Use of Large Unmanned Vehicles in Joint Intelligence, Surveillance, and Reconnaissance

Word Count: 3,528 words

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)* 13-05-2022	**2. REPORT TYPE** FINAL	**3. DATES COVERED** *(From - To)* N/A
4. TITLE AND SUBTITLE Use of Large Unmanned Vehicles in Joint Intelligence, Surveillance, and Reconnaissance		**5a. CONTRACT NUMBER** N/A **5b. GRANT NUMBER** N/A **5c. PROGRAM ELEMENT NUMBER** N/A
6. AUTHOR(S) LCDR Josh Flakus, USN		**5d. PROJECT NUMBER** N/A **5e. TASK NUMBER** N/A **5f. WORK UNIT NUMBER** N/A
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Writing & Teaching Excellence Center Naval War College 686 Cushing Road Newport, RI 02841-1207		**8. PERFORMING ORGANIZATION REPORT NUMBER** N/A
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) N/A		**10. SPONSOR/MONITOR'S ACRONYM(S)** N/A **11. SPONSOR/MONITOR'S REPORT NUMBER(S)** N/A

12. DISTRIBUTION / AVAILABILITY STATEMENT
Distribution Statement A: Approved for public release; Distribution is unlimited.

13. SUPPLEMENTARY NOTES A paper submitted to the faculty of the NWC in partial satisfaction of the requirements of the curriculum. The contents of this paper reflect my own personal views and are not necessarily endorsed by the NWC or the Department of the Navy.

14. ABSTRACT
The Navy's Unmanned Campaign Framework and Strategy for Intelligent Autonomous Systems (IAS) share the Navy's vision for how it will develop unmanned platforms through iterative experimentation, focusing on developing new operating concepts and the key technologies which enable those ideas. The Navy needs to develop a concept of operations (CONOPS) for incorporating unmanned surface and underwater vessels (USV/UUV) into existing Intelligence, Surveillance, and Reconnaissance (ISR) processes at the operational levels of war and command. Unmanned vehicles (UV) face operating and sustainment challenges which will make them uniquely cumbersome in the Processing and Exploitation functions of the intelligence cycle. Discussion is limited to two unmanned platforms with significant endurance and collection capabilities, leading them to have substantial operational impact. This work reviews unclassified literature on Extra Large UUV (XLUUV) and Medium USV (MUSV) capabilities and intended missions, in comparison to the development of the MQ-4C Triton. It identifies several factors and solutions which the Navy should consider in developing CONOPs for integrating XLUUV and MUSV in ISR at the operational level.

15. SUBJECT TERMS (Key words)
Unmanned Vehicles, ISR, UUV, USV, Intelligence

16. SECURITY CLASSIFICATION OF: UNCLASSIFIED			**17. LIMITATION OF ABSTRACT**	**18. NUMBER OF PAGES**	**19a. NAME OF RESPONSIBLE PERSON** Director, Writing Center
a. REPORT UNCLASSIFIED	**b. ABSTRACT** UNCLASSIFIED	**c. THIS PAGE** UNCLASSIFIED	N/A		**19b. TELEPHONE NUMBER** *(include area code)* 401-841-6499

Introduction

Unmanned platforms play a vital role in our future fleet. Successfully integrating unmanned platforms—under, on, and above the sea—gives our commanders better options to fight and win in contested spaces. They will expand our intelligence, surveillance, and reconnaissance advantage … – Chief of Naval Operations, Navigation Plan 2021[1]

The U.S. Navy is currently developing a host of unmanned air, surface, and underwater vessels to meet its future force objectives. The Navy's Unmanned Campaign Framework,[2] and Strategy for Intelligent Autonomous Systems (IAS,)[3] share the Navy's vision for how it will develop these new platforms through iterative experimentation focusing on developing new operating concepts and the key technologies which enable those ideas.[4] Unmanned platforms will support the Navy's goal of a more distributed force capable of operations in a communications-degraded environment while challenged by anti-access and area denial threats. While the Navy's unmanned vehicles remain in various stages of development, there is sufficient data on their capabilities to propose operating concepts that mesh these new platforms with long-standing Navy priorities.

The Navy needs to develop a concept of operations (CONOPS) for incorporating unmanned surface and underwater vessels (USV/UUV) into existing Intelligence, Surveillance, and Reconnaissance (ISR) processes at the operational levels of war and command, both during combat and in day-to-day, noncombat operations. This CONOPs would support at least two of the IAS Envisioned Futures - distributed and persistent sensors, and battlespace expansion,

---

[1] Chief of Naval Operations, "Navigation Plan 2021," January 11, 2021, pg. 11
[2] Department of the Navy, "Unmanned Campaign Framework," March 16, 2021
[3] Department of the Navy, "Strategy for Intelligent Autonomous Systems," July 02, 2021
[4] Megan Eckstein, "USV, UUV Squadrons Testing Out Concepts Ahead of Delivery of Their Vehicles," USNI News, September 9, 2020

clarity, and precision.[5] While potentially potent collection platforms, unmanned vehicles (UV) face operating and sustainment challenges which will make them uniquely cumbersome in the Processing and Exploitation functions of the intelligence cycle.[6][7] The Navy's concept for employing UVs as ISR assets will need to incorporate the operational objectives these platforms are uniquely suited to accomplish, and should be developed now while the capabilities of the platforms are being formed and fielded.

To focus on the operational level of war, discussion will be limited to two unmanned platforms with significant endurance and collection capabilities, leading them to have substantial operational impact. This work reviews unclassified literature on Extra Large UUV (XLUUV) and Medium USV (MUSV) capabilities and intended missions in comparison to the development of the MQ-4C Triton, a large maritime unmanned aerial vehicle (UAV). It identifies several factors and solutions which the Navy should consider in developing CONOPs for integrating XLUUV and MUSV in ISR at the operational level. Analysis focuses on the use of these platforms in a maritime-centric theater with a near-peer or peer adversary employing military forces in the undersea, surface, air and space domains. References to the operational commander envision a theater Joint Force Maritime Component Commander (JFMCC) and intelligence staff, operating within a Maritime Operations Center (MOC) either ashore or afloat.

Background

The Navy's concept for Distributed Maritime Operations (DMO) to defeat competitors in an Anti-Access, Area-Denial (A2AD) theater relies on distributed, networked ISR platforms. ISR

---

[5] Department of the Navy, "Strategy for Intelligent Autonomous Systems," July 02, 2021, pg. 8

[6] United States Navy, Office of the Chief of Naval Operations, "Naval Intelligence," Naval Warfare Publication (NWP) 2-0, Norfolk, VA, Department of the Navy, March 2014, pg. 3-35

[7] U.S. Office of the Chairman, Joint Chiefs of Staff, "Joint Intelligence," Joint Publication (JP) 2-0, Washington, D.C.: CJCS, October 22, 2013, pg. I-15 – I-16

assets will locate the adversary and provide targeting support to weapon-employing platforms. Unmanned vehicles are particularly relevant to the DMO concept, as DMO envisions employing Navy assets within the engagement zone of an adversary's standoff or anti-access weapons. The Navy's FY23 long-range naval construction plan states that the Navy expects to have 89-145 unmanned platforms in FY45 and mentions that more detailed information is available in classified Capability Evolution Plans.[8] The FY22 construction plan specified that the Navy was seeking 59 to 89 USVs and 18 to 51 UUVs.[9] The Navy's funding priorities and iterative unmanned platform development support the CNO's vision of unmanned platforms as a critical component of distributed operations.

Intelligence, surveillance, and reconnaissance are three separate but intimately related functions, critical for success in military operations. Broadly described, intelligence is the collection and analysis of information relevant to decision-making. Surveillance is the use of a collection asset to monitor a location for activity of interest, while reconnaissance is the deployment of a collection asset to a defined area in order to locate or confirm the absence of activity of interest.[10] Unmanned vehicles, when used in an ISR function, will primarily serve as collection assets to either surveil or reconnoiter specific areas in search of activity of interest. The 'unmanned' nature of these platforms, which allows the platforms themselves to be more cost-effective and less challenging to place in harm's way, complicates their effectiveness as ISR assets. Collection operations must be pre-programmed with sufficient rigor to meet the

---

[8] Chief of Naval Operations, "Report to Congress on the Annual Long-Range Plan for Construction of Naval Vessels for Fiscal Year 2023," Deputy Chief of Naval Operations for Warfighting Requirements and Capabilities - OPNAV N9, April 2022, pg. 8, 10

[9] Congressional Budget Office, "An Analysis of the Navy's Fiscal Year 2022 Shipbuilding Plan," September, 2021, pg. 5-6

[10] U.S. Office of the Chairman, Joint Chiefs of Staff, "Joint Intelligence," Joint Publication (JP) 2-0, Washington, D.C.: CJCS, October 22, 2013, pg. I-11

commander's requirements in a communications-denied environment where re-tasking is unlikely. Additionally, the collected data must be transmitted to an analyst capable of developing the information into intelligence used to inform operational decisions.[11]

MQ-4C Triton

The MQ-4C Triton is a large UAV adapted from the RQ-4 Global Hawk to provide persistent maritime ISR. Triton was developed in response to a Navy need for persistent ISR, eventually identified as Broad Area Maritime Surveillance (BAMS),[12] to use in A2AD environments. Triton can fly for over 24 hours on a single mission and has an operational range of 8,200 nautical miles. Specific modifications were made to RQ-4 to meet Navy requirements, most notably the requirement to descend and ascend in harsh maritime weather in order to visually identify surface vessels located by electronic signals. This requirement necessitated adding de-icing capabilities, lightning protection, and other strengthening measures.

[11] "Scouting is not accomplished until the information is delivered to the commander being served." CAPT Wayne P. Hughes Jr. and RADM Robert P. Girrier, Fleet Tactics and Naval Operations, Third Edition (Annapolis: Naval Institute Press, 2018), pg. 336

[12] Ernest Snowden and Robert F. Wood Jr., *Maritime Unmanned From Global Hawk to Triton* (Annapolis: Naval Institute Press, 2021), pg. 14-15

In January, 2020 the Navy conducted the first Early Operational Capability (EOC) deployment of Triton, fielding two airframes to Andersen Airfield in Guam.[13][14] The aircraft operated as part of CTF-72 and provided maritime patrol and reconnaissance, an aspect of ISR, to joint forces operating in the INDO-PACOM area of responsibility. During flight operations Triton is controlled by a crew of four aviators operating from a ground control site.[15] These operators fly the aircraft and do not conduct intelligence exploitation, which is provided by a separate team of specialists. The airframes fielded to Guam in 2020 did not possess the entire suite of intended collection capabilities, having only electro-optical/infrared (EO/IR) video streaming and a maritime radar.[16] The Navy is currently testing an upgraded, multi-intelligence variant of Triton which adds a signals intelligence collection capability and is the platform intended to replace the manned EP-3E Aeries II aircraft.[17][18]

Although not yet fully operational the early employment of Triton provides lessons which should inform the development of large, unmanned surface and underwater vessels. One, the information collected by Triton and other unmanned platforms will need to be transmitted to human analysts for exploitation. While automated processes to identify signals of interest exist, they are not yet capable of placing this information into the context of current friendly and adversary operations and informing decision makers. Two, large unmanned systems are reliant on shore-based sustainment and maintenance. Like Triton, any large UV will need to return to a base or port for repair, refueling, and to off-load collected data. These shore facilities present a

[13] Department of the Navy, "Department of the Navy Unmanned Campaign Framework," March 16, 2021, pg. 14
[14] Ben Werner, "Navy's First MQ-4C Triton Unmanned Aircraft Deploy To Guam," USNI News, January 27, 2020
[15] NAVAIR, "Manning the Unmanned: A Day in the Life of Triton Operators," Video, Accessed on April 30, 2022
[16] Megan Eckstein, "US Navy Triton UAV returns from Guam, ahead of transition to more capable variant," DefenseNews, December 16, 2021
[17] NAVAIR News, "Navy conducts first MQ-4C Triton test flight with multi-intelligence upgrade," July 29, 2021
[18] Congressional Research Service, "Intelligence, Surveillance, and Reconnaissance Design for Great Power Competition," June 04, 2020, pg. 25

critical requirement for UV operations and could be subject to disruption or attack. Three, unmanned platforms should be constructed with an understanding that missions and payloads may change in the future. Unmanned platforms built for calm sea states and moderate temperatures may be less effective or unable to operate in heavy seas, harsh weather, or extremes in water temperature.

Top and Left – Boeing Echo Voyager XLUUV. Top picture displays the communication mast raised during submerged operations.

Orca Extra Large Unmanned Undersea Vehicle (XLUUV)

The first of five Orca XLUUV, funded in FY19 and based on the Boeing Echo Voyager XLUUV, is expected in FY22 as a testbed platform for the development of operating concepts and key enabling technologies. XLUUV will almost certainly not have the capability to detect, track, and classify acoustic contacts with the fidelity of a manned submarine. This is primarily because a UUV lacks the expertise of trained and experienced submariners onboard, and because XLUUV is a much smaller platform than a manned submarine which limits the capability of any onboard sonar array. However, the modular nature of XLUUV expands its potential collection capability to include any deployable system carried onboard, as well as hull-mounted or towed sonar arrays. The operational considerations discussed below are based on collecting data from either organic sensors or from carried payloads which communicate with the XLUUV.

The most significant challenge in employing the XLUUV as an ISR asset is the lack of frequent communication with a ground controlling site. Available capability information does not identify whether XLUUV will have the capability to raise a communications mast or buoy to transmit data and receive revised instructions. To do so would dampen the primary advantage of employing an underwater vehicle as an ISR asset, it's stealth. This identifies three possible courses of action for operational planners. One, the XLUUV could not transmit or receive any data during its operations. This would restrict the XLUUV then to only carrying out pre-planned operations and deny the operational commander any ability to re-task the asset. Two, the XLUUV could deploy a communications antenna with a receive-only capability. This would allow the commander to re-task the XLUUV but would not permit the asset to broadcast a receipt of the instructions, leaving the operator uncertain if the new guidance is being carried out. The broadcast used to communicate this new guidance could potentially reveal the general area of UUV or submarine operations. Third, the XLUUV could employ a communications buoy with both transmit and receive capability. This would allow the commander to issue new instructions and confirm that the XLUUV had received and will carry out the new tasking, but would also likely reveal the location of the UUV to an adversary. Each option presents a compromise between security and flexibility for the operational commander.

Following stealth, the second primary advantage a UUV has as an ISR asset is its ability to collect acoustic data. Acoustic intelligence, the processing and exploitation of this data, is an extremely challenging discipline to master. Acoustic data requires an analyst to spend years or perhaps decades of training and experience to exploit. Because of the challenges in this discipline, the Navy should look to existing centers of excellence in acoustic intelligence to exploit XLUUV-collected data. The Navy has two Naval Ocean Processing Facilities (NOPFs) in Virginia and Washington which are manned by a combination of acoustic and intelligence specialists. These facilities operate as part of the Integrated Undersea Surveillance System (IUSS) and conduct continuous exploitation of acoustic data from collection assets employed at sea.[19][20] For ISR functions the Navy should consider including XLUUV as an IUSS asset and leverage the resident acoustic intelligence expertise at the NOPFs to process and exploit collected data.

Recorded acoustic information also generally produces a large amount of data covering an extended period of time. It may take weeks or months to fully exploit all the recorded data from a XLUUV mission. When considered along with the communication challenges discussed earlier, employing a XLUUV as an ISR asset will take detailed planning on the exact operational objective that the XLUUV is supporting. This planning should result in pre-programming the UUV's responses to specific detections meeting the commander's intent. There are three general categories of response operators should consider, an immediate response, a temporarily delayed response, or a decision to continue the mission and exploit data upon returning to port.

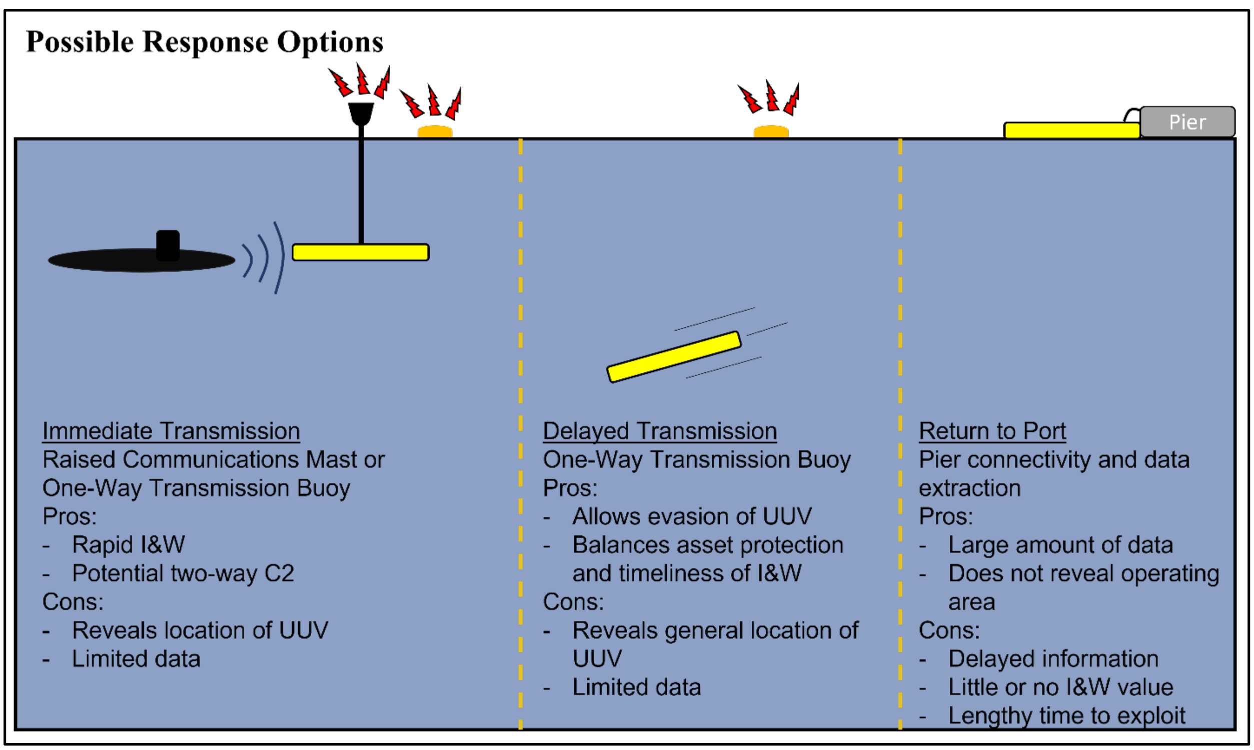
Once the XLUUV has detected specific criteria, for example the acoustic signature of a particular adversary submarine, its response should be carefully pre-determined by the operational commander. In this scenario, the XLUUV has three possible actions. One, cease its mission and issue an immediate notification, via either a communications mast or a non-tethered, one-way transmission buoy, to the operational commander that it has detected the adversary submarine. This response could be appropriate if the adversary submarine presents a danger to the commander's forces and time-sensitive locating information is needed to bring Anti-

---

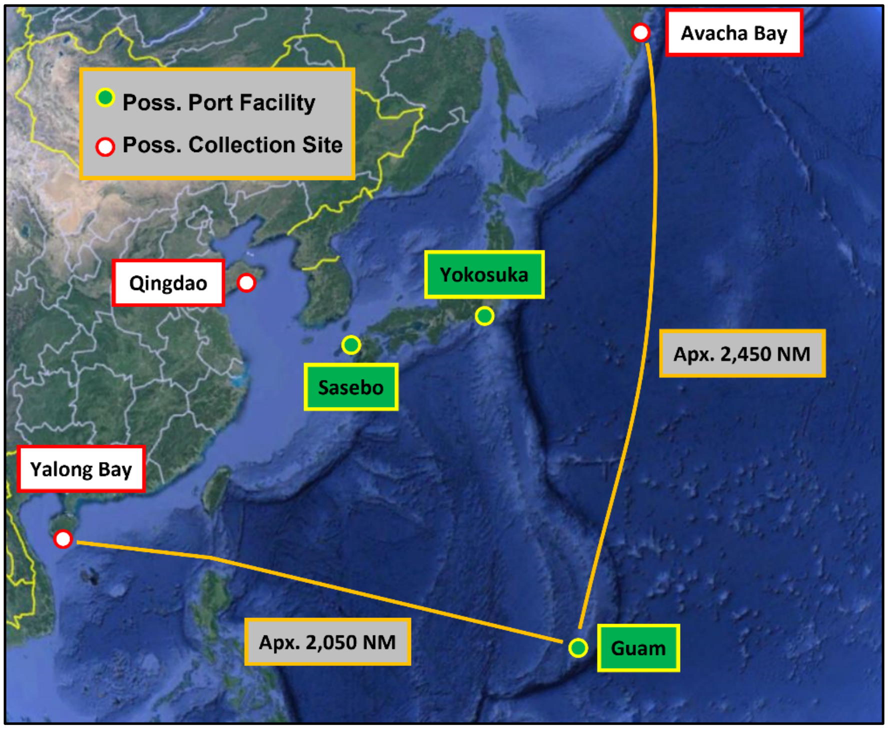
[19] "NOPF Dam Neck," Website, Accessed April 29, 2022

[20] Jeffrey T. Richelson, *The US Intelligence Community* (New York: Westview Press, 2016), pg. 286

Submarine Warfare (ASW) assets into the fight. Two, the XLUUV could release a one-way communications buoy which would broadcast the detection to the operational commander after a delay. This compromise response will provide the commander with recent locating data and improve his situational awareness, but also allow the UUV to leave the area and continue its mission without revealing its location. This response could be appropriate if the commander desires enhanced situational awareness during a near-conflict period but is not trying to actively target the adversary submarine. Three, the XLUUV could simply continue recording acoustic data, make a log note of the detection, and carry on with its mission. The log notation will assist shore-based exploitation upon returning to port. This response could be appropriate during a non-conflict period and when the XLUUV is on a general surveillance mission or gathering operating environment information. Each of these response options utilizes technology available today and provides the operational commander flexibility in directing the desired response based on the operational need.



Boeing's publicly available data for the Echo Voyager XLUUV states that it has a range of 6,500 nautical miles (NM), a maximum speed of 8.0 knots and an optimal speed of 2.5-3.0 knots.[21] It is approximately 2,450 NM from Apra Harbor, Guam to Avacha Bay, the home of Russia's Pacific Fleet, and approximately 2,050 NM to Yalong Bay, home to much of China's Southern Theater Navy. If Orca XLUUV's capabilities closely match Echo Voyager's, this would place the most likely locations for intelligence collection well within the operational reach of a XLUUV deployed to Guam. However, utilizing XLUUV at a great distance from its homeport will likely result in significant delay in receiving and exploiting collected data. The return transit from Avacha Bay to Guam would take roughly 13 to 40 days, based on a 2.5-8.0 knot speed of advance. The lengthy travel time of the platform, compounded with the significant time needed to analyze collected data, drives the most likely use of XLUUV in ISR towards general collection of the operating environment, or potentially into surveillance missions combining the long endurance of the platform with the immediate or delayed transmission communication methods described earlier.



[21] Boeing, "Echo Voyager Product Sheet," 2017

As an unmanned platform XLUUV will also face unique challenges in sustainment and maintenance which will affect its use as an ISR asset. XLUUV is envisioned as a somewhat deployable or expeditionary capability. Discussion of this capability seems limited to a single or small numbers of hulls however the DMO concept and Navy shipbuilding plans envision several dozen platforms, all of which will require transportation, ground support, and pier space to operate.[22] Maintenance is a particularly vexing problem, as there is simply no one onboard to resolve even minor maintenance issues. Any material defect which degrades or denies mission accomplishment will necessitate a lengthy return to port or potentially to a surface vessel located outside of the adversary's threat range. Sustainment and maintenance realities will need to be incorporated in any operational plan utilizing UVs as ISR assets, likely leading to their employment primarily in non-combat, intelligence preparation tasks where failure is less impactful than during combat operations.

Top - An artist's conception of the L3Harris MUSV. L3HARRIS TECHNOLOGIES.

Left – Sea Hunter prototype unmanned surface vessel. Department of the Navy Unmanned Campaign Framework.

Medium Unmanned Surface Vessel (MUSV)

The Navy's MUSV is currently in development based on the initial prototype platforms, Sea Hunter (SH1) and Seahawk (SH2). MUSV is specifically intended to function in an ISR role,

[22] Gregory V. Cox, "The U.S. Navy's Plans for Unmanned and Autonomous Systems Leave Too Much Unexplained," War on the Rocks, December 10, 2021

providing an unmanned sensor and electronic warfare platform integrated into the Navy's Tactical Grid.[23][24] The MUSV program is currently less defined in terms of platform capabilities than the XLUUV, but is sufficiently developed to consider specific ISR functions and operating concepts. The crucial decision in employing MUSVs as an ISR asset will be determining whether they will function as independent collectors or as an asset subordinate to manned surface vessels.

In either use MUSV will largely function in a similar manner - collecting available electronic data, performing initial exploitation and processing, and relaying the results of that collection to analysts and systems ashore and afloat. The difference will come in what signals the vessel's onboard collection systems are looking for, and to whom and how that collection is relayed. While operating as a support to manned ships the MUSV's collection systems should focus on detecting and tracking incoming threats, and to providing targeting assistance to the supported vessels. Sensor packages should be able to simultaneously identify and track anti-ship cruise missiles, ballistic missiles, hypersonic missiles, surface vessels, manned and small unmanned aircraft, and provide a periscope detection capability. The MUSV should be able to provide the results of its collection directly to the supported ships without relying on intervening ground stations or satellites, and then assist with selecting and targeting defensive measures or counter-fires.

If operating as an independent collector, the MUSV should ideally be equipped with sensors capable of beyond-the-horizon tracking of multiple air and surface targets and automatically correlating those tracks to known or suspected adversary platforms. This data

[23] Department of the Navy, "Department of the Navy Unmanned Campaign Framework," March 16, 2021, pg. 15
[24] Congressional Research Service, "Navy Large Unmanned Surface and Undersea Vehicles: Background and Issues for Congress," February 17, 2022, pg. 2

should be relayed to the operational commander to build the Common Operating Picture (COP). These two missions, directly supporting manned ships or independent operations providing COP development, comprise elements of surveillance and reconnaissance tasking. However optimal sensor and communication capabilities vary between the missions, which warrants consideration in further development of the MUSV.

As predominantly electronic intelligence (ELINT) collectors MUSVs will need to rely on existing ELINT analysts to exploit the collected data. Navy surface ships generally have cryptologic personnel onboard who can conduct this analysis, although they are currently tasked with operating and exploiting their ship's organic collection capabilities. If sufficient communication capabilities are present on the MUSVs then data collected could be sent to shore-based analysts for exploitation. In this case, the Navy Information Operation Commands (NIOCs) are the logical sites for data exploitation. Infrastructure and information technology will need to be developed to incorporate MUSV-collected ELINT into existing processing systems. Additionally, cryptologic manning onboard surface ships and at shore facilities will need to reflect the addition of a new collection platform providing multiple streams of data requiring analysis.

Counter-Argument

Large UVs like Orca and MUSV are envisioned as one component of future technologies which will enable the Navy's DMO concept. This vision asserts that data collected from UVs will be communicated to the operational-level commander via the Naval Tactical Grid and the

Joint All-Domain Command and Control (JADC2) network.[25][26] The CNO's NAVPLAN 2021 identifies the creation of a robust Naval Operational Architecture (NOA), which will support integrating UV collected data into JADC2, as the second highest development priority behind recapitalizing the at-sea strategic deterrent.[27] The Navy's IAS strategy implies that data collected by unmanned systems will be processed and exploited by Artificial Intelligence and Machine Learning (AI/ML) tools.[28][29] Current ISR platform development is shifting focus from a manpower-intensive force to automated capabilities geared towards defeating a peer adversary in a contested environment.[30] The use of AI/ML will lead to exponential growth in the speed at which collected data can be processed and exploited, greatly enhancing the operational commander's situational awareness and reducing the time from detecting an adversary to engaging with weapons. Networked, automated exploitation of collected data will be a critical enabler of distributed operations.

Rebuttal

Expecting that networked communications and AI/ML developments will necessarily result in the effective employment of unmanned platforms falls short for three reasons. One, operational art depends on an in-depth analysis and understanding of the operating environment, adversary and friendly forces, and the operational objective. That understanding and the effective employment of forces will always depend on a capable operational commander regardless of the

[25] Congressional Research Service, "Intelligence, Surveillance, and Reconnaissance Design for Great Power Competition," June 04, 2020, pg. 10-11

[26] Congressional Research Service, "Joint All-Domain Command and Control: Background and Issues for Congress," January 21, 2022, pg. 14

[27] Chief of Naval Operations, "Navigation Plan 2021," January 01, 2021, pg. 9

[28] Department of the Navy, "Strategy for Intelligent Autonomous Systems," July 02, 2021

[29] Congressional Research Service, "Intelligence, Surveillance, and Reconnaissance Design for Great Power Competition," June 04, 2020, pg. 26

[30] Congressional Research Service, "Intelligence, Surveillance, and Reconnaissance Design for Great Power Competition," June 04, 2020, pg. 14

tools provided. As an ISR asset, UVs will rely on clear operational tasking from the commander and intelligence personnel. Two, the current state of AI/ML tools in intelligence analysis is promising but likely a long way off from advancing to a capability which begins to replicate human analysis.[31][32] This is particularly true for acoustic intelligence, which exists as a combination of art and science. AI/ML tools can only replicate patterns that have been formed by human thought and action, and are almost certain to miss new trends and outlier data relevant to operational art regardless of the algorithm developed. The Navy also faces challenges in training and retaining AI/ML expertise.[33] Three, large UVs are currently in an iterative experimentation stage and operational concepts need to be developed now while platform capabilities are being designed. Waiting until UV platforms have reached a final, production state to develop ISR CONOPs for these new collection assets will preclude Naval intelligence experts from informing the development process on the sensors and capabilities needed to meet the operational intent.[34]

Conclusion

The Naval intelligence community needs to be fully invested in the development of large UVs, particularly in developing the capabilities and concepts needed to employ these platforms in ISR roles. The Navy's experience in incorporating UAVs into ISR processes will inform but not directly translate into utilizing unmanned surface and undersea vessels. UVs operating in a communication degraded or denied environment will likely necessitate significant shore-side infrastructure to process and exploit collected data, and investment in this infrastructure and

[31] Congressional Research Service, "Intelligence, Surveillance, and Reconnaissance Design for Great Power Competition," June 04, 2020, pg. 33-35
[32] Cheryl Pellerin, "Project Maven to Deploy Computer Algorithms to War Zone by Year's End," DoD News, 07/21/2017
[33] LT Andrew Pfau, "Preparing Sailors for the Age of AI," Proceedings, Vol. 148/4/1,430, April 2022,
[34] CAPT Tony Butera, "Navy Information Warfare Needs More Resources – and Command at Sea," Proceedings, Vol. 145/1/1,391, January 2019

manpower should occur alongside platform development. Data collected from UVs will likely take significant time to process and exploit, diminishing their usefulness in Indications and Warning (I&W) tasks and likely steering the best sensor suite to favor operating environment collection. Due to the challenges in processing and exploiting collected data, UVs will not replace the existing ISR functionality of manned aircraft, surface and subsurface vessels, and national overhead collection, but will likely become powerful tools in developing a commander's situational awareness if the right combination of capabilities and operating concepts are developed and employed.

Bibliography:

Boeing, "Echo Voyager Product Sheet," 2017, https://www.boeing.com/resources/boeingdotcom/defense/autonomous-systems/echo-voyager/echo_voyager_product_sheet.pdf

Butera, Tony, "Navy Information Warfare Needs More Resources – and Command at Sea," U.S. Naval Institute, January 2019, Vol. 145/1/1,391 https://www.usni.org/magazines/proceedings/2019/january/navy-information-warfare-needs-more-resources-and-command-sea.

Chief of Naval Operations, "Navigation Plan 2021," January 11, 2021

Congressional Budget Office, "An Analysis of the Navy's Fiscal Year 2022 Shipbuilding Plan," September, 2021, https://www.cbo.gov/system/files/2021-09/57414-Shipbuilding_1.pdf

Congressional Research Service, "Intelligence, Surveillance, and Reconnaissance Design for Great Power Competition," June 04, 2020

Congressional Research Service, "Joint All-Domain Command and Control: Background and Issues for Congress," January 21, 2022

Congressional Research Service, "Navy Large Unmanned Surface and Undersea Vehicles: Background and Issues for Congress," February 17, 2022

Cox, Gregory V., "The U.S. Navy's Plans for Unmanned and Autonomous Systems Leave Too Much Unexplained," War on the Rocks, December 10, 2021, https://warontherocks.com/2021/12/the-u-s-navys-plans-for-unmanned-and-autonomous-systems-leave-too-much-unexplained/

Department of the Navy, "Strategy for Intelligent Autonomous Systems," July 02, 2021

Department of the Navy, "Unmanned Campaign Framework," March 16, 2021

Eckstein, Megan, "US Navy Triton UAV returns from Guam, ahead of transition to more capable variant," DefenseNews, December 16, 2021, https://www.defensenews.com/naval/2021/12/16/us-navy-triton-uav-returns-from-guam-ahead-of-transition-to-more-capable-variant/

Eckstein, Megan, "USV, UUV Squadrons Testing Out Concepts Ahead of Delivery of Their Vehicles," USNI News, September 9, 2020, https://news.usni.org/2020/09/09/usv-uuv-squadrons-testing-out-concepts-ahead-of-delivery-of-their-vehicles

Hughes Jr., Wayne P. and Robert P. Girrier. *Fleet Tactics and Naval Operations, Third Edition.* Annapolis: Naval Institute Press, 2018.

NAVAIR, "Manning the Unmanned: A Day in the Life of Triton Operators," Video, Accessed on April 30, 2022, https://www.northropgrumman.com/what-we-do/air/triton/

NAVAIR News, "Navy conducts first MQ-4C Triton test flight with multi-intelligence upgrade," July 29, 2021, https://www.navair.navy.mil/news/Navy-conducts-first-MQ-4C-Triton-test-flight-multi-intelligence-upgrade/Mon-07122021-1340

"NOPF Dam Neck," Accessed April 29, 2022, https://www.csp.navy.mil/nopfdn/

Office of the Chairman, Joint Chiefs of Staff, "Joint Intelligence," Joint Publication (JP) 2-0, Washington, D.C.: CJCS, October 22, 2013

Office of the Chief of Naval Operations, "Naval Intelligence," Naval Warfare Publication (NWP) 2-0, Norfolk, VA, Department of the Navy, March 2014

Pellerin, Cheryl, "Project Maven to Deploy Computer Algorithms to War Zone by Year's End," DoD News, July 21, 2017, https://www.defense.gov/News/News-Stories/Article/Article/1254719/project-maven-to-deploy-computer-algorithms-to-war-zone-by-years-end/

Pfau, Andrew, "Preparing Sailors for the Age of AI," Proceedings, Vol. 148/4/1,430, April 2022, https://www.usni.org/magazines/proceedings/2022/april/preparing-sailors-age-ai

Richelson, Jeffrey T. *The US Intelligence Community*. New York: Westview Press, 2016.

Snowden, Ernest and Robert F. Wood Jr., *Maritime Unmanned From Global Hawk to Triton.* Annapolis: Naval Institute Press, 2021.

Werner, Ben, "Navy's First MQ-4C Triton Unmanned Aircraft Deploy To Guam," USNI News, January 27, 2020, https://news.usni.org/2020/01/27/navys-first-mq-4c-triton-unmanned-aircraft-deploy-to-guam