

Autonomous underwater vehicles: A force multiplier to India's maritime capabilities

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Objective

This research article majorly deals with the advancements made in the context of AUVs (by focussing on USA and Russia) followed by AUV development in India and how these autonomous underwater vehicles will help India in ensuring its maritime security.

Introduction

The quest for the development and advancement of unmanned systems gained momentum among both developed and developing countries of the world. These unmanned systems occupied their individual positions in land, sea and aerial domains because of their operational capabilities. Of these unmanned systems one such operated in the maritime domain is gaining more prominence. Even though these maritime unmanned systems were in their infancy stages of development, emerging technological advancements assist them in performing suitable tasks. These emerging developments help these systems to acquire the capability of changing the nature of future naval warfare.

Maritime Unmanned Vehicles (MUVs) were broadly classified as Unmanned Surface Vessels (USVs) and Unmanned Underwater Vehicles (UUVs). Further the Unmanned Underwater Vehicles was divided into two types this includes Remotely Operated Underwater Vehicles (ROUVs) and Autonomous Underwater Vehicles (AUVs). Of these two the AUV's probably tend to be a game changer in terms of future maritime conflict. This was due to the wide range of operational capability it possesses which ranges from oceanographic data collection, Intelligence, Surveillance and Reconnaissance (ISR), mine counter measure, Anti-Submarine Warfare (ASW), payload deployment, etc.

Many nations across the world have deeply indulged in research over the practical deployment and use of UUV's. They include US, Russia, China, India, Israel, UK, Australia and several others. Their UUV category ranges from a small AUV to that of Extra Large Unmanned Underwater Vehicle (XLUUV) which differs in operational depth and endurance.

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The prominent reason for this race for underwater vehicle development was due to its autonomous feature. It helps the naval forces to deploy those vehicles in extreme environments and to carry out specific tasks and operations. It is because of this reason AUV's gained strategic advantage than its predecessor the ROUV's. This vital capability of these AUV's drive those nations to involve in further research and testing in order to develop more reliable and durable undersea vehicles. Data for this article has been obtained from books, relevant journal articles and reports.

This research article addresses by providing brief introduction to the history of Maritime Unmanned Vehicles first (with special focus on AUV's). Secondly, it discusses about the recent advancements made in USA and Russia pertaining to the development of AUV. Third it briefly discusses about the advancements that were made in India in the field of AUV. At last, the discussion will be concluded by taking a note on how AUV's will possibly help India in ensuring its maritime security (with special emphasis on coastal security).

Brief history of Autonomous Underwater Vehicles

The exact year of development of AUV is not known. The AUV's were probably first developed in 1957 in USA named as Self-Propelled Underwater Research Vehicle (SPURV). As the name denotes it was primarily used to carry out research purposes in the Arctic to collect oceanographic data. Then several technological advancements led to the creation of SPURV II with some improved performance than its predecessor. In 1983, when Autonomous Remote-Controlled Submarine introduced it made several advancements in battery life, navigation and communication systems. Most of the AUV developmental projects were assisted by Defense Advanced Research Projects Agency (DARPA) and US Navy. (Sharma, 2022). In 1995, the Woods Hole Oceanographic Institute designed and developed an AUV called Autonomous Benthic Explore or the ABE AUV. It was utilized by scientists to monitor the large underwater area for longer periods of time. One notable quality of this AUV was that it goes into sleep in order to conserve its energy. This eventually helped it to operate in depth of about 5000m (Mondal, Banerjee , & Panja, 2019). Specifically in 1990s a remote mine hunting prototype was used in an operation in Persian Gulf. Thereupon the US Navy shifted its focus on developing such technologies which is used for littoral warfare and anti-terrorism missions. (Sharma, 2022).

Recent AUV advancements in USA and Russia

AUV advancements in USA:

From the above introduction it is known that UUV's were developed in USA for research purposes and also for military purposes especially for the US Navy. The US advancements in the domain of AUV development ranges from small AUV to that of Extra Large (XLUUV).

AUV categories	AUV model	Operational depth	Weight	Manufacturer
Small	Sandshark Micro-AUV	200m	5.12kg	General Dynamics Mission Systems
	Mk 18 Mod 1	100m	36kg	Hyroid Inc.
	IVER4 900	300m	90kg	L3 Harris
Medium	LBS-Glider	150-1000m	55-70kg	Teledyne
	Mk 18 Mod 2	600m	282kg	Hyroid Inc.
	REMUS 600	600m	282kg	Hyroid Inc.
	Knifefish	4500m	750kg	General Dynamics Mission Systems
	Knifefish P31	-	920kg	General Dynamics Mission Systems
Large	ONR Innovative Naval Prototype	121m	-	ONR
	Snakehead Ph1	600m	-	General Atomics Electromagnetic Systems

Extra large	ONR Innovative Naval Prototype	150-1000m	50,000kg	ONR
	ORCA	150-1000m	50,000kg	Boeing
	XLUUV Future Capabilities	243m	14,060kg	Naval Undersea Warfare Centre Division Newport

Table 1. Source: (Agarwala, 2022)

The above table describes about the AUV capabilities of USA. Most of the AUV developments were assisted by DARPA. It was classified into four broad categories which has its operational depth ranging from 100m to 1000m.

The Remote Environmental Monitoring Units 600 or REMUS 600 was one such AUV developed in 2003 by Woods Hole Oceanographic Institute with the help of funding provided by Office of Naval Research (ONR). Its characteristics include speed of 5 knots, operational depth of 600m and endurance of about 70hours. The REMUS 600 belonged to a series of its AUV family which ranges from REMUS 100 to REMUS 6000. The main reason for the development of REMUS 600 was to support the US Navy's demand for an AUV capable with high endurance, higher operational depth and payload capacity when compared with its predecessor the REMUS 100. (Button, Kamp, Curtin, & Dryden , 2009)

On the other hand, the weight of those large and extra-large AUV's in the above table also describes its ability to carry large payloads. The US Navy's UUV Masterplan for the year 2004 has depicted the use of UUV's for various range of missions which includes, (Nichols, et al., 2020)

- Intelligence, Surveillance and Reconnaissance
- Mine-Countermeasure
- Anti-Submarine Warfare
- Inspection/ Identification
- Oceanography
- Communications/ Navigation Network Node (CN3)
- Payload Delivery

- Information Operations and
- Time Critical Strike (TCS).

AUV advancements in Russia:

On par with USA, Russia on the other side is working towards modernising its armed forces with unmanned systems. The development of unmanned systems in Russia can be traced back to Soviet era. Russia developing their own unmanned underwater vehicles in order to safeguard their resource rich Arctic region and also to bolster its naval forces. Their UUV capabilities ranges from small glider vehicles to that of large deep-water UUV’s.

The following table describes the capabilities of Russia in the domain of Unmanned Underwater Vehicles:

AUV name	Manufacturer	Function
Sarma	ARF & Lazurit	Long-range ISR UUV
Klavesin – 2R -PM	Rubin Design Bureau	ISR UUV
Galtel	Institute of Marine Technology Problems (RAS)	ISR UUV
Vityaz	ARF & Rubin Design Bureau	ISR UUV
Surrogat	Rubin Design Bureau	Combat UUV
Cephalopod	Rubin Design Bureau	Combat UUV
Poseidon	Rubin and Malahit Design Bureau	Long – range combat underwater vehicle

Table 2. Source: (Bendett, et al., 2021)

The above table describes the various autonomous underwater vehicles that is being operated and in development stages in Russia. For Russian military the AUV’s ensures greater ISR actions. Apart from that they help them to acquire data regarding the underwater environment and to inform surface, aerial and undersea components. In addition to this the Russian Navy

also has the plan to equip its vessels with surface and subsurface autonomous vehicles. (Bendett, et al., 2021). This will eventually improve the overall capabilities of its naval force.

One such unmanned underwater vehicle called as the Galtel described as an underwater reconnaissance robot. It was first mentioned in public in 2012 at the (Asia-Pacific Economic Cooperation) APEC summit. This particular UUV was used by the Russian Navy in its operations conducted in Syria. It had also patrolled the Russian logistics facility in Tartus (Syria) by performing underwater surveys of the ocean floor. It consists of two autonomous submarines as a single complex with about 24 hours of endurance and 100km of range. (Edmonds, et al., 2021)

Of these UUV's in the above table the Poseidon was supposed to be a game changer in upcoming years for the Russian Navy. This was because of the capability it possesses. The Poseidon was initially known as "Oceanic Multipurpose System Status" or "Status – 6". It was described as large autonomous nuclear tipped UUV. According to Russian President Vladimir Putin, the Poseidon is a multi-purpose UUV which has the ability to carry conventional and nuclear warheads. This helps it to pose a potential threat to Aircraft carrier groups, coastal fortifications and infrastructure. (Bendett, et al., 2021, pp. 25,26) In addition to this it ensures Russia for an assured second-strike capability.

The above two countries efforts in developing their autonomous underwater vehicle depicts that UUV's probably has the ability to change the future naval battles. Even though it enables the power of naval forces at one end. On the other end, it is also necessary to look over the present governing laws regarding their usage in real time operations. Therefore, more attention regarding the use of nuclear capable UUV's in naval operations need to be paid. Which probably exhibit more damages to the marine environment in case of any accidents.

AUV development in India:

India as a developing nation is focussing on modernizing its naval fleet this includes the present induction of its Indigenous Aircraft Carrier INS Vikrant and several other nuclear capable submarines such as INS Arihant. In addition to this it is also working on underwater vehicles by considering the advancements made in this sector by China. The state-owned Defence Research and Development Organization (DRDO) is involved in the process of developing its own autonomous underwater vehicle.

Way back in 2016, DRDO scientists developed an autonomous underwater vehicle prototype for multiple maritime missions. Manohar Parrikar, former Defence Minister said in the Parliament that a feasibility study has been conducted for the development of different AUV platforms by DRDO. (Singh, 2016)

In addition to this the Larsen and Toubro (L&T) is working on the development of three UUV's this includes MAYA, AMOGH and ADAMYA. These were showcased at the DefExpo 2020 in Lucknow, Uttar Pradesh. Among this ADAMYA has endurance of 8 hours and operational depth of 1500 feet under the sea. (Sharma, 2022, p. 39).

India's present capabilities in the development of undersea vehicle need to be improved by considering its present stage. Since the technology for the development of a better underwater vehicle is emerging day-by-day. A rapid approach is needed in order to thwart the emerging undersea threats. If considerable advancements were made in the deployment of UUV's in the real-time scenario. There is no doubt that these autonomous underwater vehicles will ensure India to counter its maritime threats.

How AUV's will probably help India?

India as a peninsular nation has vast access to its ocean. The Indian Ocean provides it with enormous opportunities from acting as an economic bridge (by Sea trade) to that of emerging player in the Indo-Pacific region. This makes India to behave as a responsible actor in the Indian Ocean Region and also in the greater Indo-Pacific. At the same time, it is also important for India to ensure its own security in maritime domain.

India's coastal assets:

As mentioned earlier India's majority of its trade was carried out through maritime route. It resembles the importance of major ports and harbours that resided in its coasts. In addition to this India's coastline has some notable strategic assets this consists of the following,

- Nuclear Powerplants
- Nearby coastal islands
- Naval Commands and bases
- Major cities like Chennai, Mumbai, Vishakhapatnam, Mangalore, Cochin, etc.
- Special Economic Zones like (Kandla SEZ, Cochin SEZ, etc.)
- Naval Shipbuilding facilities.

- Missile testing facilities.

All these aforementioned assets were more probable for any sort of attacks by the adversary in the nearby future. If these attacks were carried out by either state or non-state actor from the undersea domain it poses a serious threat. Hence it is much needed to dismiss such kind of menace. So, patrolling of underwater domain is much important. Here the autonomous underwater vehicle plays a credible role in ensuring coastal security. This can be through port and harbour surveillance, intelligence gathering, conducting search and rescue operations, etc. On the other hand, large and extra-large UUV's will help the manned submarines in some notable operations this includes intelligence gathering, anti-submarine warfare, oceanographic mapping and data collection. When the surface waters were guarded by conventional naval vessels. Patrolling in the underwater domain remains as a lag. So, it is utmost important for a maritime nation like India to work in a proactive manner in the development and deployment of these unmanned undersea systems.

Conclusion

AUV's one such category in the maritime unmanned systems is gaining more attention due to its autonomous nature. This made several nations to work on its development in order to enhance their naval capabilities. This is evident from the initial development of SPURV by USA in 1957 to observe and collect data in the Arctic waters to the Russian development of Poseidon (Nuclear tipped multi-purpose UUV). When these systems at one part assure several nations in safeguarding their maritime space. On the other part it also poses a menace to the maritime domain. So, it is necessary for any nation to act in a responsible manner regarding their deployment and usage. This can be done by creating a specific law regarding the operational usage of maritime unmanned systems (both in peace and war times). So, this article concludes by laying emphasis for the creation of a specific law regarding autonomous underwater vehicles usage in maritime domain.

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