences, by swarming all around it, are more than obvious. The Chinese private Industries' plans to collaborate with the defense industry to further develop USVs and related devices for reconnaissance, command, attack and other sea battle functions were reflected in one such statement to the effect that "*Unmanned swarm boats can be used with high efficiency in escorting, mine sweeping, intelligence gathering and amphibious operations.*"[13]

China also claims to have successfully tested the World's first armed amphibious USV on 08 April 2019. The USV, named Marine Lizard (Hai Xiyi), is 12 m long, has a trimaran hull; and is propelled by a diesel-powered hydrojet, enabling 50 knots speed. When approaching land, the USV can release four track units from under its hull which find traction to climb the beach. The amphibious USV can reportedly sail autonomously, avoid obstacles and plan routes with the help of indigenous Beidou satellite navigation network. The amphibious USV is also capable of integrated operations with other units in the theatre.[14]

China has been conducting trials of a large unmanned cargo ship named '*Jindouyun*' since 2017. The prototype USV carried out its first trial cargo delivery run in December 2019, wherein its networked and distributed control systems and cyber-physical algorithms, enabled the Cargo USV to carry out autonomous navigation, track management, obstacle avoidance, and controlled berthing, sailing and other decision-making functions.[15] Since, Chinese maritime administrators are exploring the feasibility of commercial operation of these cargo USVs in the transport, supply and marine sectors in due consultation with the IMO,[16] it is not entirely inconceivable that such ships can be programmed for rogue behaviour to possibly collide with the adversary's warships in narrow channels, restricted waters or choke points. While such 'incidents' may possibly be explained away as having occurred on account of technological malfunction; the diabolical plan of putting that combat unit of the adversary out of action for some duration at the minimum, would have been achieved.

Innovative Usage of UUVs

The most innovative use of UUVs is in the form of Extra-large UUVs (XLUUVs), wherein there is an ongoing effort to manufacture as large a UUV as is possible, and equip it with as many capabilities as feasible vis-à-vis manned submarines. In the absence of human element, advanced artificial intelligence algorithms would control their autonomous navigation, collision avoidance, depth keeping, and combat mission suite.

The US, as the foremost technologically advanced nation is running the '*ORCA*' research and development project, wherein five prototype XLUUVs based on Boeing's 'Echo Voyager' are being developed for operational use in combat, alongside the US Navy manned ships and submarines. While the details of '*ORCA*' project are classified, Boeing's 'Echo Voyager's' dimensions – 51 feet long with rectangular cross section of 8.5X8.5 feet, weight about 50 tons – provide an indicative assumption of its size. The 'Echo Voyager' XLUUV can attach an additional modular 34 feet long payload, increasing its final length to as 85 feet. The US Navy reportedly commenced the underwater testing of '*ORCA*' XLUUV on 04 April 2023.[17]

China, considering itself as the technological peer competitor of the US, has developed its own XLUUV named 'HSU-001'; and unveiled it for the first time during its National Day military parade on 01 October 2019.[18] While details of its capabilities and dimensions are not yet available, maritime analysts believe that such vessels can carry smaller UUVs, mines or torpedoes. They can possibly be carried to deployment locations on board regular submarines, warships, landing ships or even large helicopters, and thereafter deployed for wide-ranging tasks associated with manned submarines. Given the nature of undersea warfare, stealth, autonomy, and scope of operational tasks which are beyond the capabilities of manned submarines/submersibles; these XLUUVs will indeed prove to be huge force multipliers during futuristic warfare.

STATUS OF DEVELOPMENT OF USVS IN INDIA

Though the Indian Navy has been using radio controlled target boat (RCTB) since 1990s for practice firing by ships' guns, the boats have been imported from abroad. The boats measuring about 7 meters long, displacing about 2 Tons, capable of cruising at 15-20 knots with maximum speed of 35 knots and controllable from 20-25 km away, provide a high-speed maneuvering target for realistic surface action firing practice by ships. These boats which continued to be used after life extensions were sought to be repaired through open tender bidding by Naval Dockyard, Mumbai in 2016.[19]

The Indian Navy's Directorate of Indigenisation has sought to develop remote controlled target boat (RCTB) – amongst a list of other products – through private industry participation, as laid down in its Indian Naval Indigenisation Plan (2015-2030) document.[20] While the document is quite aspirational, not much is known about the actual progress on the ground. Some expectations about the production of a USV in India were raised, when a model of Seagull USV was presented by Elbit Systems of Israel to the Garden Reach Shipbuilders & Engineers (GRSE) during Def-Expo 2018. The attendant insinuation was that the two firms will jointly build this USV.[21] For the record, Seagull is a 12 meter long USV that can be operated from a mother ship or shore station. It provides multi-mission capabilities including ASW, MCM, EW, maritime security and underwater commercial missions.[22]

It is quite apparent from the above discussion that research and development on USVs in India is at a very nascent conceptual stage only; and whatever little is available in service, is all imported. The need for indigenisation is now being articulated in the 2030 time frame.

STATUS OF DEVELOPMENT OF UUVS IN INDIA

Research and development scenario in India, in respect of UUVs is far better USVs. The Defence Research and Development Organisation (DRDO) is currently designing and building multiple types of Autonomous Underwater Vehicles (AUVs) – under generic category of UUVs – to meet naval requirements. These range from small slow-speed vehicles to military-class, free-flooding ones weighing up to 1.7 tons. These are meant for various maritime security roles like surveillance and mine counter measures in ports/harbours, coastal waters, as well as in deep seas.[23]

One such vehicle is the 4-meter long, 1.4 meter wide, flat-fish AUV, designed for the Indian Navy. It can travel at about 4 Knots (7 kmph) and dive up to 300 meters depth. Weighing about 1500 kg, the AUV has two interconnected cylindrical pressure hulls. The robotic vehicle is fully pre-programmed – in terms of algorithms and mission requirements – and is piloted by an onboard computer. Since the thrusters are inside the pressure hulls, it is externally vibration free.[24] The Indian Navy, apparently satisfied with its trial performance and potential for future operational usage, ordered 10 such systems.[25] Figure 1 below shows a representative picture of the flatbed AUV.

Figure 1: Flatbed AUV: Representative Picture

Source: India Defence Blogspot

The Central Mechanical Engineering Research Institute (CMERI), Ranchi, has also developed and patented a UUV named AUV-150. This UUV, built in active collaboration with DRDO, is 4.9 meter long with half meter diameter; and is capable of seabed mapping, coastal surveillance, mine counter-measures oceanographic measurements, surveying and underwater photographic inspection. It is capable of both,RF and acoustic communication; and is role stabilised for better mission performance, even during rough weather. Its slight positive buoyancy enables better diving control, and prevents it from getting lost at sea in case of malfunction.[26] Figure 2 below shows a picture of AUV-150.

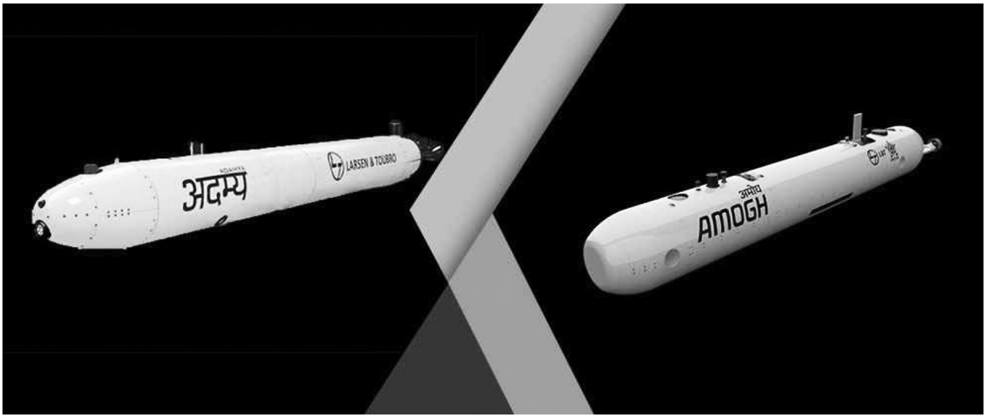
Figure 2: AUV-150

Source: CMERI.

UUV Development by Private Sector

M/S Larsen and Toubro Defence have also carried out design and development of a series of AUVs for the Indian Navy. These include 'Adamya', 'Amogh' and 'Maya' AUVs. A representative picture of 'Adamya' and 'Amogh' AUVs is shown at Figure 3.

Figure 3: 'Adamya' and 'Amogh' AUVs: Representative Picture



Source: L&T Defence

'*Adamya*' can be launched from the torpedo tube of a submarine. It is 5825 mm long with 533 mm diameter, and weighs 1012 kg. The AUV with contra-rotating propellers, has endurance of 8 hours, can operate up to depth of 500 meters, and has maximum speed of 6 knots. It can carry different payloads depending upon mission requirements. '*Amogh*' AUV is a third generation AUV, developed in collaboration with M/S Edgelab, Italy. It is designed for hydrographic and underwater surveillance. It measures 5700 mm long with 700 mm diameter, and weighs 1000 kg. The AUV has an endurance of 22 hours, can operate up to depth of 1000 meters, and has maximum speed of 5 knots. "*Maya*' is a small and modular AUV capable of carrying scientific and commercial payloads up to 4 kg till 200-metre depth. It is 1742 mm long with 234 mm diameter, and weighs 55 kg. The AUV has maximum speed of 3 knots, and endurance of 8 hours. It can be used for undersea inspection, and as an expendable underwater Target.[27]

RECOMMENDED WAY AHEAD

The maritime threat quotient for India from both, traditional as well as non-traditional sources has been on the increase. Ever-increasing Chinese naval footprint in the Indian Ocean Region – particularly since commencement of the Gulf of Aden anti-piracy escort task in 2008 – clearly indicates that China will be permanently present in India's primary areas of maritime interest. Pakistan's concept of operations against India, as mentioned in its first ever maritime Doctrine of 2018 articulated an *"approach of provocative and flexible mobility using sea space …"* and to *"… hit first with maximum effects and minimum application of force."*[28] The 26/11 Mumbai attacks by State-supported terror group, have enlarged the scope of maritime based threats to India's security, like never before.

Since it is a given that every mile of India's maritime zones can not be sanitised by manned platforms on a continuous basis; it is imperative to use technology and its applications to undertake major portion of this task – which is indeed being implemented too. The USVs and UUVs, with their inherent operational advantages with respect to autonomy, human safety, stealth and accessibility; thus, have a major role to play in the Indian maritime security architecture. The US has been using its sail-drone USVs for continuous surveillance in and around the Strait of Hormuz to ensure safety of its ships as well as security of this vital global energy SLOC. The US Navy has created an altogether new 'Task Force-59' under its Bahrain-based Central Command to integrate the unmanned systems with its manned fleet ships, and regularly conducts manned-unmanned teaming exercises to validate the concept for use in future wars.[29]

While India has not been able to leverage the USV technology to indigenously develop unmanned boats, the track record of DRDO – particularly its Visakhapatnam-based Naval Science and Technological Laboratory (NSTL) – in designing and prototyping UUVs has been quite remarkable. Therefore, this existing indigenous research, development, design and manufacturing base must be rapidly leveraged towards operationally viable military products. The Indian Navy's *Swavlamban* Document released by the defence minister Shri Rajnath Singh in August 2020 has also exhorted the Indian industry to design, and develop naval hardware including remote control target USVs, and special purpose UUVs under' Make' category of defence Procurement Procedure 2016.[30]

However, it is posited that while it is all very well to lay out requirements, conceptualise indigenisation, develop specialised technology base, produce prototypes,and successfully test technology demonstrators in many cases; the maritime security of the nation continues to be at risk all the while from broad spectrum of threats in the neighbourhood, as mentioned above. Therefore, the crying need of the hour is to push certain technologies in mission mode, with all the research establishments, scientific community,academia, public and private sector industries, national security policy makers, as well as the ultimate users, contributing to the same cause.

The final aim of course, must be to get operationally usable products in the hands of the users. The development and manufacture of USVs and UUVs, should surely find itself on top of this critical 'must have' technology, for all the operational roles that these platforms can engage in – as explained in detail earlier in this article – for achieving asymmetric advantage over the adversary.

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