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PHANTOM BOATS AND GHOST SHIPS

A NEW FRAMEWORK FOR ASSESSING UNMANNED SURFACE VESSELS



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Contents

EXECUTIVE SUMMARY I
Key Findings iii
Recommendations vi
CHAPTER 1: INTRODUCTION **1**
Definitions and Scope 4
Research Questions, Methodology, and Report Outline 5
CHAPTER 2: A SURVEY OF UNMANNED SURFACE VESSEL DEVELOPMENT AND ADOPTION **7**
Brief History of U.S. and Allied USV Programs 7
USV programs of key U.S. Partners: Ukraine and the Republic of China (Taiwan) 25
Adversary USV Programs 29
CHAPTER 3: UNMANNED SURFACE VESSELS: THE THEORY OF THE CASE **33**
Rationales for Fielding USVs 33
Challenges and Enduring Questions Concerning USV Employment 41
USV Use-Cases Today 48
CHAPTER 4: CATEGORIZING UNMANNED SURFACE VESSELS **53**
A New USV Framework 53
USV Conceptual Categories with Historical Analogies 56
CHAPTER 5: ASSESSING UNMANNED SURFACE VESSEL TYPES BY NAVAL MISSION, SCENARIO, RISK, AND EXPECTED VALUE **65**
Matching the USV Concept Types to Naval Missions 65
Matching the USV Concept Types to Adversaries, Threats, and Scenarios 69
Assessing Risk and Reward for USV Types Going Forward 76
CHAPTER 6: FINDINGS AND RECOMMENDATIONS **85**
Key Findings 85
Recommendations 88
Final Thoughts 93
APPENDIX A: USV BUDGET DATA **95**
LIST OF ACRONYMS **98**

FIGURES

FIGURE 1: THE FAA'S UAS GROUPS: NO CORRELATING USV CATEGORIES 3
FIGURE 2: *SEA HUNTER*, ORIGINALLY THE ACTUV 10
FIGURE 3: LCS MCM USV 11
FIGURE 4: *RANGER* AND *MARINER* USVS FROM THE GHOST FLEET OVERLORD PROGRAM 12
FIGURE 5: THE GARC SMALL USV 14
FIGURE 6: THE U.S. MARINE CORPS' EXPERIMENTAL ALPV 19
FIGURE 7: A "VOYAGER" USV BUILT BY SAILDRONE DEPLOYED BY THE DANISH GOVERNMENT 22
FIGURE 8: A MODEL RENDERING OF THE REPUBLIC OF KOREA'S NAVY SEA GHOST USV 24
FIGURE 9: UKRAINIAN MAGURA V5 USV 26
FIGURE 10: MODEL OF TAIWAN'S KAUI-CHI ATTACK USV 28
FIGURE 11: PRC JARI-USV-A 30
FIGURE 12: GREATER USV CAPACITY 37
FIGURE 13: GREATER SENSOR COVERAGE FROM USV INTEGRATION 39
FIGURE 14: STRIKE ENHANCEMENT OFFERED BY USV INTEGRATION 40
FIGURE 15: VISUAL REPRESENTATION OF HELLSCAPE STRATEGY IN TAIWAN STRAIT SCENARIO 51
FIGURE 16: USV FRAMEWORK WITH EXISTING USV CONCEPTS 55
FIGURE 17: NEW FRAMEWORK FOR EVALUATING USV TYPES 56
FIGURE 18: CONCEPUTAL USV INVOLVMENT IN FLEET-ON-FLEET ENGAGEMENTS 73
FIGURE 19: OVERALL ASSESSMENT OF QUALITATIVE RISK FOR EACH USV TYPE 82
FIGURE 20: NAVY PROCUREMENT SPENDING AND RDT&E FUNDING BY UNMANNED SYSTEM TYPE . . . 95
FIGURE 21: LCS MCM MISSION MODULE PROCUREMENT SPENDING BY YEAR 96

TABLES

TABLE 1: THEORETICAL ADVANTAGES AND DISADVANTAGES OF FLEET USVS 47
TABLE 2: USV TYPES AND MISSIONS OF THE NAVY 69
TABLE 3: USV TYPES AND SELECTED SCENARIOS 76
TABLE 4: USV OVERALL RISK ASSESSMENT BY TYPE OF RISK 81

Executive Summary

The U.S. Navy is pursuing numerous efforts to incorporate unmanned surface vessels (USVs) into its force structure. These efforts have picked up speed over the past two decades as enabling technologies such as artificial intelligence have advanced. This is a trend not only within the U.S. Navy but also within navies all over the world, including those of U.S. allies, partners, and adversaries. Although the Navy has begun testing USVs in exercises and building an administrative structure for operating these vessels, many questions remain about what purposes these vessels will serve. USVs offer many advantages over manned platforms. Yet there are many uncertainties about whether enabling technologies are sufficiently mature and about whether gaps in USV doctrine, organization, training, materiel, leadership and education, personnel, facilities, and policy (DOTMLPF-P) can be resolved. The Navy has only recently begun to convey a vision for the operational and tactical problems that USVs are better suited to solve than manned platforms.

This monograph argues that the U.S. Navy would benefit from a new categorization framework for these vessels, one that would better convey the ways in which they are suited to contribute to fleet concepts of operations. The Navy has classified its developmental USVs in terms of their size (small, medium, and large—now only small and medium) or their task (mine countermeasures (MCMs), anti-submarine warfare, one-way attack (OWA), or even multimission). By contrast, this report categorizes USVs in terms of two key traits: longevity and functionality. Under this framework, four key USV types emerge: USVs as adjunct magazine ships, as auxiliaries and support ships, as munitions, and as expendable sensors.

This report assesses each of these categories in terms of the naval missions USVs are optimized to perform (sea denial, sea control, power projection, and presence) and the six operations in which they could be employed:

1. a Western Pacific amphibious invasion denial,
2. high-end anti-submarine warfare,
3. a high seas fleet-on-fleet battle,

4. AirSea Battle,
5. permissive power projection operations, and
6. homeland air and missile defense.

This report finds that given enough time and investment, USVs could contribute to any of these scenarios. However, whether they can do so meaningfully depends on several factors, such as whether the U.S. Navy can solve technical and DOTMLPF-P related challenges, the ability of the industrial base to produce USVs at scale, and the extent to which the Navy can provide clear concepts of operation for their employment.

One important parameter this report considers is the level of risk that the U.S. Navy must take to pursue a certain type of USV program. A ship-like USV that can fire missiles and integrate within a network of distributed ships would contribute to most of the naval missions that a manned platform can, but it would bring a host of engineering and DOTMLPF-P–related challenges, not to mention a mounting cost that might not make it as inexpensive to field as USV proponents believe. Furthermore, such vessels would be susceptible to the same general threats as manned ships, such as anti-ship missiles. With the Navy's recent shipbuilding challenges, the risk of failure is high.

Another key factor in assessing different types of USVs is time. If a USV concept will take decades to fully mature, it may not be useful for near-to-medium scenarios, potentially including a Chinese amphibious invasion of Taiwan or of another U.S. ally or partner in the Pacific. This report finds that although the Navy has many ambitious plans for employing USVs in the fleet, some of its real-world operational efforts have been relatively sclerotic. The Navy is caught between a rock and a hard place: Despite the political risks of high-profile programmatic failure, it must move quickly to field some of these systems in a short time and at the required scale.

Munitions-like vessels are a very promising category of USVs, as demonstrated by Ukraine's use of OWA USVs in its war against Russia. The mission scope is narrower than ship-like USVs—sea denial only—but using USVs as munitions eliminates many of the technical challenges associated with maintaining and resupplying ship-like platforms. Furthermore, they are smaller and can be produced at lower cost than ship-like USVs, so they can be fielded sooner. On top of this, they are less susceptible to anti-ship missiles and are far more expendable than even the least expensive ships. Whether such vessels can meaningfully contribute to a conflict in a wider maritime geography such as the Western Pacific remains to be seen, but U.S. government and U.S. Navy investments demonstrate that they believe these vessels offer potential.

Two other promising areas for USVs adoption highlighted by this report's framework are anti-submarine warfare and maritime domain awareness. USVs' ability to operate with appendages streamed below the surface collecting acoustic data while transmitting electromagnetic energy above the surface makes them well suited among robotics and autonomous

systems (RAS) for this task. Additionally, because USVs float on the surface, they require less energy to maintain their position than unmanned aerial vehicles (UAVs) expend to remain aloft or unmanned underwater vessels (UUVs) expend to maintain neutral buoyancy. This persistence could enable USVs to serve as persistent maritime domain awareness (MDA) sensors.

One of the most important but frequently overlooked barriers to USV implementation is the need for facilities to house these vessels until they need to be employed. This was a consistent concern among all the experts interviewed for this report. No matter the type of USV, it will require some kind of berthing, husbanding, and periodic maintenance prior to use.

A summary of key findings in this monograph is provided next. These findings are based in part on interviews between the author and naval officers and civilians from organizations within and outside the Navy. Interview participants included current and former USV operators; representatives from type commanders, resource sponsors, Naval Sea Systems Command, and requirements managers; and executives and middle managers within the defense industry.

Key Findings

The U.S. Navy is serious about acquiring USVs, but it lacks the detailed, specific USV concepts of operation it needs to guide development efforts. It was clear during interviews with officers who were working on designing, acquiring, and implementing USV technology for the fleet that the U.S. Navy places a high priority on this effort. Many talented, patriotic individuals want to see the Navy succeed, and they are working on solving many of the key challenges identified in this report. Additionally, Navy officials at the highest level are emphasizing the need to incorporate USVs in the fleet; there are no Luddites visible.

Nevertheless, announcements and policy documents have lacked much detail about exactly what the Navy envisions USVs will do in the context of a larger concept of operations. The *Fighting Instructions* document released in February 2026 discusses the Navy's hedge strategy and the need for RAS, including USVs, in the Navy's force structure. It also provides examples of tasks that "tailored offsets" can perform, but it does not explain (nor is it intended to explain) exactly why USVs would be better for these tasks than other platforms, nor does it specify the types of tasks that USVs are best suited to perform.[1]

A more effective, formal framework for categorizing USVs is required to better understand how they should fit into naval force architecture. USVs have been

1 Understandably, there could be classification concerns related to releasing too many details about the composition of tailored hedge forces, but more details could be provided at the unclassified level. Daryl Caudle, "U.S. Navy Fighting Instructions," U.S. Navy, February 2026, p. 33, https://media.defense.gov/2026/Feb/06/2003871752/-1/-1/1/CNO%20FIGHTING%20INSTRUCTIONS.PDF.

categorized with narrow task functions or amorphous size groupings. The U.S. Navy recently merged medium and large USVs into the single modular attack surface craft (MASC) classification, then it canceled MASC and opted only for medium USVs (MUSVs). A framework that describes USVs in terms of their longevity and functionality is more appropriate because it divides USVs into groups that better describe what they can contribute to the fleet.

More real-world operation is necessary to determine where USVs provide the greatest benefit over manned platforms. Chapter 3 details many of the theoretical advantages that USVs purport to have over manned platforms, but whether these advantages materialize remains to be seen. For example, some advantages include USVs' potential for higher endurance and sustainment than manned platforms and the expectation that they can be cheaply produced. The need for human operators to conduct refueling and repair could negate the sustainment advantages, however, and other factors could drive up cost in unforeseen ways, as has happened in other recent shipbuilding programs. Although the uncertainty regarding realized advantage will not be resolved until the fleet begins incorporating USVs into fleet operations, there are some clear applications where USVs will be necessary. Hazardous tasks like MCM are ripe for USV employment, as are strike missions involving munitions-like vessels.

Against an adversary with whom the U.S. Navy is at a firepower disadvantage, munitions-like unmanned vessels offer an asymmetric sea denial capability that ship-like vessels do not. In the Western Pacific, the U.S. Navy is preparing for a sea denial mission against the People's Republic of China, which fields a precision strike network designed to prevent U.S. intervention in the theater by overwhelming the defenses of U.S. warships with masses of advanced anti-ship missiles. Given the mission and threat environment, munitions-like USVs are better suited for this theater than missile-shooting unmanned ships. Even if the Navy fielded a force structure that was partially composed of ship-like USVs armed with missiles, China's anti-ship missile advantage in the Western Pacific is so great that such a force structure would not have much impact on the firepower imbalance in that theater.

Solving the DOTMLPF-P problems associated with employing USVs in the fleet will be difficult for any of the USV categories described in this report; however, it will be more challenging for some categories than others. Almost every naval officer and administrative official interviewed for this report highlighted the challenges associated with fielding USVs of any type, especially with the doctrine, organization, policy, and facilities aspects of DOTMLPF-P. All USV operations will need to be supervised by trained operators; their doctrine will require that they team effectively with manned platforms; there will need to be facilities to operate them from, including forward, overseas bases; and the policy for their use needs to be in place for them to operate effectively. The distributed maritime operations (DMO) concept in which networked, ship-like USVs are meant to fire missiles in coordination with manned units requires more development and testing than simpler concepts where USVs contribute to fleet operations on the margins. More ambitious

concepts involve more risk to the Navy, as implementing them will not assuredly translate to combat effectiveness.

The least risky kinds of USV concepts the U.S. Navy could invest in are those that involve highly expendable vessels and those in which USVs perform supporting tasks. Expendable USVs that resemble munitions or sensors within this report's framework are expected to be relatively cheap to build. Ukraine's experience building its OWA USVs provides a basis for this expectation, and the U.S. Navy could make (and indeed already is making) targeted investments in manufacturing many of these kinds of vessels without risking significant programmatic failure. Certain tasks within the fleet that are ripe for automation today, such as MCM, anti-submarine warfare (ASW), and contested logistics transport, are areas where auxiliary ship-like USVs would be good candidates to take the place of manned platforms, since the doctrine and broader concepts of operations associated with these missions are already in place and are well understood.

The simplest concepts that support the current fleet architecture are the most likely ones to contribute to the near-term fight. Networked USVs that take the form either of adjunct missile magazine ships or expendable distributed sensor nodes are similar in that they will likely require the longest time before they can contribute meaningfully to fleet operations. Magazine USVs must be able to coordinate fires with manned platforms, and expendable sensor USVs must be able to meaningfully contribute to scouting operations as part of a wide sensor network. Because these are concepts that must be built out and not just platforms performing individual support tasks or individual strikes for the fleet, they will most likely require more time before becoming fully integrated fleet components. On the other hand, USVs that act as munitions, ship-like USVs that perform auxiliary support roles, or expendable USVs for MCM or port defense are more feasible in the near term. A single munitions-like USV designed for OWA could be employed today, given that Ukraine and the Houthis are already performing this mission. Likewise, auxiliary ship USVs have already demonstrated a modest resupply capability in exercises, implying that they could soon serve a useful purpose in a contested environment.

USVs are the best type of unmanned system for integrated ASW operations and could be especially effective at countering the Russian submarine threat. The greatest naval threat from Russia in the North Atlantic and to some extent China outside the First Island Chain is from these nations' undersea capabilities. Russia's submarines are highly capable and can threaten the continental United States. USVs are ideally suited to counter this threat, given their position at the air–water interface at the surface of the ocean, collecting acoustic data from below the water and simultaneously transferring it via electromagnetic signal. Neither UUVs nor UAVs have this capability. This advantage could be extremely valuable given the U.S. Navy's dearth of ASW support ships that can stream towed sonar arrays and a shortage of trained personnel to man them. Ship-like support USVs could theoretically be manufactured at lower cost than tactical auxiliary general ocean surveillance ships and could provide wider mobile sensor coverage than what is available today.

This could prove especially useful in the mid- or eastern Pacific and North Atlantic operating areas.

Although USVs are not the optimal units for fleet scouting, they can enhance the U.S. Navy's overall sensing capability. Because they operate on the surface of the ocean, USVs have shorter sensor horizons than UAVs or space-based assets, which can "see" much farther in all directions thanks to their altitude. That said, because USVs can persist in an area much longer than UAVs can, they can add significant value to a maritime sensor network. If mass produced cheaply, expendable sensor USVs could be deployed in such high numbers that their coverage would be great enough to provide the offensive elements of the fleet with adequate early warning and sufficient MDA to perform detection, targeting, battle damage assessment, and other tasks within the kill chain. UAVs and satellites could focus on the most important targeting tasks while USVs performed zone defense and served as pickets on the ocean surface. A concept like this would be more challenging to implement than other support tasks, but it could provide significant upside in the form of better scouting than the adversary.

Recommendations

Near Term: 2026 Through 2030—The Davidson Window and the Fight Tonight

The U.S. Navy's most dangerous challenge in the near term is the threat of a conflict with the People's Liberation Army (PLA) in the Western Pacific, as well as any opportunistic aggression from Russia, North Korea, Iran, or nonstate actors that would occur simultaneously.[2] U.S. commanders have spoken of the need to be ready to "fight tonight," indicating their concern that great power armed conflict could be imminent.[3] As such, these recommendations assign highest priority to the acute threats in regional hot spots such as the South China Sea.

Begin adopting a new framework to describe USVs in a more useful way. This report envisions USVs as adjunct magazine ships, one-way munitions, support ships, and expendable support vessels. Adopting this framework in place of the legacy categories of size or task will benefit the Navy by describing what a type of USV is for and helping it develop more robust concepts of operations for the fleet as it determines how to include USVs in its force architecture.

2 China's readiness to invade Taiwan in the late-2020s is often associated with comments made by commander of USINDOPACOM Admiral Phil Davidson to the Senate Armed Services Committee in 2021. *Hearing to Receive Testimony on United States IndoPacific Command in Review of the Defense Authorization Request for Fiscal Year 2022 and the Future Years Defense Program: Hearing before the U.S. Senate Committee on Armed Services* (2021), p. 48, https://www.armed-services.senate.gov/imo/media/doc/21-10_03-09-2021.pdf.

3 See, for example, *Statement of Admiral John C. Aquilino, U.S. Navy, Commander, U.S. Indo-Pacific Command on U.S. Indo-Pacific Command Posture: Hearing before the U.S. Senate Armed Services Committee* (2024), p. 21, https://www.armed-services.senate.gov/imo/media/doc/aquilino_statement.pdf.

Identify the types of USVs that require very little time to field in meaningful ways and begin building them. The near-term threat requires solutions now, so they must be compatible with the existing force architecture and bureaucratic infrastructure. Munition-like USVs, auxiliary ship USVs, expendable MCMs, and port defense USVs are the most promising vessel types that could contribute to the fight tonight. A good-enough solution with such vessels would be superior to doctrinal and technical perfection, as Ukraine has demonstrated with its OWA USVs. For example, instead of pursuing perfect autonomous capability, remote operation via resilient command and control links should be the focus for these USVs in the short term. The fact that the U.S. Navy is likely including attack USVs as part of the hellscape concept could indicate that it understands the urgency.[4]

Develop and present detailed, longer-term USV concepts that serve as the basis for the Navy's USV development efforts. While the U.S. Navy pursues acquisition of USVs that can add value to tonight's fight, the development of longer-term USV concepts must continue in parallel during the short term. Today, there are ongoing efforts in doctrine writing, engineering testing, facilities procurement, manpower recruitment and training, policy approval, and long-term acquisition, but concrete concepts of operation must be devised if these efforts will pay off in the future rather than be ineffectual. Navy officials have discussed the Navy's new hedge strategy, but few concrete, detailed concepts of operation rooted in ends–ways–means strategic analysis have been presented at an unclassified level to the public. These strategy-based concepts should drive the ongoing DOTMLPF-P development efforts.

Surface Development Squadron (SURFDEVRON) ONE is working on USV development, but it is unclear from publicly available sources how the U.S. Navy is assessing its progress. Additionally, although the Navy has adopted the hedge strategy, it is not clear how USVs will contribute. Without detailed concepts of operation in place, it will be difficult for the Navy, let alone Congress or the public, to assess whether it is effectively adopting USVs into the fleet.

Accept risk in USV requirements, especially for highly expendable USV types, to keep costs low and get useful USVs to the fleet quickly. One of the biggest advantages USVs offer over manned platforms is the promise of lower costs, especially for the expendable USVs that behave like munitions or sensors. Some experts interviewed for this report nevertheless expressed frustration that the standards the U.S. Navy is requiring for USV performance in testing and evaluation—no matter the type—remain too high to allow for agile experimentation.[5] The Navy should accept lower standards of performance in exchange for good-enough systems that reach the fleet sooner and in greater numbers.

4 Carter Johnston, "Breaking Down the U.S. Navy's 'Hellscape' in Detail," *Naval News*, June 16, 2024, https://www.navalnews.com/naval-news/2024/06/breaking-down-the-u-s-navys-hellscape-in-detail/.

5 Based on interviews with experts from industry and the U.S. Navy conducted by the author in January and February 2026.

This may lead to USV failure or capture, but that should be expected in the friction of maritime combat.

Ship-like USVs serving either as adjunct magazines or auxiliaries are less expendable, but the U.S. Navy must still accept that performance will not be on par with manned multimission platforms. It must avoid the requirements creep that plagued the *Constellation* class and the excessive technical optimism that led to the problems of the littoral combat ship (LCS) program. Ship-like USVs will serve as the low end of a high–low force architecture. To keep their costs down in the near term, it must be understood that these vessels will be less capable, less survivable, and less lethal than large multimission platforms. Even if this is internalized at an intellectual level by Navy leaders, the Navy must proceed with caution to avoid adding excessive requirements that could drive up platform cost.

Leverage allies and partners in the near term to deal with acute threats in those nations' theaters. As Chapter 2 of this report shows, many U.S. allies and partners see potential benefits from USV technology and are endeavoring to incorporate these vessels into their naval force structures. The U.S. Navy should assess the capabilities these allies possess today for a fight tonight and the capabilities that they could stand up easily and quickly, such as those developed by Ukraine after Russia's 2022 invasion. This could help identify gaps that could be filled in the short term with existing USV technology. For example, to support sea denial in the South China Sea, the Navy should assess the strength of Taiwan's offensive mining and attack USV capabilities and coordinate with other allies and partners in the Indo-Pacific theater. Additionally, the Navy should call on partners in Europe to begin developing their own specialized USV capabilities to counter Russian threats—especially in the undersea domain.

Medium Term: The Next FYDP and the 2030s

The medium-term threat environment continues to be characterized by the potential for great power war, with the potential for conflict in multiple theaters due to opportunistic aggression. There is enough time, however, to plan for further USV concept development and to accept more risk on USV concepts that would not immediately pay off in the short term. These recommendations consider the threat environment expected in the 2030s, which could feature the proliferation of cheaper, attritable precision weapons and advanced hypersonic missiles.

By the late 2030s, the U.S. Navy should aim to have overcome most of the DOTMLPF-P challenges associated with employing USVs. This should include having firm doctrine in place that describes exactly how it employs each type of USV described in this report's framework and how they fit into the greater fleet force organization charts. It should aim to have mature training pipelines in place to produce USV operators as well as logistics pipelines for maintenance and repair. It should aim to have shifted USV maintenance and repair away from contractor support, which is the maintenance model today. Like the early naval aviation community, the U.S. Navy should promote champions

for USVs within its leadership to ensure that they do not die on the vine when they inevitably meet resistance from leaders of the manned communities.[6] The Navy should make it a goal to secure adequate facilities for basing USVs in theater and should explore technical solutions to the challenge of deploying them from larger multimission platforms. Finally, by this point the Navy must have policies in place that facilitate safe USV employment without hampering their effectiveness. Rules of engagement and guidance for autonomous operations must be in place to ensure the Navy can employ USVs to maximum effectiveness.

Facilitate mass production by establishing USV programs of record that send a clear demand signal to industry and consider narrowing the scope of that signal. Many of the advantages of all types of USVs in this report rest on the assumption that these vessels can be produced at low cost and in large numbers. A consistent theme in interviews with members of industry was the need for a clear and steady demand signal from the Pentagon for the USVs it wants. Additionally, the USV production enterprise is beginning to become saturated with interest from industry. One executive from industry pointed out that interest in this space is now so high that people "working out of their garage" are trying to get in on what they see as lucrative government contracts to produce USVs.[7] The Navy has now committed to a marketplace approach for MUSVs to allow a large number of defense industry newcomers to manufacture them, but this risks creating a patchwork force of platforms with varying maintenance standards, sustainment requirements, and levels of performance. The Navy must clearly articulate the minimum requirements to any manufacturer that wants to participate in the marketplace while maintaining a steady demand signal for these vessels over several future years defense programs (FYDPs) to ensure that they are produced in meaningful numbers.

Deploy USV formations of all categories on a macroscopic scale to understand real-world operational benefits and constraints. In recent years, the U.S. Navy has pursued the modest goal of operating single USV prototypes with the fleet; by the end of the 2030s, it should aim to scale up promising capabilities. It should consider deploying early versions of these capabilities in sufficient numbers to demonstrate where they perform well and where they fall short. This could be done in less contested theaters to test their operational feasibility. For example, expendable USVs acting as networked sensors and auxiliary USVs acting as ASW picket ships could be employed in the Caribbean Sea to monitor illicit activity.[8]

6 Stephen Peter Rosen, *Winning the Next War: Innovation and the Modern Military* (Ithaca, NY: Cornell University Press, 1994), p. 70.

7 Based on an interview with a defense industry executive conducted by the author in February 2026.

8 The U.S.–Iran conflict of 2026 offers examples of low-intensity USV employment and of USV employment in a permissive combat environment. For examples, see Aaron-Matthew Lariosa, "Saronic USV Rescues Two U.S. Army Pilots Downed by Iran," *Naval News*, June 9, 2026, https://www.navalnews.com/naval-news/2026/06/saronic-usv-rescues-two-u-s-army-pilots-downed-by-iran/; and Shelby Holliday and Alistair MacDonald, "America's Latest Weapon Against Iran: Sea Drones," *Wall Street Journal*, July 13, 2026, https://www.wsj.com/world/middle-east/americas-latest-weapon-against-iran-sea-drones-3d5150e7?eafs_enabled=false.

Because a great deal of the thinking associated with USV employment is theoretical, it will be crucial to inform USV doctrine with actual operations that begin to approach the imagined scale of future employment. The U.S. Navy's recent announcement that a medium-size USV will deploy with the *Theodore Roosevelt* carrier strike group (CSG) later in 2026 is a start, but this remains an experimental effort and is not the kind of significant USV operation that will be required to validate the assumptions associated with employing large numbers of these vessels at once, such as those related to networking or maintenance.[9]

Test the DMO concept extensively by the end of the 2030s to help decision makers determine whether adjunct magazine USVs will play a significant role in future fleet operations. The U.S. Navy cannot afford to wait until the 2040s to determine whether the most advanced versions of DMO, involving networking and coordinated missile fires, are feasible. The successful conceptual implementation of networked, ship-like magazine USVs depends on the success of DMO as a concept. Testing this concept using manned platforms—assuming the U.S. Navy is not forced to try it in combat before then—will be crucial to understanding whether it is all it is made out to be. The DMO concept remains untested today and could suffer from overly optimistic expectations about how easy it will be to target enemy units or faulty assumptions about how difficult it will be to coordinate fires between multiple units at once. If the DMO concept does not stand up to real-world testing on the scale envisioned, then ship-like magazine USVs could still be viable platforms, but they will not have as much upside for the Navy as they might appear to have today.

Long Term: The 2040s and Beyond

In the long term, the U.S. Navy could once again face a credible combat threat on the high seas as the PLA Navy (PLAN) begins operating away from the littorals of the Chinese mainland. According to the U.S. Department of Defense (DoD), the PLAN aims to have nine operational carriers by 2035.[10] It would not be unthinkable for China to begin deploying its CSGs across the world in the 2040s and thus threaten U.S. naval supremacy over sea lanes on the high seas. The PLAN is already beginning to conduct dual carrier operations outside the First Island Chain, which could indicate it is resolved to pursue these kinds of far seas operations.[11] Navy planners can begin the work now of building USVs into naval fleet architecture with this challenge in mind.

9 Diana Stancy, "Navy to Experiment with Tailored Force Pairing with *Theodore Roosevelt* Deployment: SWO Boss," *Breaking Defense*, February 12, 2026, https://breakingdefense.com/2026/02/navy-to-experiment-with-tailored-force-pairing-with-theodore-roosevelt-deployment-swo-boss/.

10 DoD, *Annual Report to Congress on the Military and Security Developments Involving the People's Republic of China 2025* (Washington, DC: DoD, 2025), p. 16.

11 Yu-cheng Chen and K. Tristan Tang, "PLA Navy Shifts Training Focus from Near-Shore to Blue-Water Operations," Jamestown Foundation, July 25, 2025, https://jamestown.org/program/pla-navy-shifts-training-focus-from-near-shore-to-blue-water-operations/.

Develop clear metrics of success for implementing the most ambitious USV plans by the 2040s. With the near certainty that the PLAN will gain greater combat capacity over the next two decades and the likelihood that it will have more potential to threaten the U.S. Navy's global sea control capability, U.S. naval power will need to significantly improve to keep pace. The situation is similar to the Soviet Union's naval buildup of the 1960s and 1970s under Admiral Sergei Gorshkov, which prompted the U.S. Navy to begin designing a significantly larger fleet.[12]

The U.S. Navy should make it a goal to have magazine USVs acting as integrated nodes within the Navy's battle network by the time the PLAN is ready to expand its operations globally. It should set clear metrics for the fleet combat power it hopes to achieve and a deadline to achieve them by. Long-term plans that seek to keep pace with the PLAN must significantly increase the U.S. fleet's missile capacity. For example, by 2049, the centennial of the Chinese Communist Party's takeover of mainland China, the U.S. Navy could publicly plan to have over 500 ships capable of networking together, each armed with a meaningful number of long-range anti-ship missiles. Some existing plans call for a fleet of a similar size but are less ambitious in terms of offensive power, because much of the USV component of the force would remain in supporting roles rather serving as missile platforms that could threaten an enemy's fleet.[13] The Navy must seek out navalist allies in Congress and the executive branch who share the conviction that such a fleet will be required; otherwise, there will not be enough support to marshal the funding and bureaucratic resources to build such a fleet over the next several decades.

Improve USV survivability and endurance, especially for munitions-like USVs. One concern about OWA USVs is whether they will be survivable enough and have enough endurance to be effective in a Western Pacific conflict. In the long term, transitioning these vessels from simple speedboat designs to something stealthier and more combat effective—with lower freeboard, higher speed, and longer range—will help ensure they can remain credible threats that are hard to destroy or counter. Pursuing engineering improvements in endurance, perhaps by powering these USVs with networks of charging stations or with renewable onboard charging capability, could help them stay in their patrol areas longer. Both improvements in survivability and endurance would make these USVs more lethal and less susceptible to adversary countermeasures. The challenge will be to make these improvements while maintaining low costs of production.

12 John B. Hattendorf and Naval War College, eds., *US Naval Strategy in the 1970s: Selected Documents* (Newport, RI: Naval War College, 2007), p. 131.

13 See, for example, George Galdorisi, "A Concept of Operations for Achieving a Navy Fleet of 500 Ships," Center for International Maritime Security, February 20, 2026, https://cimsec.org/a-concept-of-operations-for-achieving-a-navy-fleet-of-500-ships/.

CHAPTER 1

Introduction

The U.S. Navy is poised to make generational changes to its force structure by incorporating unmanned surface vessels (USVs) into the fleet. Facing an unprecedented strategic competition in the maritime domain against the People's Republic of China (PRC), steady demand from U.S. combatant commanders across the globe for naval assets, and a plethora of shipbuilding challenges, U.S. strategists and officials see unmanned systems as potential force multipliers that can mitigate these challenges.[14] The Navy's 2025 shipbuilding plan was the first congressionally mandated 30-year shipbuilding plan to include specific targets for unmanned vessels.[15] Its 2026 shipbuilding plan doubled down on adding medium USVs (MUSVs) to the battle force, proposing a total procurement of 393 vessels from Fiscal Year (FY) 2026 through FY 2056.[16]

Despite this movement toward adopting unmanned systems in general and USVs in particular, how the U.S. Navy will use them remains unclear. It has not yet released any official, unclassified concept of operations (CONOPS) for USVs, let alone outlined details about the acquisition strategies it intends to use for procuring them. It faces many challenges associated with resolving USV doctrine, organization, training, materiel, leadership, personnel, facilities, and policy (DOTMLPF-P).[17]

14 Ray Mabus, "Future Platforms: Unmanned Naval Operations," *War on the Rocks*, January 21, 2014, https://warontherocks.com/2014/01/future-platforms-unmanned-naval-operations/; and Bryan Clark, "Build a Fleet That Contests Every Inch," U.S. Naval Institute, July 1, 2022, https://www.usni.org/magazines/proceedings/2022/july/build-fleet-contests-every-inch.

15 Eric Labs, *An Analysis of the Navy's 2025 Shipbuilding Plan*, No. 60732 (Washington, DC: Congressional Budget Office, January 2025), p. 1.

16 Hung Cao, "U.S. Navy Shipbuilding Plan," U.S. Navy, May 2026, p. 56, https://media.defense.gov/2026/May/11/2003928909/-1/-1/1/NAVY%20SHIPBUILDING%20PLAN%20MAY%202026.PDF.

17 Ronald O'Rourke, *Navy Large Unmanned Surface and Undersea Vehicles: Background and Issues for Congress*, No. R45757 (Washington, DC: Congressional Research Service, 2024).

There is no shortage of USV-related activity within the U.S. Navy, with multiple prototype vessels operating in various exercises, organizational changes to stand up USV squadrons and task forces (TFs), and multiple contracts for USV manufacturing awarded to defense companies. This has all occurred against the backdrop of the Russo-Ukrainian war, the Red Sea conflict, and the U.S.–Iran conflict, where combatants—including the United States—have demonstrated some USV use cases as they employ these vessels in combat.[18] Without a clear CONOPS, however, the Navy risks investing in USVs that are not suitable to its mission requirements or, worse, that are counterproductive to achieving its strategic goals.

Much of the discussion about USV CONOPS, employment, and force structure is confused because there is ambiguity about what USVs are. There is no suitable classification scheme for describing them. By contrast, unmanned aerial systems (UASs) have a comprehensive system of groupings that depend on gross takeoff weight, normal operating altitude, and speed. This system of UAS groupings is shared between DoD and the Federal Aviation Administration (FAA).[19] There is no similar formal system of categorization for USVs; in fact, the U.S. Navy has shifted the way it informally categorizes them over time, making it even more confusing to understand the roles it intends to give these vessels within its future force structure.

18 Thane Clare, *A Navy of Necessity: Ukraine's Unmanned Surface Vessels at War* (Washington, DC: Center for Strategic and Budgetary Assessments, 2025), p. 42; and "Houthi USVs: A Rising Threat to Global Trade," Solace Global, accessed March 17, 2026, https://www.solaceglobal.com/report/houthi-usvs/.

19 Daniel M. Gettinger, *Categories of Uncrewed Aircraft Systems*, Defense Primer No. IF12797 (Washington, DC: Congressional Research Service, 2024), p. 3, https://www.congress.gov/crs_external_products/IF/PDF/IF12797/IF12797.2.pdf.

FIGURE 1: THE FAA'S UAS GROUPS: NO CORRELATING USV CATEGORIES

UAS Category	Maximum Gross Takeoff Weight (lbs)	Normal Operating Altitude (ft)	Speed (kts)	Examples
Group 1	0-20	<1,200 above ground level (AGL)	100	Wasp III, TACMAV, RQ-14A/B, Buster, Nighthawk, RQ-11B, FPASS, RQ-16A, Pointer, Aqua/Terra Puma
Group 2	21-55	<3,500 AGL	<250	ScanEagle, Silver Fox, Aerosonde
Group 3	<1,320	<18,000 mean sea level (MSL)	<250	RQ-7B Shadow, RQ-15 Neptune, XPV-1 Tern, XPV-2 Mako
Group 4	>1,320		Any Airspeed	MQ-5B Hunter, MQ-8B Fire Scout, MQ-1C Gray Eagle, MQ-1A/B/C Predator
Group 5	>1,320	>18,000 MSL	Any Airspeed	MQ-9 Reaper, RQ-4 Global Hawk, RQ-4N Triton

USV Category	Hull Size (feet)	Displacement (tons)	Examples
Large USV	200-300	1,000-2,000	Overlord Nomad, Ranger, & Mariner
Medium USV	<200	<500	Sea Hunter, Sea Hawk
Small USV	<MUSV	<MUSV	Global Autonomous Reconnaissance Craft, Saildrone Voyager

Source: Created by CSBA; UAS chart compliments of the FAA

A wide range of vessels falls under the USV designation, varying in hull form, size, and function—anything from corvette-sized surface vessels that are meant to complement and sail alongside manned surface combatants to one-way kamikaze attack drones. To date, most analysts have categorized USVs in terms of their size (small, medium, and, until recently,

large).[20] Analysts have also described various tasks that USVs could perform, such as enabling logistics and transportation, sensing, and conducting strike.[21] These size-based categories can overlap task-based categories and vice versa, making it difficult for the U.S. Navy to present the public with a clear view of what it means when it talks about USVs. A formal system for categorizing USVs is required to help practitioners determine what these vessels can do for the fleet, which kinds of USVs the Navy should prioritize developing, and how it should plan to use them.

Definitions and Scope

For this report, the term USV refers to any vessel that is capable of operation without a crew with varying degrees of autonomy, that displaces water at rest, and that operates with near-continuous contact with the surface of the water.[22] USVs are distinct from unmanned underwater vessels (UUVs) and unmanned aerial vessels (UAVs). This monograph only focuses on USVs in detail, but it occasionally draws comparisons to other types of unmanned systems.

The USV acronym has been used for both unmanned surface vessels and unmanned surface vehicles. The U.S. Navy's current unmanned campaign plan treats the terms as equivalent and uses the unmanned surface vessel nomenclature, while Congressional Research Service reports use unmanned surface vehicle to refer to the same systems.[23] This report simply uses USV to describe these systems.

The terminology for describing USV sizes shifted very recently. Until 2026, the Congressional Research Service classified USVs based on the size of their hull and their displacement, defining large USVs (LUSVs) as vessels 200 to 300 feet in length that displace 1,000 to 2,000 tons at full load (making them the size of a corvette) and MUSVs as USVs less than 200 feet in length that displace less than 500 tons (making them the size of a patrol craft).[24] However, the U.S. Navy merged its LUSVs and MUSVs into a single program, the modular attack surface craft (MASC), and then canceled MASC to establish a MUSV

20 O'Rourke distinguishes medium USVs (MUSVs) and large USVs (LUSVs) based on vessel length and displacement and also uses the USV designation to describe small craft that could be deployed from manned surface vessels. O'Rourke, *Navy Large Unmanned Surface and Undersea Vehicles*.

21 Scott Savitz et al., *U.S. Navy Employment Options for Unmanned Surface Vehicles (USVs)* (Santa Monica, CA: RAND Corporation, 2013).

22 "The Navy Unmanned Surface Vehicle (USV) Master Plan," U.S. Department of the Navy, July 23, 2007, p. 6, https://dn790003.ca.archive.org/0/items/DTIC_ADA504867/DTIC_ADA504867.pdf.

23 O'Rourke, *Navy Large Unmanned Surface and Undersea Vehicles*; and Thomas Harker et al., "Department of the Navy Unmanned Campaign Framework," Department of the Navy, March 16, 2021.

24 O'Rourke, *Navy Large Unmanned Surface and Undersea Vehicles*, pp. 10–11.

"marketplace."[25] There is no specific designation for small USVs within Congressional Research Service reports. Within this report, if LUSVs or MUSVs are discussed specifically, it will be in reference to the Congressional Research Service size ranges and the corresponding acronym will be used; otherwise, the general USV acronym will be used to describe vessels of any size.

Research Questions, Methodology, and Report Outline

This report seeks to help the U.S. Navy articulate its strategy for employing USVs in the fleet by developing a new framework for categorizing them, assessing USVs based on the types within this new framework, and providing recommendations. This study offers a framework for categorizing USVs based on where they lie across two spectra: the longevity spectrum (i.e., expendable vs. enduring) and the functionality spectrum, which ranges from support to offensive operations (i.e., USVs that are solely for augmenting manned platform capabilities vs. USVs that are for offensive strike). The 2 x 2 matrix that results from this framework groups USV concepts into four categories: a fleet with a large proportion of distributed warship-like USVs that act as adjunct missile magazines (enduring and offense-oriented); flotillas of small, OWA USVs (expendable and offense-oriented); USVs as auxiliaries or support ships (enduring and support-oriented); and small, single-use USVs solely to support sensing (expendable and support-oriented).

This new categorization can help strategists think about USVs in terms of the concepts they could be part of rather than their size or the discrete tasks they might be designed to do. These other categorizations can be valuable for various reasons, but they do not describe broader CONOPS let alone identify the USV concepts that offer the greatest potential upside to the fleet or that could be implemented soonest or most effectively. Categorizing USVs in terms of longevity and functionality can shed light on the kinds of USVs the U.S. Navy should focus on deploying, as well as on how they should be organized.

Outline

Chapter 2 provides a brief history of modern USV development, starting with the United States and its allies. This discussion then provides a synopsis of USV development efforts in Ukraine and in Taiwan, two nations that face America's two largest competitor navies. Finally, it summarizes the USV development efforts of China and Russia.

Chapter 3 presents a theory of the case for developing and employing USVs. It discusses some of the primary arguments that strategists and others have provided for why navies would benefit from adopting USV technology. Additionally, it lists some of the challenges and

25 Diana Stancy, "Navy Nixes MASC Program, Unveils New MUSV 'Marketplace' amid Golden Fleet Push," *Breaking Defense*, March 26, 2026, https://breakingdefense.com/2026/03/navy-nixes-masc-program-unveils-new-musv-marketplace-amid-golden-fleet-push/.

barriers to fielding USVs that have already arisen. Finally, it describes some of the strategic concepts the U.S. Navy has discussed that could include unmanned platforms like USVs.

Chapter 4 sets up the framework for categorizing USVs in terms of longevity and functionality. It also provides more detail on the kinds of vessels that would fall into each category. It offers historical examples of naval innovation that fell into these categories to illustrate how analogous capabilities have provided options to naval planners in the past.

Chapter 5 assesses each of the USV categories identified in chapter 4. It identifies the naval mission areas each category of USV could most optimally contribute to and provides rationale for these selections. It then uses these mission areas to suggest optimal USV categories for specific adversaries, scenarios, and threats.

Chapter 6 provides a summary of findings and recommendations.

By investing in USVs for the fleet, the U.S. Navy has an enormous opportunity to increase its lethality across a variety of scenarios. Yet there are also risks. The American public and the U.S. Congress are understandably wary of major force structure changes after nearly all the U.S. Navy's recent high-profile shipbuilding programs have been delayed, gone over budget, or both.[26] Another program failure would erode trust further and jeopardize the real progress the U.S. Navy has already made in USV development. It is imperative, therefore, that the U.S. Navy articulate a cogent strategy for how it plans to employ USVs, starting with clear requirements for the different kinds of USVs it plans to develop and build.

26 *Navy Shipbuilding: Enduring Challenges Call for Systemic Change: Hearing on GAO-25-108225* (2025), Government Accountability Office, https://www.gao.gov/products/gao-25-108225.

CHAPTER 2

A Survey of Unmanned Surface Vessel Development and Adoption

Current USV development efforts and the force structure decisions they drive are taking place against the backdrop of strategic competition between the United States and China. Conflicts in other regions are also shaping the pace of USV development. China's anti-access area denial (A2/AD) network in the Western Pacific and the rapid qualitative and quantitative growth of the PLAN are placing pressure on the U.S. Navy to innovate or risk being shut out of the region during a potential conflict, such as a Chinese invasion of Taiwan. The Navy sees USVs as a potential solution for some of these challenges. Meanwhile, small states like Ukraine have demonstrated the utility of USVs against the navies of much more powerful rivals.[27] Other U.S. allies, partners, and adversaries see potential utility from USVs for other reasons.

This chapter summarizes the U.S. Navy's USV development efforts, and that of other navies around the world since the beginning of the 21st century, and then provides an overview of USV technology.

Brief History of U.S. and Allied USV Programs

Some of the first unmanned naval platforms that operated at the surface of the ocean were naval mines, which navies began using in large numbers during the mid to late 19th century, including in the American Civil War and the Russo-Japanese War.[28] The development of

27 Clare, *Navy of Necessity*.

28 Nicholas A. M. Rodger, *The Price of Victory: A Naval History of Britain 1815–1945* (New York, NY: W.W. Norton and Company, 2024), p. 180.

more mobile systems did not begin in earnest until the late 1990s and early 2000s, with some notable exceptions, such as Germany's attempt to field remote control explosive surface ships during World War II and the U.S. Navy's use of remote-controlled USVs for measuring radioactivity after nuclear tests and mine clearance in the Vietnam War.[29] USV development in the U.S. Navy began expanding rapidly at the turn of the 21st century, especially after the September 11, 2001, attacks.

The U.S. Navy's USV Development Efforts

The U.S. Navy's first USV development efforts in the new century focused on applications for the global war on terror (GWOT). In 2003, the Office of Naval Research (ONR) deployed two Spartan Scout prototype USVs. With small, speedboat-like hull forms, the Navy envisioned that they would serve as mine countermeasure (MCM) and anti-submarine warfare (ASW) craft that could deploy either from shore or another ship and operate semiautonomously.[30] The Navy also planned to procure the Remote Minehunting System, which was meant to deploy on guided missile destroyers (DDGs) and littoral combat ships (LCSs) to perform MCM tasks.[31]

With these initial developments under its belt, the U.S. Navy in 2007 published a USV master plan. Chartered under the Program Executive Office for Littoral and Mine Warfare (PEO LMW), this document sought to define USV capabilities from near to long term, establish USV classes that were aligned with capabilities, and assess the readiness of the technology to inform future investments.[32] It identified seven mission areas where USVs could be applicable: MCM, ASW, maritime security, surface warfare, special operations forces support, electronic warfare, and maritime interdiction operations support.[33] To accomplish these missions, it identified four classes of USVs, which were primarily delineated by hull form and size.[34] By nesting USV development under PEO LMW, the Navy was signaling that it saw USVs as littoral support vessels, mostly for performing the MCM mission. This was a logical application for unmanned systems at the time because of the threat that naval mines in the U.S. Central Command (CENTCOM) area of responsibility (AOR) had posed in the past.[35]

29 Savitz et al., *U.S. Navy Employment Options for USVs*, p. 1; "Unmanned Systems Integrated Roadmap FY2011–2036," Office of the Undersecretary of Defense for Acquisition, Technology, and Logistics, October 2011, p. 25.

30 Ronald O'Rourke, *Unmanned Vehicles for U.S. Naval Forces: Background and Issues for Congress*, CRS Reports No. RS21294 (Washington, DC: Congressional Research Service, 2007), p. 3.

31 O'Rourke, *Unmanned Vehicles for U.S. Naval Forces,* p. 3.

32 "Navy USV Master Plan," p. x.

33 "Navy USV Master Plan," p. xi.

34 "Navy USV Master Plan," p. xii.

35 R. W. Apple, "2 U.S. Ships Badly Damaged by Iraqi Mines in Persian Gulf," *New York Times*, February 19, 1991, https://www.nytimes.com/1991/02/19/world/war-gulf-overview-2-us-ships-badly-damaged-iraqi-mines-persian-gulf.html.

In 2011, the Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics released *The Unmanned Systems Integrated Roadmap FY 2011–2036*. This document identified challenges with unmanned system development across all domains, such as the need for greater autonomy, assured communications for command and control (C2), and improved training.[36] Although this document described possible use cases for USVs using scenario-based vignettes, most of its discussion remained broad and at a high level; it deferred to the U.S. Navy's earlier master plan for defining USV form and function.

In 2013, the Office of the Chief of Naval Operations (OPNAV) commissioned a report from the RAND Corporation on employment options for USVs. OPNAV asked RAND to explore the state of the commercial USV marketplace, the suitability of USVs for certain naval missions, and the technical, operational, and programmatic developments that would be needed to move closer to fielding USVs.[37] Among other findings, this study identified specific mission areas where USVs were either highly suitable, possibly suitable, or less suitable and compared their potential utility to certain missions with other types of unmanned systems.[38] This systematic review of USV suitability signaled a shift away from thinking of USVs solely from the perspective of the MCM mission set and toward more general applications.

The mid-2010s saw a marked increase in interest in robotics and autonomous systems (RAS) across the Department of Defense (DoD). In late 2014, Secretary of Defense Chuck Hagel debuted the so-called third offset strategy, a plan for countering the quantitative advantages of U.S. adversaries by focusing on U.S. qualitative advantages in existing and emerging technologies like RAS, miniaturization, big data, and advanced manufacturing.[39] Although the third offset strategy did not specifically name China as the principal adversary, this was a significant step to move RAS—and eventually USV—development efforts away from GWOT-focused littoral applications and toward competition against great power rivals.

This was also the decade when the U.S. Navy's USV prototyping expanded significantly. As early as 2010, the Defense Advanced Research Projects Agency (DARPA) was soliciting industry for proposals for an ASW-capable USV called the ASW Continuous Trail Unmanned Vessel (ACTUV); in 2012, it awarded a contract to design the first ACTUV prototype.[40] Envisioned as a platform that could perform ASW patrols in place of manned ships

36 "Unmanned Systems Integrated Roadmap FY2011–2036," pp. v–vi.

37 Savitz et al., *U.S. Navy Employment Options for USVs*, p. 3.

38 Savitz et al., *U.S. Navy Employment Options for USVs*, pp. 24–27.

39 Sydney Freedburg, "Hagel Lists Key Technologies for US Military; Launches 'Offset Strategy,'" *Breaking Defense*, November 16, 2014, https://breakingdefense.com/2014/11/hagel-launches-offset-strategy-lists-key-technologies/; and Robert Martinage, *Toward a New Offset Strategy* (Washington, DC: Center for Strategic and Budgetary Assessments, 2014), p. 2.

40 "DARPA Industry Day Conference Announcement," Defense Advanced Research Projects Agency, 2010, https://www.agriculturedefensecoalition.org/sites/default/files/pdfs/17U_2010_DARPA_ASW_ACTUV_Program_February_16_2010_Announcement_Submarines.pdf; and David Szondy, "DARPA Developing Unmanned Sub Hunters," New Atlas, August 22, 2012, https://newatlas.com/robot-sub-hunter/23759/.

and thus free up their time to perform other tasks, ACTUV was to incorporate "autonomy to enable independently deploying systems capable of missions spanning thousands of kilometers of range and months of endurance under a sparse remote supervisory control model."[41] In 2014, DARPA awarded Leidos Group the contract to build follow-on models of ACTUV, which would go on to be christened *Sea Hunter* in 2016.[42] DARPA transferred the first *Sea Hunter* prototype to ONR in 2018 as the medium-displacement USV. PMS 406, a division of Naval Sea Systems Command (NAVSEA) handling unmanned maritime systems, took custody of the vessels and conducted more complicated autonomy testing and development in subsequent years.[43]

FIGURE 2: *SEA HUNTER*, ORIGINALLY THE ACTUV



Source: Defense Visual Information Distribution Service

41 "ACTUV: Anti-Submarine Warfare (ASW) Continuous Trail Unmanned Vessel," DARPA, accessed January 9, 2026, https://www.darpa.mil/research/programs/anti-submarine-warfare.

42 David Szondy, "Construction Begins on DARPA's Autonomous Unmanned Anti-Submarine Vessel," New Atlas, July 17, 2014, https://newatlas.com/leidos-actuv-darpa/32896/; and Paul Benecki, "DARPA Christens (Mostly) Autonomous Vessel," The Maritime Executive, April 7, 2016, https://maritime-executive.com/features/darpa-christens-mostly-autonomous-vessel.

43 "ACTUV 'Sea Hunter' Prototype Transitions to Office of Naval Research for Further Development," DARPA, January 30, 2018, https://www.darpa.mil/news/2018/sea-hunter-prototype; and "Capable, Adaptive, Partners: Unmanned Surface Vessels in RIMPAC," Naval Sea Systems Command, accessed January 12, 2026, https://www.navsea.navy.mil/Media/News/Article-View/Article/3102282/capable-adaptive-partners-unmanned-surface-vessels-in-rimpac/.

FIGURE 3: LCS MCM USV



Source: Naval Sea Systems Command

While these efforts were ongoing, the U.S. Navy continued efforts to build USVs for MCM applications. Through NAVSEA, the Navy awarded an engineering and manufacturing development contract in 2014 for the Unmanned Influence Sweep System (UISS). This system was to be part of the LCS's MCM mission package, a USV towing a minesweeping payload. Formal testing and development for the program successfully concluded in 2019.[44] UISS would go on to achieve initial operational capability (IOC) in 2022, a key acquisition milestone that indicates the capability will be fielded in significant numbers.[45] By mid-2025, the Navy had received nine MCM vessels and had 18 more under contract.[46]

44 "US Navy's Unmanned Influence Sweep System Achieves Milestone C," Naval Sea Systems Command, February 26, 2020, https://www.navsea.navy.mil/Media/News/Article-View/Article/2094860/us-navys-unmanned-influence-sweep-system-achieves-milestone-c/.

45 "Modernized Selected Acquisition Reports (MSAR): Littoral Combat Ship Mission Modules (LCS MM)," DoD, October 8, 2024, p. 7, https://www.esd.whs.mil/Portals/54/Documents/FOID/Reading%20Room/Selected_Acquisition_Reports/FY_2023_SARS/LCS%20MM%20MSAR%20Dec%202023.pdf; and "Initial Operating Capability Declared for Unmanned Influence Sweep System (UISS)," Naval Sea Systems Command, July 28, 2022, https://www.navsea.navy.mil/Media/News/Article-View/Article/3109399/initial-operating-capability-declared-for-unmanned-influence-sweep-system-uiss/.

46 "Mine Countermeasures Unmanned Surface Vehicle (MCM USV)," U.S. Navy, July 2, 2025, https://www.navy.mil/OLD-PAGES/Fact-Files-OLD/Display-FactFiles-OLD/Article/2167996/mine-countermeasures-unmanned-surface-vehicle-mcm-usv/.

In parallel, another large USV program began in 2018 under the DoD Strategic Capabilities Office. Known as the Ghost Fleet Overlord program, its idea was to convert large, commercially available vessel designs into autonomous vessels for the U.S. Navy.[47] Two vessels called *Ranger* and *Nomad* were built, the former completing a Pacific Ocean transit autonomously in 2020 and the latter completing its own transit in 2021.[48]

An inflection point in the U.S. Navy's USV development occurred in 2019, when it began formalizing many of its mature USV programs as it continued developing and testing new ones. It established a SURFDEVRON to help develop operational concepts for both LUSVs and MUSVs. That was also the first fiscal year when the Navy requested funding from Congress for the MUSV program, doing so via the middle tier acquisition authority.[49] This was part of a larger USV funding push for what was then known as the future surface combatant force, a hybrid force of both manned and unmanned ships and sensors, including USVs of all sizes.[50] Going into the 2020s, the U.S. Navy began institutionalizing its USV architecture, maturing its USV acquisitions, and developing some USV concepts through its new SURFDEVRON ONE.

FIGURE 4: *RANGER* AND *MARINER* USVS FROM THE GHOST FLEET OVERLORD PROGRAM



Source: Defense Visual Information Distribution Service

47 "Ghost Fleet Overlord Unmanned Surface Vessels, USA," Naval Technology, accessed January 9, 2026, https://www.naval-technology.com/projects/ghost-fleet-overlord-unmanned-surface-vessels-usa/.

48 "Ghost Fleet Overlord Unmanned Surface Vessel Program Completes Second Autonomous Transit to the Pacific," U.S. Department of Defense, June 7, 2021, https://www.defense.gov/News/Releases/Release/Article/2647818/ghost-fleet-overlord-unmanned-surface-vessel-program-completes-second-autonomou/.

49 O'Rourke, *Navy Large Unmanned Surface and Undersea Vehicles*, pp. 3, 10.

50 O'Rourke, *Navy Large Unmanned Surface and Undersea Vehicles*, p. 5.

In 2021, the Department of the Navy released a new document, the "Unmanned Campaign Framework," which discussed the utility of unmanned systems in general terms, along with some intended uses for the Navy's surface unmanned portfolio. This was one of the first official unclassified documents to explicitly discuss USVs as offensive platforms instead of merely supporting platforms, stating that LUSVs would "add meaningful offensive weapons capability in Strike and Anti-Surface Warfare."[51]

That same year, TF 59 was established. Still based in the U.S. Navy Fifth Fleet AOR, which encompasses the Middle East and the western Indian Ocean regions, the Navy touts it as its "first Unmanned and Artificial Intelligence Task Force" and the first time that the Navy integrated unmanned surface units into a numbered fleet command.[52] TF 59 has conducted several exercises involving small USVs, which have included live-fire demonstrations from small USVs and combined operations between manned vessels and small dedicated sensing USVs.[53]

Leveraging the success of these demonstrations and the other activities of TF 59, the U.S. Navy began establishing unmanned surface TFs in other numbered fleets, including the Fourth (U.S. Southern Command AOR) and Sixth Fleets (U.S. European and African Command AOR). The Fourth Fleet intended that its unmanned TF incorporate the systems under its cognizance into normal fleet operations, a deviation from the dedicated testing and exercise operations of TF 59.[54] The slightly different vision for TF 66 is to manage a small fleet of USVs that remain permanently in the Sixth Fleet AOR but would be employed by operators either at the U.S. Sixth Fleet maritime operations center (MOC) or from a mothership in the theater.[55] As of the writing of this report, USV operations at these theater TFs have been limited to niche applications like harbor defense patrols with some combat testing. Integrated fleet operations involving large numbers of differently sized USVs remain some time off.

In the wake of standing up SURFDEVRON and the theater TFs, the U.S. Navy continued building out the administrative command structure for USV development and operations. The surface force established USV squadrons to manage the personnel and equipment associated with USV operations, first with USV Squadron 1 (USVRON 1) in 2022 for "testing, evaluating, and integrating medium USVs into fleet operations" and providing

51 Harker et al., "Department of the Navy Unmanned Campaign Framework," p. 15.

52 "Task Force 59 Launches New Unmanned Task Group 59.1," U.S. Navy, January 16, 2024, https://www.navy.mil/Press-Office/News-Stories/display-news/Article/3645647/task-force-59-launches-new-unmanned-task-group-591/.

53 Agnes Helou, "With Middle East 'Deterrence' in Mind, US 5th Fleet Conducts First Unmanned Live Fire Test," *Breaking Defense*, November 3, 2023, https://breakingdefense.com/2023/11/with-middle-east-deterrence-in-mind-us-5th-fleet-conducts-first-test-live-fire-from-unmanned-naval-systems/; and "Integrating USVs & AI into an Operational Maritime Environment," Saildrone, accessed January 9, 2026, https://www.saildrone.com/missions/task-force-59-unmanned-integration.

54 Justin Katz, "Unmanned Ships Deploying to SOUTHCOM, as Navy Seeks to Prove Technology 'Ready to Scale,'" *Breaking Defense*, April 4, 2023, https://breakingdefense.com/2023/04/unmanned-ships-deploying-to-southcom-as-navy-seeks-to-prove-technology-ready-to-scale/.

55 Based on conversations between the author and action officers at Task Force 66.

"recommendations to Navy leadership on the development of unmanned systems."[56] In 2024 and 2025, respectively, the Navy established two more unmanned surface squadrons: USVRON 3 and USVRON 7.[57] Unlike USVRON 1 and its focus on larger USVs, these squadrons procure and operate small, 16-foot USVs called the Global Autonomous Reconnaissance Craft (GARC).[58] Yet another key administrative development was the creation in 2024 of a robotics warfare specialist rating for enlisted sailors. More recently, the Navy established a specific unmanned track for surface warfare officers.[59] In early 2026, Navy officials announced a plan to create three new "early command" USV divisions and eventually have "operationalized USV squadrons" in every fleet.[60]

FIGURE 5: THE GARC SMALL USV



Source: Defense Visual Information Distribution Service

56 Ryan Williams, "Unmanned Surface Vessel Squadron One Holds Change of Command Ceremony," America's Navy, Naval Surface Force, U.S. Pacific Fleet, July 10, 2025, http://www.surfpac.navy.mil/Media/News/Article/4249385/unmanned-surface-vessel-squadron-one-holds-change-of-command-ceremony/.

57 Jon Harper, "Navy to Establish USVRON 7, Adding Another Robotic Ship Squadron to the Force," *DefenseScoop*, January 30, 2025, https://defensescoop.com/2025/01/30/navy-usv-unmanned-surface-vessel-squadron-usvron-7-san-diego/.

58 Jon Harper, "Navy Stands up New Robo-Ship Squadron as Pentagon Pursues Replicator Systems," *DefenseScoop*, May 20, 2024, https://defensescoop.com/2024/05/20/navy-unmanned-surface-vessel-squadron-three-usvron-established/.

59 Harper, "Navy Stands Up New Robo-Ship Squadron;" and Derek Trinque, "America's Future Fleet Symposium," Panel, Center for Maritime Strategy, December 4, 2025.

60 Michael Marrow, "No Longer 'Experimental': Navy to Deploy Drone Boats This Year, Official Says," *Breaking Defense*, January 16, 2026, https://breakingdefense.com/2026/01/no-longer-experimental-navy-to-deploy-drone-boats-this-year-official-says/.

As it began establishing these new commands, the U.S. Navy continued its efforts to integrate USVs with manned platforms in fleet demonstrations. The Rim of the Pacific Exercise (RIMPAC) 2022 featured four of the prototype LUSVs that had originated in the DARPA and Ghost Fleet Overlord programs: *Seahawk, Sea Hunter, Ranger,* and *Nomad*. The USVs were controlled by DDGs participating in the exercise. The demonstration included a test of distributed sensing capability, allowing the controlling DDG to receive targeting information from the USV. *Ranger* and *Nomad* operated during the exercise with an embarked crew.[61] The U.S. Navy considered the RIMPAC exercise a success and continued to test and integrate the Ghost Fleet Overlord LUSV prototypes. In early 2024, the same four vessels that participated in RIMPAC 2022 took part in the Navy's Integrated Battle Problem 23.2 to further develop USV operational concepts.[62] This testing was impressive from a technical perspective: The four USVs traveled over a combined 46 thousand nautical miles and navigated "primarily by autonomous systems."[63] This success set the stage for further investment and development.

The LUSV program was the target of significant congressional oversight in the early 2020s. In 2021, Undersecretary of the Navy Gregory Slavonic noted that the LUSV program had been "marked" (i.e., assigned lower funding levels) by congressional staff over concerns about the U.S. Navy's ability to deliver the platforms on time and on budget, considering its trouble with other shipbuilding programs like the LCS. According to U.S. Navy officials, this oversight action slowed LUSV development.[64] In 2024, the chairman and ranking member of the Senate Armed Services Committee expressed concern over the LUSV programs because they believed ships of this size would compete for resources with manned frigates under construction and that the Navy could better spend the funding on MUSVs.[65]

Still, the Navy pushed on with the LUSV prototypes it already owned. By 2024, it assessed that the Ghost Fleet Overlord vessels had reached the significant technical milestone of successful engine testing over 720 straight hours, implying the capability to operate

61 Mallory Shelbourne, "RIMPAC 2022: Navy Teaming Warships with Unmanned Surface Vessels," *USNI News*, July 14, 2022, https://news.usni.org/2022/07/14/rimpac-2022-navy-teaming-warships-with-unmanned-surface-vessels.

62 "Integrated Battle Problem 23.2 Concludes as Unmanned Surface Vessels Return to Homeport," U.S. Navy, January 16, 2024, https://www.navy.mil/Press-Office/News-Stories/display-news/Article/3645411/integrated-battle-problem-232-concludes-as-unmanned-surface-vessels-return-to-h/; and "Overlord Unmanned Surface Vessels (OUSV)," U.S. Navy, August 28, 2025, https://www.navy.mil/OLD-PAGES/Fact-Files-OLD/Display-FactFiles-OLD/Article/4288694/overlord-unmanned-surface-vessels-ousv/.

63 U. S. Navy, "Integrated Battle Problem 23.2 Concludes."

64 Michael Fabey, "Surface Navy 2021: Congressional Oversight Slows Naval Unmanned Programme Development, US Navy Officials Contend," Janes, January 14, 2021, https://www.janes.com/osint-insights/defence-news/surface-navy-2021-congressional-oversight-slows-naval-unmanned-programme-development-us-navy-officials-contend.

65 Justin Katz, "2 Key Senators Urge Navy to Change Course on Large USV Program," *Breaking Defense*, December 2, 2024, https://breakingdefense.com/2024/12/exclusive-top-2-senators-urge-navy-to-change-course-on-large-usv-program/.

autonomously for at least one month nonstop.[66] In spite of this success, there was still confusion in Congress, the public, and the Navy itself about what the Navy planned to do with the ships. Later that same year, the Department of the Navy Science and Technology Board released a report titled "The Path Forward on Unmanned Systems," which suggested there were still open questions about the CONOPS for the Navy's USVs. In addition to providing recommendations and identifying key areas where unmanned systems would be most suitable for contributing to naval operations, the report highlighted what it considered to be an unrealistically long timeline for unmanned system development: "Several suppliers we spoke with were confused and even despondent that the Navy would develop a 15-year plan around a technology that Ukraine has demonstrated is presently imperative and evolving in real time."[67]

In 2025, there were some shifts in the U.S. Navy's USV procurement plans. In the middle of the year, the Navy announced it would merge its MUSV and LUSV programs into one program, moving away from optionally manned vessels like those of the Ghost Fleet Overlord project.[68] At around the same time, the House Armed Services Committee indicated it would authorize more funding for unmanned vessel production as part of the defense budget reconciliation process inaugurated by the new Donald Trump administration.[69] Deviating from the DARPA and Ghost Fleet Overlord prototype models, the Navy solicited industry for a new modular, multimission USV design. BlackSea Technologies (formerly the Maritime Applied Physics Corporation) responded with a concept called the MASC.[70] Although meant to be a successor to the older MUSV and LUSV programs, BlackSea's design for MASC would have shared subsystem components and its

66 "U.S. Navy Achieves Significant Engine Testing Milestones for Large Unmanned Surface Vessel," Naval Sea Systems Command, March 22, 2024, https://www.navsea.navy.mil/Media/News/Article-View/Article/3716370/us-navy-achieves-significant-engine-testing-milestones-for-large-unmanned-surfa/.

67 "The Path Forward on Unmanned Systems," U.S. Department of the Navy Science and Technology Board, December 3, 2024, p. 1, https://www.secnav.navy.mil/donsandtboard/Shared%20Documents/DON%20S&T%20Board%20-%202024%20-%20Path%20Forward%20on%20Unmanned%20Systems%20-%20Final%20for%20public%20release%20(1).pdf.

68 Justin Katz, "Navy Will Consolidate Medium, Large USV Programs: GAO," *Breaking Defense*, June 12, 2025, https://breakingdefense.com/2025/06/navy-will-consolidate-medium-large-usv-programs-gao/; and Sam LaGrone, "Navy Moving Away from 'Optionally Manned' Vessels as Service Mulls Unmanned Future," *USNI News*, August 15, 2025, https://news.usni.org/2025/08/15/navy-moving-away-from-optionally-manned-vessels-as-service-mulls-unmanned-future.

69 Carter Johnston, "House Armed Services Committee Earmarks $3.1 Billion for Unmanned Vessel Production in Historic Reconciliation Bill," *Naval News*, May 13, 2025, https://www.navalnews.com/naval-news/2025/05/house-armed-services-committee-earmarks-3-1-billion-for-unmanned-vessel-production-in-historic-reconciliation-bill/.

70 "U.S. Navy Seeks Industry Feedback for Modular Attack Surface Craft Program," Naval Sea Systems Command, July 31, 2025, https://www.navsea.navy.mil/Media/News/Article-View/Article/4261138/us-navy-seeks-industry-feedback-for-modular-attack-surface-craft-program/; and "BlackSea Technologies Unveils MASC USV Family to Support U.S. Navy Fleet Modernization," *Naval News*, September 21, 2025, https://www.navalnews.com/naval-news/2025/09/blacksea-technologies-unveils-masc-usv-family-to-support-u-s-navy-fleet-modernization/.

hull form design with smaller USVs already in mass production for the Navy such as the GARC, the 16-foot speedboat-like USV mentioned previously.[71]

Initial discussions about the 2026 National Defense Authorization Act included a provision that would have effectively prohibited the Navy from designing MASC with optional manning, indicating Congress's strong desire for a naval vessel built without a requirement for manned operation.[72] In March 2026, however, the Navy canceled MASC; instead, Secretary of the Navy John Phelan announced that the service would pursue a marketplace for MUSVs that were already commercially available.[73] The Navy's 2026 shipbuilding plan will procure 47 MUSVs within the FYDP beginning in FY 2027.[74] Going forward, it appears that the U.S. Navy is committed to introducing MUSVs to every carrier strike group (CSG) and in every numbered fleet, starting with the *Theodore Roosevelt* CSG in 2026.[75] In an April 2026 exercise, as a prerequisite to this kind of operation, the Navy demonstrated the ability to refuel a MUSV at sea, though conducting the replenishment required personnel to board the vessel.[76]

The U.S. Navy is posturing itself for success as it continues its USV development and acquisition efforts. USV acquisitions are managed by the new office of the Program Acquisition Executive for Robotics and Autonomous Systems (PAE RAS).[77] Whereas previous acquisition constructs separated acquisition of autonomous platforms and their payloads, PAE RAS consolidates acquisition efforts under one empowered office, which many in the Navy consider to be an important step to enabling USV operations in the fleet.[78] Commander, Naval Surface Forces is the type commander handling the manning, training, and equipping of the USV squadrons—the concrete tasks that must be completed to operationalize USVs. OPNAV's Director of Surface Warfare, OPNAV N96, remains the resource sponsor for all USVs except MCM-related USVs, which are sponsored by OPNAV's

71 "BlackSea Technologies Unveils MASC USV Family."

72 Joseph Trevithick, "Crew Optional Designs Could Be Barred by Law from Navy's Drone Ship Program," *The War Zone*, December 10, 2025, https://www.twz.com/sea/crew-optional-designs-could-be-barred-by-law-from-navys-drone-ship-program.

73 Stancy, "Navy Nixes MASC Program."

74 Cao, "U.S. Navy Shipbuilding Plan," p. 56.

75 Abbey Shepherd, "Navy Plans for MUSV in Carrier Strike Group, USV Squadrons in Every Fleet," *Inside Defense,* January 14, 2026, https://insidedefense.com/insider/navy-plans-musv-carrier-strike-group-usv-squadrons-every-fleet; and Stancy, "Navy to Experiment with Tailored Force Pairing."

76 Aaron-Matthew Lariosa, "Navy to Deploy Thousands of Unmanned Surface Vessels to the Indo-Pacific by 2030," *USNI News*, April 21, 2026, https://news.usni.org/2026/04/21/navy-to-deploy-thousands-of-unmanned-surface-vessels-to-the-indo-pacific-by-2030.

77 Sam LaGrone, "New Navy Unmanned Acquisition Office Could Oversee up to 66 Programs, Consolidate 6 PEOs," *USNI News*, November 18, 2025, https://news.usni.org/2025/11/18/new-navy-unmanned-aqusition-office-could-oversee-up-to-66-programs-consolidate-6-peos.

78 Based on conversations between the author and U.S. Navy stakeholders working on USV development for the fleet.

Director of Expeditionary Warfare (N95). The U.S. Navy's success at enabling meaningful contributions from USVs will depend on these organizations working closely together.

Beyond its planned MUSV investments, the U.S. Navy's efforts developing small USVs in the early 2020s were significant because of the backing for very small, attritable unmanned systems within the greater U.S. defense complex. In 2023, the Defense Innovation Unit within DoD began the Replicator 1 Initiative, which focused on delivering "all-domain attritable autonomous systems (A2AS) to warfighters at a scale of multiple thousands."[79] While it is uncertain whether GARC was funded by the Replicator initiative, it resembles the kind of system that the initiative sought to deliver and remains the primary craft the Navy is using in its USVRONs and theater TFs.[80] In December 2025, the Navy contracted with the defense firm Saronic Technologies to mass produce its own line of small, speedboat-like USVs with the requirement that they could travel at a speed of 35 knots over 1,000 nautical miles and with the goal of going from prototype to production in 12 months.[81] Additionally, in April 2026 the Navy announced that it planned to test fire a Joint Air-to-Ground missile from a small USV manufactured by Saildrone during the 2026 iteration of the RIMPAC exercise.[82] These efforts show that small USVs are another development path the U.S. Navy has prioritized.

79 "The Replicator Initiative," Defense Innovation Unit, accessed January 13, 2026, https://www.diu.mil/replicator.

80 Jon Harper, "Navy Ramping up Production of Autonomous GARC Vessels," *DefenseScoop*, January 17, 2025, https://defensescoop.com/2025/01/17/navy-garc-global-autonomous-reconnaissance-craft-ramp-up-production/.

81 Kapil Kajal, "1,000-Mile-Range Drone Boats to Boost US Navy's Strike Power," Interesting Engineering, accessed December 11, 2025, https://interestingengineering.com/military/us-navy-to-get-robot-attack-boats.

82 Stew Magnuson, "Navy to Test Armed Robotic Boat at RIMPAC 2026," *National Defense*, April 16, 2026, https://www.nationaldefensemagazine.org/articles/2026/4/16/navy-to-test-armed-robotic-boat-at-2026-rimpac.

FIGURE 6: THE U.S. MARINE CORPS' EXPERIMENTAL ALPV



Source: U.S. Marine Forces Pacific

Another important small USV effort has been the U.S. Marine Corps' Autonomous Low-Profile Vessel (ALPV), a semisubmersible USV intended for enabling logistics in remote archipelagic waters. Inspired by so-called narco-boats, these vessels have an extremely low profile and can be operated remotely from thousands of miles away.[83] Still in testing, the Navy and Marine Corps want the ALPV to be a low-cost, attritable vessel with ship-to-shore, ship-to-ship, and shore-to-shore logistics transport capability.[84] This is significant because it is one of the first small USVs designed solely for logistics and resupply.

In summary, over the past two decades the U.S. Navy has been developing its USV programs at breakneck speed. As the dust begins to settle, three main areas of USV development have taken form, with varying levels of maturity. First, the MCM module for the LCS has achieved IOC and is beginning to deliver capability to the Navy. Second, the LUSV/MUSV experimental programs showed a great deal of promise in terms of technical development, but the Navy opted not to begin mass producing the ACTUV or Ghost Fleet Overlord designs and

83 John Grady, "Marines Testing Low-Profile Vessels, Oil Industry Support Ships to Resupply Distant Outposts," *USNI News*, September 4, 2024, https://news.usni.org/2024/09/04/marines-testing-low-profile-vessels-oil-industry-support-ships-to-resupply-distant-outposts.

84 "Small Unmanned Surface Vehicles (sUSV) Family of Systems (FoS)," U.S. Navy, August 28, 2025, https://www.navy.mil/OLD-PAGES/Fact-Files-OLD/Display-FactFiles-OLD/Article/4288613/small-unmanned-surface-vehicles-susv-family-of-systems-fos/.

instead was moving forward with the MASC concept before it settled on the MUSV marketplace concept. It remains to be seen whether the Navy can scale up MUSV production and develop CONOPS for these vessels. Finally, the Navy has devoted significant resources toward (and has built up the administrative structure to support) small USVs, particularly with the theater TFs and USVRONs.

Appendix A provides a summary of the DoD's USV-related budget information.

NATO's USV Development Efforts

America's NATO allies began formally pursuing collective USV development a few years after the U.S. Navy released its USV master plan. In 2012, NATO's Combined Joint Operations from the Sea Centre of Excellence published "Guidance for Developing Maritime Unmanned Systems (MUS) Capability." This document used the term MUS to describe UUVs and USVs and described future capability requirements, USV missions and tasks, key challenges, and next steps. Its vision was ambitious, stating that "the development and acquisition of MUS technology must be identified as a mainstream element in the future force generation process."[85]

NATO's approach to USV development focused on demonstrating the capabilities of prototypes during multinational exercises. It quickly recognized that interoperability could become an issue as defense industries across multiple member nations began developing unmanned systems that would need to function together effectively. One of the first exercises dedicated to unmanned system experimentation was the Anti-Submarine Warfare Operational Deployment of Concepts sea trials conducted by the NATO-affiliated Centre for Maritime Research and Experimentation off the coast of La Spezia, Italy, in 2017 to examine a "heterogeneous autonomous ASW network."[86] This is noteworthy because of the early emphasis the NATO alliance placed on using USVs and other unmanned systems for the ASW mission.

The exercises off Italy were followed in 2022 and 2023 by the Dynamic Messenger series of dedicated unmanned system integration exercises hosted by the Portuguese Navy's Maritime Operational Experimentation Centre. Focusing on maritime domain awareness primarily in the context of the MCM and ASW mission sets, they continued NATO's strategy of using operational experimentation to drive development. Dynamic Messenger 2023 featured observers from the Republic of Korea, Japan, and New Zealand, demonstrating

85 "Guidance for Developing Maritime Unmanned Systems (MUS) Capability," NATO Combined Joint Operations from the Sea Centre of Excellence, July 9, 2012, pp. vi–ix, https://info.publicintelligence.net/CJOSCOE-MUS.pdf.

86 Riccardo Costanzi et al., "Interoperability Among Unmanned Maritime Vehicles: Review and First In-Field Experimentation," *Frontiers in Robotics and AI* 7, July 2020, p. 91, https://doi.org/10.3389/frobt.2020.00091.both above and below the surface, have traditionally been carried out by manned surface ships and submarines equipped with advanced sensor systems. Unmanned Maritime Vehicles (UMVs

cross-theater interest in unmanned system interoperability.[87] NATO conducted the next exercise in the Dynamic Messenger series in 2025. This again focused on undersea warfare, including the defense of undersea infrastructure, MCM, and "underwater warfare," and had even more observers from partner nations outside the NATO alliance.[88]

In parallel with these broader NATO efforts, U.S. allies France and the UK collaborated on an MCM-focused USV they called the maritime mine counter measures (MMCM) capability under the joint Organisation for Joint Armament Cooperation. Formally initiated by treaty in 2010, the effort led to a contract award in 2015 and the delivery of the first two prototype vessels in 2021.[89] The MMCM system includes two USVs, one equipped with a towed sonar array and the other with a remotely operated vehicle and two autonomous underwater vehicles tasked with detecting and locating mines. The program's stated objective is to secure the deployment of "strategic units" and protect local sea lines of communication.[90]

The Royal Navy also plans to invest in arsenal ships as part of a broader campaign to be at the "vanguard of autonomous maritime warfare," according to First Sea Lord General Gwyn Jenkins.[91] One of the ways it intends to do this is through a new "air warfare command ship" that can deploy six smaller vessels, each able to operate autonomously when required, with its own sensing capability and an inventory of 32 offensive missiles.[92] Adding autonomous vessels with missile shooting capability like these to the battle force would be an ambitious departure from most other Europeans navies' investment strategies, which have focused on USVs that perform niche support missions.

87 "Dynamic Messenger 22: An OPEX Exercise Designed for the Future," NATO Allied Command Transformation, September 29, 2022, https://www.act.nato.int/article/dynamic-messenger-22-an-opex-exercise-designed-for-the-future/; and "Dynamic Messenger 23 Provides Lessons for Autonomous Vehicles in NATO Multi Domain Operations," NATO Allied Command Transformation, October 2, 2023, https://www.act.nato.int/article/dynmsg23-furthers-nato-mdo/.

88 "NATO Advances Maritime Innovation and Readiness Through Exercise Dynamic Messenger 2025," NATO, September 29, 2025, https://mc.nato.int/media-centre/news/2025/nato-advances-maritime-innovation-and-readiness-through-exercise-dynamic-messenger-2025.aspx.

89 "MMCM—Maritime Mine Counter Measures," OCCAR, accessed January 20, 2026, https://www.occar.int/our-work/programmes/mmcm-maritime-mine-counter-measures; and "Thales Delivers First SLAM-F Module to the French Navy," *Naval News*, December 20, 2024, https://www.navalnews.com/naval-news/2024/12/thales-delivers-first-slam-f-module-to-the-french-navy/.

90 "Thales Delivers First SLAM-F Module."

91 Jaroslaw Adamowski, "UK Navy Fleet Rebuild Will Prioritize Unmanned Systems, Chief Says," *Defense News*, September 10, 2025, https://www.defensenews.com/global/europe/2025/09/10/uk-navy-fleet-rebuild-will-prioritize-unmanned-systems-chief-says/.

92 Matt Oliver, "Robot Missile Warships to Boost Royal Navy Firepower," *Yahoo News*, September 7, 2025, https://www.yahoo.com/news/articles/robot-missile-warships-boost-royal-181829223.html.

FIGURE 7: A "VOYAGER" USV BUILT BY SAILDRONE DEPLOYED BY THE DANISH GOVERNMENT



Source: Saildrone

Many other NATO states are pursuing their own USV programs but have only recently begun seriously moving forward. The Danish navy launched USVs manufactured by the U.S. company Saildrone in the middle of 2025 and intends to use them immediately in the Baltic Sea as nodes in a large maritime domain awareness (MDA) network.[93] Norway successfully test operated a 24-meter offshore USV early that same year.[94] The Netherlands and Belgium are focusing on MCM in a joint USV program, with eight ships planned for delivery by 2030.[95] Germany released a plan to build USV magazine ships called large remote missile vessels (LRMVs), which it will task with carrying and firing offensive missiles. These vessels would be roughly the size of a corvette and would have vertical launch capability. A frigate would act as a controlling station and would order fires from its "wingmen" LRMVs, which would be designed to be seaworthy enough to operate in the rough waters of the North Atlantic.[96] More ambitious than other European USV concepts, the LRMV remains notional and has yet to enter production.

93 James Brooks, "Danish Military Using Robotic Sailboats for Surveillance in Baltic and North Seas," *AP News*, June 16, 2025, https://apnews.com/article/denmark-robot-sailboats-baltic-sea-bfa31c98cf7c93320115c0ad0e6908c5.

94 "Kongsberg Maritime Delivers First REACH REMOTE USV," Kongsberg, January 16, 2025, https://www.kongsberg.com/maritime/news-and-events/news-archive/2025/delivers-first-reach-remote-usv/.

95 "First Sea Trials of the Vlissingen, First Mine Countermeasure Vessel for the Dutch Navy," Naval Group, accessed January 20, 2026, https://www.naval-group.com/en/first-sea-trials-vlissingen-first-mine-countermeasure-vessel-dutch-navy.

96 Thomas Newdick, "Germany to Build Uncrewed Missile-Toting Arsenal Ships for Its Frigates," *The War Zone*, September 23, 2025, https://www.twz.com/air/germany-to-build-uncrewed-missile-toting-arsenal-ships-for-its-frigates.

In summary, NATO's USV development efforts have been coordinated across the alliance to a limited extent, but even more diverse efforts have begun within individual member nations with various levels of ambition and program maturity. Most efforts focus on applications involving MCM, MDA, and subsea–seabed warfare, with the notable exception being Germany's LRMV concept. NATO is still very much in the prototyping and testing phases of development, and its USV development began too recently for USVs to be a core part of NATO or European nations' fleet architectures. It remains to be seen to what extent these countries will succeed at integrating USVs into their fleets.

USV Development Efforts of U.S. Allies in the Indo-Pacific

Like the NATO alliance, most of the USV development efforts of America's Indo-Pacific allies began only recently. Australia adopted a test-to-field model and began a series of exercises called Autonomous Warrior in 2018 that focused on the MCM and undersea missions.[97] The U.S. joined that exercise in 2023, with participation from USVRON-1.[98] The Royal Australian Navy ramped up its acquisition of USVs in the early 2020s, purchasing several hybrid solar- and diesel-powered Blue Bottle USVs. These 24-foot USVs feature sails with solar panels and are meant to have a high degree of persistence. They will perform intelligence, reconnaissance, surveillance, and targeting tasking, including undersea surveillance using a deployed sonar array.[99]

97 Marilyn Tangye Butler, "Autonomous Warrior 2018," *Asia-Pacific Defence Reporter*, September 26, 2018, https://asiapacificdefencereporter.com/autonomous-warrior-2018/; and "Exercise Autonomous Warrior Testing New Technologies to Meet Emerging Maritime Security Challenges," Australian Government Defence, May 16, 2022, https://www.defence.gov.au/news-events/releases/2022-05-16/exercise-autonomous-warrior-testing-new-technologies-meet-emerging-maritime-security-challenges.

98 Jesse Monford, "USVDIV-1 Participates Alongside RAN in Autonomous Warrior 2023," Naval Surface Force, U.S. Pacific Fleet, November 1, 2023, http://www.surfpac.navy.mil/Media/News/Article/3601631/usvdiv-1-participates-alongside-ran-in-autonomous-warrior-2023/. This official U.S. Navy press release names "USVDIV-1" as the U.S. Navy participant, but there is no such entity in the U.S. Navy's force structure. Searches for "USVDIV-1" redirect to "USVRON-1."

99 Oishee Majumdar, "Ocius Launches Hybrid-Powered Bluebottle USV for Surveillance," Janes, December 4, 2025, https://www.janes.com/osint-insights/defence-news/c4isr/ocius-launches-hybrid-powered-bluebottle-usv-for-surveillance.

FIGURE 8: A MODEL RENDERING OF THE REPUBLIC OF KOREA'S NAVY SEA GHOST USV



Source: Janes

The Republic of Korea (ROK) also released its own USV concept recently, in 2022. Dubbed the "Navy Sea GHOST," the concept incorporates various kinds of networked unmanned systems, with USVs focused on reconnaissance.[100] The ROK Navy unveiled a conceptual design for a MCM support USV at Drone Show Korea, a trade show, in 2025.[101] Outside the Navy Sea GHOST efforts, the U.S. Navy reported that during the RIMPAC 2024 exercise, it successfully tested a live munition alongside the ROK Navy, fired from what it described as a "common" USV. The test was meant to demonstrate USVs' utility as escorts for high value units.[102]

Japan also only recently signaled interest in building USV programs. A 2024 defense white paper described unmanned assets as key to enhancing MDA. Stephen Nagy, a professor at Japan's International Christian University, framed unmanned systems as enablers for MCM

100 Navy Sea GHOST is an English acronym that stands for Navy Sea Guardian Harmonized with Operating manned Systems and Technology based unmanned systems. Juho Lee, "South Korea Reveals New Unmanned 'Navy Sea GHOST' Concept," *USNI News*, November 17, 2022, https://www.navalnews.com/naval-news/2022/11/south-korea-reveals-new-navy-sea-ghost-concept/.

101 Eunhyuk Cha, "New Mine Warfare USV Unveiled by ROK Navy," *Naval News*, March 14, 2025, https://www.navalnews.com/naval-news/2025/03/new-mine-warfare-usv-unveiled-by-rok-navy/.

102 Elton Wheeler, "US, ROK Test Unmanned Vehicles in Live Fire Exercise During RIMPAC 2024," U.S. Navy, August 9, 2024, https://www.navy.mil/Press-Office/News-Stories/display-news/Article/3867512/us-rok-test-unmanned-vehicles-in-live-fire-exercise-during-rimpac-2024/.

and ASW applications, as well as for intelligence gathering.[103] In mid-2025, Tokyo's Maritime Self-Defense Force announced that Japan's Acquisition, Technology, and Logistics Agency was working with Mitsubishi Heavy Industries to develop a USV that would be delivered by the end of 2027. Described as a modular platform, it could be fitted out for either supporting or offensive operations.[104] At the end of 2025, Japan's cabinet approved a defense spending increase that included a 100 billion yen investment for a system of unmanned systems it calls Synchronized, Hybrid, Integrated, and Enhanced Littoral Defense, which it plans to deploy by March 2028.[105] This investment signals that Tokyo is committed to building out USVs and other unmanned systems, but much like other USV development efforts among other U.S. allies, it remains to be seen whether it will succeed at fielding them in large numbers.

USV programs of key U.S. Partners: Ukraine and the Republic of China (Taiwan)

Ukraine's USVs in the Russo-Ukraine War

Ukraine was the first state to employ USVs to great effect in a wartime environment. Although its use of this technology has been well documented elsewhere, it is worth noting some details about what made Ukraine's development efforts different and how these efforts would or would not map onto USV development elsewhere. Ukraine was one of the first nations to use USVs for strike rather than for supporting roles like undersea sensing or MCM. It also developed a theory of the case for using OWA USVs as part of a greater sea denial strategy. Finally, it demonstrated the feasibility of using commercial off-the-shelf (COTS) equipment not only to build the vessels themselves but for its C2 network.

In October 2022, just eight months after Russia's full-scale invasion, Ukraine launched the first publicly known USV attack on Russia's navy base in Sevastopol.[106] Some analysts described how this was an historical development in naval combat, noting that using USVs for offensive strikes was a departure from what most navies were doing with them at the

103 Thrisanka Siripala, "Japan's USV Technology Gains Momentum amid Escalating Maritime Tensions," Indo-Pacific Defense Forum, August 1, 2024, https://ipdefenseforum.com/2024/08/japans-usv-technology-gains-momentum-amid-escalating-maritime-tensions/.

104 Daisuke Sato, "Japan Takes Step Closer to Unmanned Warships," Defence Blog, December 27, 2025, https://defence-blog.com/japan-takes-step-closer-to-unmanned-warships/.

105 Helen Davidson, "Japan's Cabinet Approves Record Defence Budget amid Escalating China Tensions," *The Guardian*, December 26, 2025, https://www.theguardian.com/world/2025/dec/26/japan-defence-budget-china.

106 H. I. Sutton, "USVs at Work in the Black Sea," U.S. Naval Institute, December 1, 2022, https://www.usni.org/magazines/proceedings/2022/december/usvs-work-black-sea.

time.[107] Although the Sevastopol attack reportedly failed to sink any vessels, Ukraine's USV strikes over the next three years became more sophisticated and succeeded at causing significant damage to several Russian warships and port infrastructure.[108]

FIGURE 9: UKRAINIAN MAGURA V5 USV



Source: U.S. Naval Institute *Proceedings* September 2025 Vol. 151/9/1,471

Tactically, these actions showcased the advantages of using very small USVs as strike platforms, especially when employed against larger, more expensive warships. Ukraine's USVs were able to remain undetected, visually and by radar, until they were already within minimum range of the defenders' missiles or large-caliber guns.[109] Their stealth allowed them to penetrate even well-fortified ports.[110] If the target remained within the USVs' maximum effective range, it was highly likely that it could be damaged or destroyed by them.

Ukraine's tactical victories against Russia's naval forces resulted in the cumulative strategic effect of pushing Russia's Black Sea naval forces far to the east, allowing Ukraine to continue

107 H. I. Sutton, "Why Ukraine's Remarkable Attack on Sevastopol Will Go Down in History," *Naval News*, November 17, 2022, https://www.navalnews.com/naval-news/2022/11/why-ukraines-remarkable-attack-on-sevastopol-will-go-down-in-history/; and Charles Layne, "Ukraine Symposium—Ukraine's 'Suicide Drone Boats' and International Law," Lieber Institute West Point, January 25, 2023, https://lieber.westpoint.edu/ukraines-suicide-drone-boats-international-law/..

108 "Russian Navy Vessel Damaged in Drone Attack—Ukrainian Source," *Reuters*, August 4, 2023, https://www.reuters.com/world/europe/russian-navy-vessel-damaged-drone-attack-ukrainian-source-2023-08-04/; Dan Sabbagh et al., "Ukraine Thought to Have Sunk Russian Warship near Occupied Crimea," *The Guardian*, February 1, 2024, https://www.theguardian.com/world/2024/feb/01/ukraine-sea-drone-hits-russian-warship-near-occupied-crimea; and Yuliia Dysa and Tom Balmforth, "Ukraine Says Underwater Drones Hit Submarine, but Moscow Denies Damage," *Reuters*, December 15, 2025, https://www.reuters.com/world/europe/ukraine-hits-russian-submarine-first-underwater-drone-attack-2025-12-15/.

109 Clare, *Navy of Necessity*, p. 20.

110 "Russian Navy Vessel Damaged in Drone Attack."

shipping grain out of its Black Sea ports and thus maintain its economic lifeline. In other words, Ukraine's offensive USV strikes were part of a broader sea denial campaign against the Russian navy, one that also featured anti-ship missiles fired from shore. The strike USVs that Ukraine employed at sea thus contributed at the operational and strategic levels of war to influence what was happening on land.[111]

Part of Ukraine's success stemmed from how quickly it was able to begin fielding USVs. This was the result of what has been referred to as "minimum viable warfare," the idea that instead of developing a perfect product, Ukraine's USVs would only need to be good enough to incrementally support the operational campaign.[112] Ukraine was able to go so fast with its development efforts because it elected to use commercially available products. Its *Magura* and *Sea Baby* USVs were built from COTS parts, while its C2 initially came from commercially procured Starlink terminals.[113] This demonstrates that the barrier to entry into offensive USV operations is quite low.

Taiwan's USV Development

Ukraine's USV employment has affected Taiwan's procurement strategy, with Taipei recently deciding to focus its USV employment efforts on similar OWA USVs. In March 2024, it began developing its Endeavor Manta USV, which it first unveiled a year later.[114] The Taiwan International Shipbuilding Corporation plans to build 40 Endeavor Mantas per year using components guaranteed to be from non-PRC sources.[115] Taiwan's official government Ocean Affairs Council explicitly referred to Ukraine's use of unmanned systems as an impetus for developing Endeavor Manta. It also cited the Endeavor Manta's low radar signature, portable land-based deployment, and its ability to conduct "rapid, unpredictable operations in the dynamic conditions of the Taiwan Strait" as potential benefits against Taiwan's likeliest adversaries.[116]

111 Clare, *Navy of Necessity,* chap. I.

112 Clare, *Navy of Necessity,* chap. II.

113 Bryan Clark, "Sea Drones in the Russia-Ukraine War Inspire New Tactics," *IEEE Spectrum*, July 10, 2024, https://spectrum.ieee.org/sea-drone.

114 Akhil Kadidal, "TADTE 2025: CSBC Positions Endeavor Manta as Unmanned Attack Vessel," Janes, September 23, 2025, https://www.janes.com/osint-insights/defence-news/defence/tadte-2025-csbc-positions-endeavor-manta-as-unmanned-attack-vessel; and "Taiwan's M1A2T Tanks, HIMARS to Debute at Taipei Defense Expo," ROC (Taiwan) Overseas Community Affairs Council, September 9, 2025, https://www.ocac.gov.tw/OCAC/Eng/Pages/Detail.aspx?nodeid=329&pid=79150733.

115 Jake Chung, "CSBC Taiwan to Produce 40 USV Drones per Year," *Taipei Times*, September 18, 2025, https://www.taipeitimes.com/News/taiwan/archives/2025/09/18/2003844005. Note that the Taiwan International Shipbuilding Corporation is often assigned the acronym CSBC, standing for "Chinese Ship Building Corporation."

116 "International Development: Endeavor Manta—Speed, Stealth, and Intelligent Advantage in Taiwan's Unmanned Surface Vessel Innovation," Ocean Affairs Council, 海洋委員會, December 15, 2025, https://www.oac.gov.tw/en/home.jsp?dataserno=202601130006&id=62&mcustomize=onemessages_view.jsp&parentpath=0%2C4&utm_source=chatgpt.com.

FIGURE 10: MODEL OF TAIWAN'S KAUI-CHI ATTACK USV



Source: Tso-Juei Hsu, Naval News

Taiwan is diversifying its USV procurement strategy by investing in different vehicle types. Its National Chung-Shan Institute of Science and Technology, the primary arms developer for its Ministry of National Defense, unveiled a USV called Project Kaui-Chi in June 2025. When it was unveiled, it had already completed at-sea testing that involved launching its own UAVs at a target and then ramming it at high speed.[117] This is significant because, like some models of Ukraine's *Magura* that can launch Sidewinder air-to-air missiles, Project Kaui-Chi demonstrates how small OWA USVs can house even smaller munitions to contribute to a larger swarm operation.[118] While it remains to be seen whether its efforts produce USVs at a significant scale, Taiwan's actions have demonstrated it is all-in on a Ukraine-like strategy to use USVs for naval strike—a deviation from the support missions that other nations have recently pursued, including nations in East Asia such as the ROK or Japan.

117 Tso-Juei Hsu, "Taiwan Showcases New 'Kaui-Chi' Attack USV at TADTE 2025," *Naval News*, September 25, 2025, https://www.navalnews.com/naval-news/2025/09/taiwan-showcases-new-kaui-chi-attack-usv-at-tadte-2025/.

118 For an example of how Ukraine has employed munitions from USV variants, see Howard Altman, "Two Russian Su-30 Flankers Downed By AIM-9s Fired From Drone Boats: Ukrainian Intel Boss," *The War Zone*, May 3, 2025, https://www.twz.com/news-features/two-russian-su-30-flankers-downed-by-aim-9s-fired-from-drone-boats-ukrainian-intel-boss.

Adversary USV Programs

Although they have different reasons for developing USV programs, it is worth noting what Russia and the PRC have done in this area in response to U.S. and allied developments. While much of Russia's efforts have been in response to Ukraine's innovative tactics in the Black Sea, the PRC's PLAN has been developing and fielding USV prototypes for other reasons, primarily to keep in line with U.S. efforts and to bolster its fleet's end strength.

People's Liberation Army Navy

China began significant USV testing in the late-2010s—before some U.S. allies, but well after the U.S. Navy began prototyping its first USVs earlier in the decade. In 2018, a collaboration of Chinese organizations from government, academia, and industry began operating together at the Wanshan Unmanned Vessel Test Site off Guangdong Province in southern China.[119] Earlier the same year, China's Yunzhou Tech Corporation released a video demonstrating USVs performing coordinated swarm tactics.[120] In 2019, China launched what it called the JARI combat boat, an 18-meter vessel that state media claimed could be controlled remotely but also had artificial intelligence–driven autonomy.[121] Some sources refer to it as a "mini-destroyer" because of China's intent to fit it with sensors and weapons.[122] In 2021, a new USV of similar design but longer than the JARI was imaged at a pier near Dalian, potentially demonstrating the PLAN's commitment to building ship-like USVs fitted with missile-shooting combat capabilities.[123]

119 Mike Ball, "World's Largest Marine Unmanned Systems Test Site Opened," Unmanned Systems Technology, December 6, 2018, https://www.unmannedsystemstechnology.com/2018/12/worlds-largest-marine-unmanned-systems-test-site-opened/.

120 Kelsey Atherton, "See China's Massive Robot Boat Swarm in Action," C4ISRNet, December 17, 2018, https://www.c4isrnet.com/unmanned/2018/06/01/see-chinas-massive-robot-boat-swarm-in-action/.

121 JARI likely stands for Jiangsu Automation Research Institute. The vessel has alternately been called the *Orca*. Xuanzun Liu, "China Lauonches World-Leading Unmanned Warship," *Global Times*, August 22, 2019, https://www.globaltimes.cn/content/1162320.shtml.

122 H. I. Sutton, "Chinese Testing Experimental Armed Drone Ships at Secret Naval Base," *USNI News*, October 11, 2021, https://news.usni.org/2021/10/11/chinese-testing-experimental-armed-drone-ships-at-secret-naval-base.

123 Sutton, "Chinese Testing Experimental Armed Drone Ships."

FIGURE 11: PRC JARI-USV-A



Source: H.I. Sutton

In the early 2020s, China watchers noticed that some of China's USV development efforts appeared to mimic Western designs. In 2020, images began appearing that depicted an unnamed trimaran-style USV that appeared to adopt the U.S. Navy's *Sea Hunter* ACTUV design. It was unclear whether the ship—built by Jiang Tongfang New Shipbuilding Company and launched in August 2019—was a PLAN-led effort or a private venture.[124] In 2024, the PLAN displayed a new USV model that it called the JARI-USV-A at the Airshow China 2024 exhibition. This version of the JARI, described as a "large unmanned combat vessel," was 58 meters long and sported the trimaran design of the *Sea Hunter* copy.[125]

More recently, in late 2025, observers noticed a secretive, semisubmersible, and possibly unmanned ship covered in tarpaulins at the Huangpu shipyard, where the PLAN has constructed corvettes and frigates. Analysts are not sure whether this vessel is an arsenal ship designed to house vertical launch system (VLS) cells or a carrier of smaller drones such as UAVs.[126] Either concept, if the ship is indeed unmanned, would indicate a continued preference within the PLAN for treating USVs like ships that carry munitions into combat.

124 H. I. Sutton, "Chinese Navy Crafts Unmanned Sea Hunter Knock-Off," *USNI News*, September 25, 2020, https://www.navalnews.com/naval-news/2020/09/new-intelligence-chinese-copy-of-us-navys-sea-hunter-usv/.

125 Ridzwan Rahmat, "Airshow China 2024: China Debuts 500 Tonne Unmanned Surface Vessel," Janes, November 12, 2024, https://www.janes.com/osint-insights/defence-news/security/airshow-china-2024-china-debuts-500-tonne-unmanned-surface-vessel.

126 H. I. Sutton, "Unusual Black Trimaran Drone Ship Spotted in Chinese Shipyard," *Naval News*, October 29, 2025, https://www.navalnews.com/naval-news/2025/10/unusual-black-trimaran-drone-ship-spotted-in-chinese-shipyard/.

Russian Federation Navy

The USV development efforts of the Russian Federation Navy (RFN) can be divided into two periods: before and after Ukraine began employing OWA USVs against it. In the mid-2010s, the RFN's efforts focused on the MCM mission with the Project 12700 USV.[127] This followed the vision of USVs as supporting units that other nations in Europe shared.

Russia's USV developments took a new course after Ukraine began using OWA USVs to great effect. By 2023, the Russian defense industry began producing a "multifunctional" 2.5-meter USV called the *Vizir*. Although it purportedly could be used for various applications, some outlets described it as a counterdrone vessel.[128] Soon after, Russian industry unveiled several other new models like the *Oduvanchik* and *Murena*, which both resembled Ukraine's *Magura*, and the 7-meter *Orkan*.[129]

In April 2025, Russia announced the creation of the Technical Council for Development of Unmanned Maritime Systems, an interdepartmental working group meant to speed up the development efforts of unmanned systems.[130] Ukrainian analyst Yaroslav Chornogor assessed that Russia will try to use USVs to patrol the Black Sea, counter Ukrainian USV attacks, and possibly for its own strike operations, although there have been no known instances of successful attacks from Russia.[131]

In summary, Russia's USV development has primarily been reactive. In its nascent stages at the beginning of Russia's so-called special military operation, it has begun to evolve into a counter-USV effort, but so far it has not yielded any significant operational results. It remains to be seen whether it will employ USVs extensively against Ukraine or in other theaters.

127 Dmytro Shumlyan'skyi, "Advancements in Russian Naval Drones and Their Role in the Armed Forces," *BlackSeaNews*, August 9, 2025, https://www.blackseanews.net/en/read/233967.

128 "Army 2023: KMZ from Russia Unveils New Unmanned Surface Vehicle," *Global Defense News*, August 17, 2023, https://www.armyrecognition.com/archives/archives-naval-defense/naval-defense-2023/army-2023-kmz-from-russia-unveils-new-unmanned-surface-vehicle; and Yaroslav Chornogor, "Russian Unmanned Systems: Current State, Prospects of Production and Application," *Ukrainian Prism*, August 13, 2024, https://prismua.org/en/russian-unmanned-systems-current-state-prospects-of-production-and-application/.

129 Shumlyan'skyi, "Advancements in Russian Naval Drones."

130 Tamara Rozouvan, "Russia Establishes Council for Maritime, Other Unmanned Systems," Janes, April 30, 2025, https://www.janes.com/osint-insights/defence-news/air/russia-establishes-council-for-maritime-other-unmanned-systems.

131 Chornogor, "Russian Unmanned Systems."

CHAPTER 3

Unmanned Surface Vessels: The Theory of the Case

There is a significant body of literature on the pros and cons of USVs and the use cases for which they would be valuable. This chapter consolidates these ideas and presents a conceptual theory explaining why USVs are valuable and how they could be integrated into the U.S. Navy's fleet operations. It also presents some of the challenges that have already arisen while developing USVs that could prevent effective implementation of that technology in the fleet. Finally, it makes these pros and cons concrete by discussing some of the inchoate concepts that are influencing the Navy's plans for adopting USV technology.

Rationales for Fielding USVs

Several perceived advantages of USVs are driving navies around the world, including the U.S. Navy, to adopt this technology: reduced risk to human operators, more efficient vessel designs that enable greater endurance and survivability, lower latency and greater capacity to complete certain tasks, compensation for manpower shortfalls, the potential for increasing fleet capacity more cheaply, higher attritability in combat, the potential to increase the sensor coverage of manned platforms, and the potential to be used to expand a fleet's overall strike power.[132] Several of these advantages have been demonstrated in the real world, while others have not. Some of these perceived advantages may never come to fruition due to misperception or infeasibility. This section explores each perceived advantage of USV employment and provides examples of navies realizing them in real-world operations.

132 Authors characterize these USV advantages in different ways. See, for example, Scott Savitz and Amanda Perez, *Could the U.S. Navy Fleet of the Mid-21st Century Include Large Uncrewed Vehicles?* (RAND Corporation, 2025), https://doi.org/10.7249/PEA2854-1; O'Rourke, *Navy Large Unmanned Surface and Undersea Vehicles*; and Harker et al., "Department of the Navy Unmanned Campaign Framework."

Reducing Risk to Human Operators

One of the most common rationales for employing USVs is that they can handle tasks that exhibit the so-called "three Ds"—dull, dirty, and dangerous.[133] The U.S. Navy's unmanned campaign plan lists reducing risk to human life, automating routine and repetitive tasks, and operating in "complex and contested areas" as its top reasons for needing to implement unmanned systems.[134]

It is no surprise, therefore, that the MCM mission was an early application for USVs, nor that the U.S. Navy's LCS MCM mission module was the first USV-based system to achieve IOC. Writing in 2014, Secretary of the Navy Ray Mabus said, "Nobody can argue with the idea that when clearing mines we should keep our Sailors out of the mine fields and let our unmanned systems take those risks."[135] Among almost all active-duty Navy personnel the author spoke with for this report, it was widely accepted that the MCM mission is a clear-cut application for USV technology given the danger to personnel associated with mine clearance.[136]

Endurance and Survivability

The absence of an onboard crew means that USVs can be designed to maximize endurance and survivability. Without the need for atmosphere regulation, potable water, plumbing, messing, berthing, or other hotel systems, more space on each vessel can be devoted to fuel storage. Furthermore, the energy consumed by life support systems can be conserved, which contributes to fuel efficiency and thus endurance.[137] Finally, USVs would not be hindered by the physical endurance limits of a human crew.[138] Indeed, the Navy's unmanned campaign plan lists "increased range, endurance and persistence—scalable beyond human operator limitations" as an advantage of unmanned systems.[139]

In addition, the absence of crew members would have a major influence on platform survivability. USVs need not be as survivable as manned ships.[140] Rather, they could be engineered to be survivable enough to accomplish their missions, and no more. [141] For example, without

133 Ronald O'Rourke, *Navy Large USVs*, p. 1.

134 Harker et al., "Department of the Navy Unmanned Campaign Framework," p. 10.

135 Mabus, "Future Platforms."

136 Interviews with U.S. Navy officers and defense civilians conducted by the author from September 2025 to February 2026.

137 Savitz and Perez, *Could the U.S. Navy Fleet of the Mid-21st Century*, p. 9.

138 O'Rourke, *Navy Large USVs*, p. 1.

139 Harker et al., "Department of the Navy Unmanned Campaign Framework," p. 10.

140 "DoD Dictionary of Military and Associated Terms," DoD, December 2025, p. 154.

141 This is the key argument in James Wirtz, "Get the People off the Boat: Unmanned Is the Essence of Autonomy," *U.S. Naval Institute Proceedings*, September 1, 2025, https://www.usni.org/magazines/proceedings/2025/september/get-people-boat-unmanned-essence-autonomy.

embarked personnel, USVs would not need exquisite damage control capabilities. In other respects, USVs could be more survivable than their manned counterparts. For instance, they could have sleeker hull forms that are less detectable by radar.[142] The bottom line is that designers could focus on protecting the vessel itself and its ability to accomplish the mission and would not have to focus on protecting a human crew.

Greater Task Efficiency

USVs could also be better at performing certain tasks simply because they are controlled by computers rather than human operators. The U.S. Navy describes how unmanned systems can enable "faster, scalable, and distributed decision-making putting humans at the apex of command."[143] This advantage comes not only from automation. USVs can handle and perform tasks at machine speed without the decision paralysis humans can face in combat situations. This could make them more efficient at completing certain tasks under difficult conditions.

Manpower Savings

One potential advantage of USVs is that fewer sailors would be needed to man legacy ships. USVs could increase the Navy's combat capacity without requiring a commensurate increase in personnel. This could result in significant cost savings because about 70 percent of surface ships' total ownership costs over their life cycles are the costs of the personnel required to man them.[144]

Although this manpower savings could eventually be realized, the manpower requirements associated with USVs are complex and not yet well understood. Savitz and Perez pointed out that though USVs could someday reduce the total number of sailors the U.S. Navy requires, employing USVs in large numbers could require more training.[145] In other domains, more automation has sometimes led to the need for more supporting personnel, not fewer, so it is not clear that incorporating USVs in the fleet would deliver manpower savings.[146]

Still, in the long run, the U.S. Navy may be able to operate many USVs with a relatively small manpower footprint. One vision shared by today's Navy USV operators is of USV detachments consisting of only a small handful of robotics specialists overseen by a watch officer controlling several USVs that have enough automation to handle routine operations.

142 Siripala, "Japan's USV Technology Gains Momentum."

143 Harker et al., "Department of the Navy Unmanned Campaign Framework," p. 10.

144 Galdorisi, "Concept of Operations."

145 Savitz and Perez, *Could the U.S. Navy Fleet of the Mid-21st Century*, pp. 10–11.

146 See, for example, the discussion in Jack Watling, "Automation Does Not Lead to Leaner Land Forces," *War on the Rocks*, February 7, 2024, https://warontherocks.com/2024/02/automation-does-not-lead-to-leaner-land-forces/.

Human operator action would only be needed for tasks that would require it, so the manpower requirement would be reasonably light.[147]

Related to manpower savings is the potential for a lower training barrier to employ the vessels. Even the U.S. Navy's smallest manned warship—the LCS—requires two crews of 40 sailors each.[148] Every sailor must be trained both as part of the accession process and through an on-the-job qualification process that applies just to their assigned ship. This amounts to thousands of cumulative man-hours of training. If a sailor transfers to another ship, even more training is required for that sailor to requalify. With the USVRON construct, once robotics specialists are qualified to operate a type of USV, any USV of that type can be assigned to them. This results in greater flexibility and could mean cumulatively less training is required to operate a USV squadron than manned platforms that perform comparable missions.

Greater, Cheaper Fleet Capacity and Distribution

Several analysts see USV development as a cost-effective approach to increasing the size of the fleet. MUSVs could carry missiles, adding to the fleet's firepower, and would be far less expensive to procure than manned vessels.[149] Under the logic of distributed lethality (also commonly known as distributed maritime operations or DMO), having more small, cheap combatants adds missile inventory while making it harder for adversaries to target and destroy large portions of the U.S. Navy's offensive capability.[150]

To expand the fleet without having to spend more, the U.S. Navy could also deconstruct expensive units. This would entail foregoing the construction of at least a few large multimission ships in favor of buying a larger number of smaller vessels that together can accomplish the same missions as larger combatants.[151] Assuming that USVs could perform the same tasks as effectively as larger combatants, deconstructing expensive units and building USVs instead could provide the Navy with a cost-effective way to disaggregate its

147 Based on interviews with U.S. Navy officers conducted by the author in January and February 2026.

148 "Littoral Combat Ship Class—LCS," America's Navy, U.S. Navy, accessed January 28, 2026, https://www.surfpac.navy.mil/Ships/By-Class/Littoral-Combat-Ship-Class-LCS/.

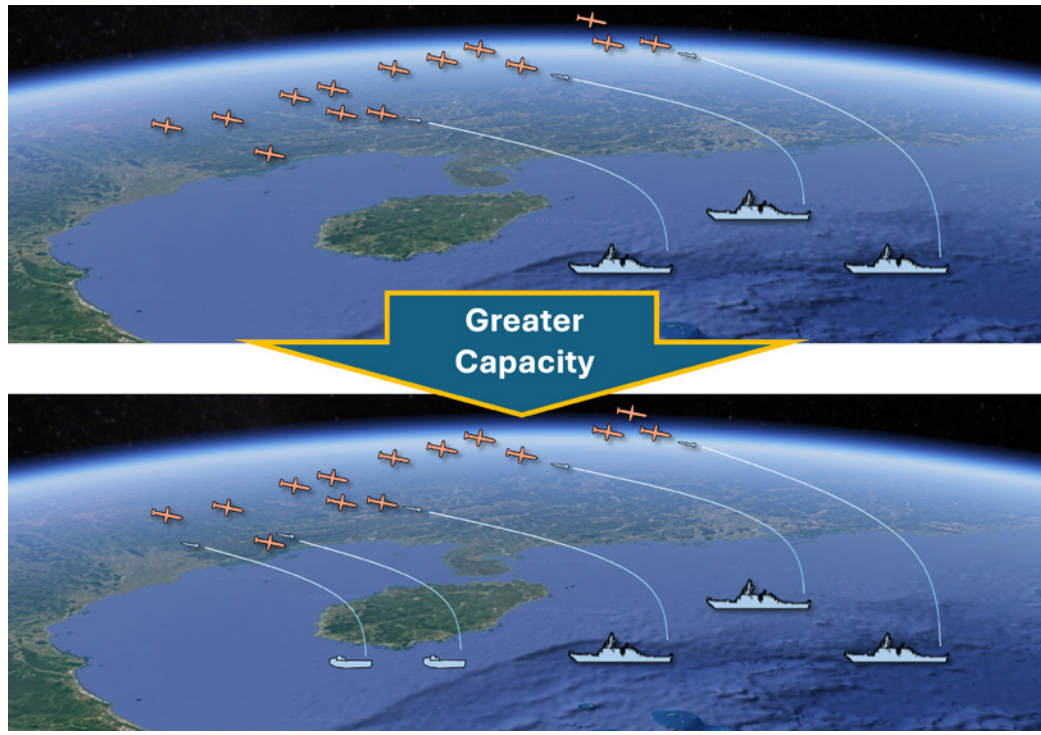
149 Each MASC is estimated to cost $50 million per hull, while an *Arleigh Burke*-class DDG is estimated to cost $2.7 billion per hull, yielding a cost ratio between the two of 54 to 1. Using this ratio, each MASC would need to carry just two VLS-capable missiles to provide more missile firepower per unit cost than the *Arleigh Burke* DDG, given the DDG's 96 VLS cells. Costs based on Hope Hodge Seck, "Navy to Simplify Drone Ship Plans, Focus on Containerized Payloads That Look Alike," *The War Zone*, January 17, 2025, https://www.twz.com/air/navy-to-simplify-drone-ship-plans-focus-on-containerized-payloads-that-look-alike; and Ronald O'Rourke, *Navy DDG-51 and DDG-1000 Destroyer Programs: Background and Issues for Congress*, Background and Issues for Congress No. RL32109 (Washington, DC: Congressional Research Service, 2025), https://www.congress.gov/crs-product/RL32109.

150 For a discussion of DMO, see Thomas Rowden et al., "'Distributed Lethality,'" U.S. Naval Institute, January 1, 2015, https://www.usni.org/magazines/proceedings/2015/january/distributed-lethality.

151 Lauren C. Williams, "How Many Drones Does It Take to Replace a Destroyer?," *Defense One*, August 27, 2025, https://www.defenseone.com/defense-systems/2025/08/how-many-drones-does-it-take-replace-destroyer/407743/.

firepower and expand its fleet. In theory, this would provide commanders with more options because smaller vessels could aggregate together only as much as required to accomplish certain missions.[152]

FIGURE 12: GREATER USV CAPACITY



Source: Created by CSBA.

Higher Attritability

One of the most attractive perceived advantages of USVs is that they would be more attritable than manned platforms. Theoretically, commanders would be more inclined to risk them in dangerous combat situations because the threat to American lives would not be a concern.[153] This could help enable key military functions like sustainment and logistics, as USVs could be used to resupply forces in contested environments where the use of the U.S. Navy's large logistics vessels might be prohibited. The expendability of USVs could also facilitate using them as decoys. If a USV could mimic the radar signature of a larger, more expensive combatant, they could attract adversary anti-ship missiles, resulting in cheaper losses for the U.S. Navy and more survivability for its high-end combatants. The Navy could still operate in and contest areas where its legacy combatants would face a high degree

152 Clark, "Build a Fleet That Contests Every Inch."

153 Savitz and Perez, *Could the U.S. Navy Fleet of the Mid-21st Century,* p. 9.

of risk, such as narrow contested waterways like the Strait of Hormuz or in the weapons engagement zone (WEZ) of the PRC's A2/AD system in the Western Pacific.[154]

There are reasons to be cautious when thinking about USV attritability, however. If the U.S. Navy plans to use unmanned vessels to draw anti-ship missile fire away from legacy platforms, some of the USVs in a tactical formation would have to be loaded out with weapons that pose enough of a threat to make them worth targeting. This means that if they were hit, their loss would necessarily constitute the loss of some of the Navy's own scarce missile inventory.

And just because a USV would be cheaper than a legacy platform does not mean it would be easy to stomach losing one. Even a USV priced at $50 million and destroyed by a salvo of four or five of the most expensive anti-ship missiles (over $4 million apiece for a comparable U.S. missile) would still result in an unfavorable cost imbalance for the United States.[155] In other words, some USVs might not be as expendable as advocates of disaggregation suggest.

Greater Sensor Coverage

The U.S. Navy is already conducting exercises with its prototype USVs to augment the sensor coverage of manned platforms.[156] Acting as sensor nodes, USVs could help the fleet scout more effectively by operating ahead of more capable legacy ships. This could enhance the fleet's combat capability, as a fleet that scouts better can more effectively initiate an attack.[157] A large number of USVs distributed across the battle space could enable network-centric warfare, a key tenet of which is linking sensor nodes that share targeting data with one another and with other platforms.[158] CENTCOM Commander Admiral Brad Cooper illustrated this by saying, "for pennies on the dollar we can put unmanned platforms out there, we can couple it with artificial intelligence … [and then] we can use our manned ships much more efficiently, much more effectively."[159]

The effective horizon of USV sensors is limited by their "height-of-eye"—the height at which the sensing equipment is situated above the surface of the water—which in turn limits the effective sensing horizon of the vessel. Aerial vehicles will always have an advantage over USVs in terms of sensor effectiveness because they have a much higher height-of-eye

154 Clark, "Build a Fleet That Contests Every Inch;" and Savitz et al., *U.S. Navy Employment Options for USVs*, p. xxvii.

155 Each MASC is estimated to cost $50 million per hull based on Seck, "Navy to Simplify Drone Ship Plans." Comparable U.S. missile cost assumes SM-6 cost from Wes Rumbaugh, "Cost and Value in Air and Missile Defense Intercepts," Center for Strategic and International Studies, February 13, 2024, https://www.csis.org/analysis/cost-and-value-air-and-missile-defense-intercepts.

156 Shelbourne, "RIMPAC 2022."

157 Wayne P. Hughes, *Fleet Tactics and Naval Operations*, 3rd ed. (Annapolis, MD: Naval Institute Press, 2025), p. 33.

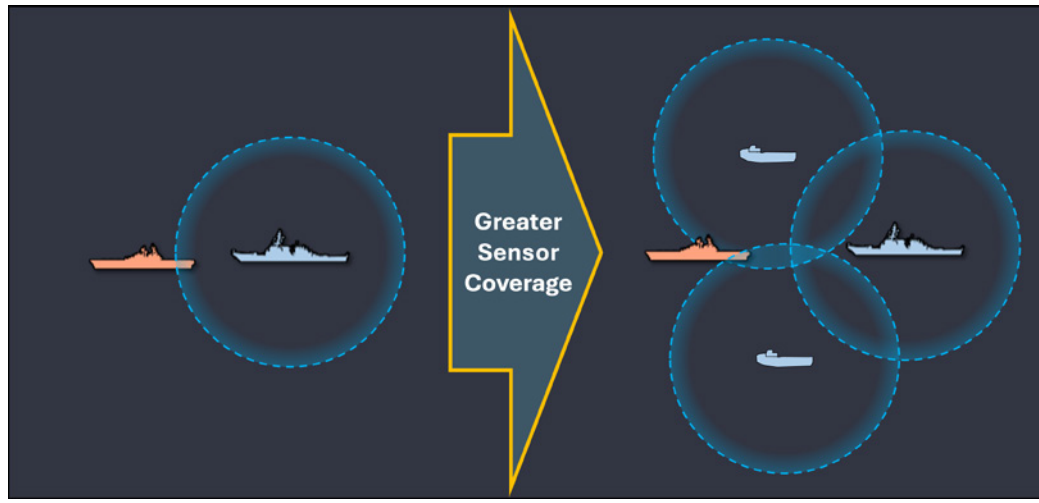
158 Arthur Cebrowski and John Garstka, "Network-Centric Warfare—Its Origin and Future," *Proceedings* 124, no. 1, January 1, 1998, https://www.usni.org/magazines/proceedings/1998/january/network-centric-warfare-its-origin-and-future.

159 "Integrating USVs & AI."

than USVs; however, USVs are more persistent because they can remain in one area for a relatively long time without using as much energy as aerial vehicles. USVs that use renewable sources of energy would provide even more endurance and persistence. This could afford them an advantage as sensor platforms over systems in other domains.[160]

One domain where USVs provide a clear advantage over any other platform is in undersea sensing. USVs have cross-domain sensing capabilities: They operate at the air–surface interface and thus can maintain continuous communications with other vessels while towing sensors under the surface of the water.[161] Although UUVs can reposition within the water column, they do not have the continuous communication capability that USVs have. Likewise, though aircraft can temporarily dip sensors into the water or use expendable sensors, they do not have the dwell time that USVs have. Therefore, USVs could be particularly suited to continuous transmission of acoustic intelligence data because they can sense it and transmit it at the same time.

FIGURE 13: GREATER SENSOR COVERAGE FROM USV INTEGRATION



Source: Created by CSBA.

Strike Enhancers

One of the most transformative ways USVs could contribute to the U.S. Navy's fleet is by bringing additional strike capacity and capability. This could come about in two ways, both of which will be explored further in chapter 4. First, it could come from expanding the number of missile-shooting vessels in the fleet. USVs could serve as adjunct missile magazines, an idea similar to the arsenal ship concept that briefly took hold in the Navy during the 1990s. As an adjunct magazine, a USV's primary purpose would be to augment the

160 Based on interviews with U.S. Navy officers conducted by the author in January 2026.

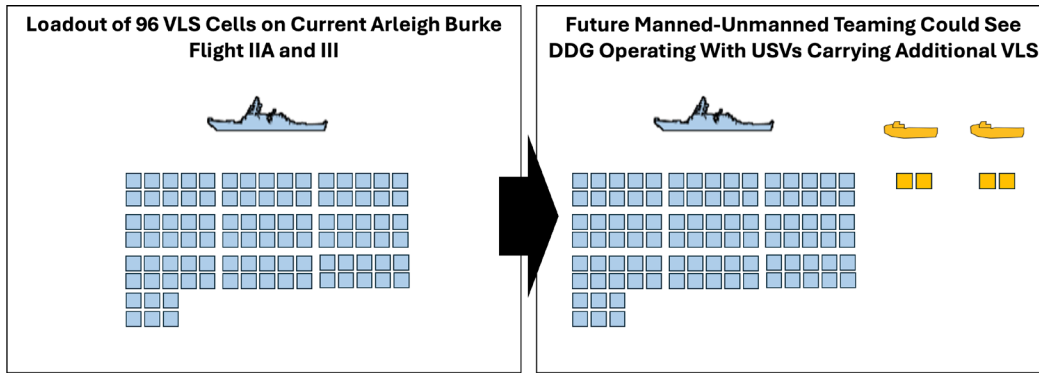
161 Savitz et al., *U.S. Navy Employment Options for USVs*, p. xxii.

fleet's firepower.[162] This would contribute to the DMO concept by spreading the U.S. Navy's weapons across platforms to avoid putting "too many eggs into one basket."[163]

Second, USVs themselves could serve as munitions, acting as OWA drones. As noted in chapter 2, Ukraine has demonstrated the viability of OWA USVs in its war against Russia. USVs would be range limited, so this concept might be difficult to employ across longer distances. Austin Gray, founder of Blue Water Autonomy, also pointed out how difficult it would be to launch such OWAs from ships in high sea state.[164]

Still, Ukraine has shown that small OWA USVs can be lethal. By attacking targets close to the water line, they can inflict more damage than a missile that strikes from above and is susceptible to being shot down. They are also less susceptible to anti-ship missiles than ships that are corvette sized or larger, simply due to their smaller hull form and lower radar cross section. Even if they are targeted, their relatively low cost per unit means that intercepting them with advanced anti-ship missiles would be uneconomical.[165] The distinction between ship-like USVs and munitions-like USVs will be explored further in chapter 4.

FIGURE 14: STRIKE ENHANCEMENT OFFERED BY USV INTEGRATION



Source: Created by CSBA.

162 Savitz and Perez, *Could the U.S. Navy Fleet of the Mid-21st Century*, p. 14.

163 O'Rourke, *Navy Large USVs*, p. ii.

164 Austin Gray, "All I Wanted for Christmas: Attritable Naval Platforms + A Force Architecture Continuum," *Austin Gray* (substack), December 27, 2024, https://austinegray.substack.com/p/all-i-wanted-for-christmas-attritable.

165 A Lockheed Martin-produced Long-Range Anti-Ship Missile costs about $1.5 million per unit, while an OWA USV with enough range to reach targets in the western Pacific, such as Saronic's *Corsair* vehicle, costs about $1.2 million each. John Tirpak, "Lockheed Get $122 Million to Accelerate JASSM Production," *Air & Space Forces Magazine*, March 18, 2025, https://www.airandspaceforces.com/lockheed-gear-jassm-and-lrasm-production/; and Jan-Erik Asplund and Marcelo Ballve, *Saronic* (New York, NY: Sacra Equity Research, 2025), https://sacra-pdfs.s3.us-east-2.amazonaws.com/saronic.pdf.

Challenges and Enduring Questions Concerning USV Employment

There is still much to work out before USVs can meaningfully contribute to fleet operations, notwithstanding the U.S. Navy's recent development efforts. The hurdles that must be overcome and enduring questions that must be answered can be divided into three broad categories: technical and engineering challenges; DOTMLPF-P–related issues; and acquisition and mass production constraints.

Engineering Challenges

The U.S. Navy's USV prototype efforts have been technically impressive, but several high-profile events highlight the engineering challenges it still faces before it can deploy USVs at scale. In June 2023, a USV that was undergoing testing off the coast of California capsized a tugboat, submerging the tugboat's captain.[166] In July of that year, two USVs collided when one vessel "smashed into" another, vaulted over its deck, and crashed back into the water. This prompted Reuters to report, "The US Navy is building a drone fleet to take on China. It's not going well."[167]

These two incidents illustrate how difficult autonomous operations can be, especially at sea. As one naval officer explained, autonomous cars have many points of reference that their sensors can detect, and they have already undergone extensive testing, yet they still sometimes make mistakes. At sea, there are fewer points of reference, and there has been far less testing, so it makes sense that technical challenges will arise.[168]

There are also technical requirements associated with the rules of the nautical road, known as the International Regulations for Preventing Collisions at Sea (COLREGs). Following these rules in complex environments can be hard to automate in a control algorithm. Doing so requires an understanding of context, such as knowing whether another vessel on the water is transiting or trawling. Moreover, in a situation where there is immediate danger, under rule 2.b a human pilot is expected to deviate from the rules to prevent collision. Engineering an autonomous system to know when and how to deviate could prove difficult.[169]

166 Brandi Vincent, "Navy Experiment Cut Short After Unmanned Vessel Flipped a Support Boat," *DefenseScoop*, July 1, 2025, https://defensescoop.com/2025/07/01/navy-unmanned-vessel-accident-boat-ventura-channel-islands-california/.

167 David Jeans, "The US Navy Is Building a Drone Fleet to Take on China. It's Not Going Well," *Reuters*, August 20, 2025, https://www.reuters.com/business/aerospace-defense/us-navy-is-building-drone-fleet-take-china-its-not-going-well-2025-08-20/.

168 Based on interviews with U.S. Navy officers conducted by the author in January 2026.

169 "International & U.S. Inland Navigation Rules," U.S. Coast Guard, June 28, 2019, p. 6, https://www.navcen.uscg.gov/sites/default/files/pdf/navRules/Handbook/NOAANavigationRulesStandardSize.pdf.

This touches on one of the enduring questions concerning how the U.S. Navy will operate its USVs: the appropriate level of autonomy that they should be capable of, as well as the appropriate level of autonomy they should normally operate with. The Navy's unmanned campaign plan defines a spectrum of autonomy that goes from human operation at one extreme to "near-independent autonomy" on the other. Other levels include remote operation, human supervision, and human–machine teaming.[170] The case for full autonomy often rests on the premise that USVs will need to operate continuously, even in communications-denied environments. The Navy must build USVs robust enough that jamming one vessel's communication signal will not completely disable it, so a degree of complete autonomous capability might be required for continuity of operations. Indeed, the unmanned campaign plan goes on to say: "Autonomy gives capable machines the ability to adapt interactively to the dynamic maritime environment. This is critical when: the world cannot be predicted, adaptation must occur at machine speed, adaptation must occur in the face of overwhelming data, and communications are limited or unreliable."[171]

To date, however, the most familiar USV C2 method has been remote operation. The challenges to remote operations are becoming more manageable. With the prospect of resilient microsatellite communications links that can withstand anti-satellite attacks, the threat to control networks could soon be much lower than it is today.[172] Local control signal jamming could still be a threat, but naval analyst Bryan Clark has pointed out that the autonomous technology available today for these systems would be sufficient for continuous effective operations. Even in the event of local signal jamming, unmanned surface munitions could navigate to preprogrammed positions using onboard inertial navigation and then find, fix, and finish targets using onboard seekers.[173] This level of autonomy would be like that of a naval mine or an aerial missile, which the U.S. military already understands well from both legal and ethical perspectives. In any case, experienced U.S. Navy operators whom the author interviewed indicated that the most reliable form of C2 to ensure proper operation is remote control by human operators, at least for now.[174]

170 Harker et al., "Department of the Navy Unmanned Campaign Framework," p. 7.

171 Harker et al., "Department of the Navy Unmanned Campaign Framework," p. 7.

172 See "Starshield: Supporting National Security," SpaceX, accessed January 29, 2026, http://www.spacex.com/starshield.

173 Clark, "Sea Drones in the Russia-Ukraine War."

174 Based on interviews with U.S. Navy officers conducted by the author in January and February 2026.

Finally, one of the most important engineering questions, especially for small USVs, is their range. To be viable tools in many theaters, they need to have a radius of action large enough to allow them to reach their operating areas. Like the assured C2 concern, this is another problem that new technology is beginning to solve, with the latest models of small, unmanned vessels offering a 1,000-nautical mile range.[175] As engineers continue to explore renewable energy sources and hybrid designs, USV radius of action could extend even farther.

DOTMLPF-P: Logistics and Repair Flexibility, Personnel Training, Facilities, and Policy

Another category of challenges involves issues associated with USV DOTMLPF-P. Chief of Naval Operations (CNO) Admiral Daryl Caudle wrote in his *Fighting Instructions* that "the Navy must address the [RAS-associated] doctrinal shortfalls, organizational seams, and process gaps, including how we will allocate RAS in service decisions like strategic laydown, dispersal, and global force management."[176] Additionally, maintenance and repair at sea could be a significant hindrance to successful USV fleet integration. If a critical system on a USV breaks—a frequent occurrence on any vessel operating in the harsh maritime environment—there will be no sailors on board to repair the problem. This could be solved by designing and building an exquisite on-board system to autonomously diagnose problems and repair them, but including such a system would make USVs more expensive.

Replenishing weapons and fuel at sea would be exceedingly difficult without a crew. When the U.S. Navy conducted its Integrated Battle Problem 23.2 in September 2023, it performed an underway replenishment involving an LUSV, but this operation required a manned rigid hull inflatable boat to facilitate the transfer.[177] If USVs cannot be replenished on station without the aid of human operators, they might have to rotate in and out of their patrol areas, increasing their fuel consumption.

Although USVs promise to reduce the need for human crews, this does not mean there would be no role for skilled manpower and training. The U.S. Navy's current efforts are demonstrating that many operators will be required to support USV operations remotely, at least in the near term.[178] This reality is consistent with the experiences of units at the edge of other RAS use cases.[179] The Navy is establishing a dedicated career path for surface warfare offi-

175 Kajal, "1,000-Mile-Range Drone Boats."

176 Caudle, "U.S. Navy Fighting Instructions," p. 13.

177 Jesse Monford, "Unmanned Surface Vessels Conduct Underway Replenishment," Defense Visual Information Distribution Service, September 16, 2023, https://www.dvidshub.net/video/897711/unmanned-surface-vessels-conduct-underway-replenishment.

178 Based on interviews with U.S. Navy officers conducted by the author in January 2026.

179 Watling, "Automation Does Not Lead to Leaner Land Forces."

cers specializing in unmanned systems. This effort will face the classic challenge of training a cadre of operators to doctrine and tactics that are not yet fully mature.[180]

Another operational problem that the U.S. Navy is working hard to solve is building out the facilities to house large numbers of USVs. As the Navy acquires more of these vessels, it must house them somewhere that offers pier space, refueling capacity, shore power, and force protection. This is an especially difficult problem as the Navy looks for ways to base hundreds of USVs in theaters outside the CONUS (OCONUS). Some officers characterize this challenge as the most important detail that must be worked out for USVs to play a meaningful role in fleet operations.[181]

Various policy instruments must also be developed. For example, Rule 5 of the COLREGs requires a proper lookout "by sight and hearing," which is impossible to meet for a fully autonomous vessel. This could require some kind of policy exemption.[182] Additionally, any OCONUS unit that is based within the territory of a partner nation must have a status of forces agreement that authorizes their presence there. Finally, another important policy question is when autonomous systems can use lethal force. In 2023, DoD issued Directive 3000.09, which began laying out guardrails on this issue by defining policy requirements for "the design, development, acquisition, testing, fielding, and employment of autonomous and semi-autonomous weapon systems." Among these is the requirement to "function as anticipated" in contested environments against "adaptive adversaries."[183]

Procuring USVs: Impact on Defense Industrial Base

One challenge the U.S. Navy faces is finding a way to procure USVs, especially ship-like MUSVs, in the numbers that it desires. This is no easy task, not only due to existing strains on the shipbuilding defense industrial base but also because of the small margin of error the Navy likely will have with the public and Congress given its recent shipbuilding track record. The Navy's decision to procure ship-like USVs through an MUSV marketplace is a tacit recognition that it needs a novel approach for USV procurement.

The U.S. Navy's recent shipbuilding acquisition programs have faced schedule delays, cost overruns, and equipment issues. The U.S. Government Accountability Office (GAO) summarized the problems succinctly: "Both [the LCS and *Zumwalt* DDG] programs were hampered by weak business cases that over-promised the capability that the Navy could deliver. Together, these two ship classes consumed tens of billions of dollars more to acquire than initially budgeted and ultimately delivered far less capability and capacity to fleet users

180 See, for example, the discussion about Admiral William Moffett and the inception of the naval aviation community in Rosen, *Winning the Next War*, pp. 57–75.

181 Based on interviews with U.S. Navy officers conducted by the author in January 2026.

182 "International & U.S. Inland Navigation Rules," p. 7.

183 Kathleen Hicks, "DoD Directive 3000.09," DoD, January 25, 2023, pp. 3–4, https://www.esd.whs.mil/portals/54/documents/dd/issuances/dodd/300009p.pdf.

than the Navy had promised. The Navy cannot expect to look within its existing playbook to find answers."[184]

Shortly after this GAO report was published, the U.S. Navy canceled its *Constellation* guided missile frigate (FFG) program, which had experienced massive cost overruns and delays that are often attributed to requirements creep: Navy requirements officers ordered numerous design changes from the baseline frigate model.[185] Originally, the *Constellation* FFG was supposed to have 85 percent commonality with Fincantieri Marine's original design, but the new requirements led to only a 15 percent commonality, resulting in a 40 percent cost underestimation and a three-year delay for the first hull.[186]

The *Constellation* program failure exemplifies the Navy's difficulties when it comes to building large numbers of less capable combatants. It also highlights the need for discipline in setting requirements for low-end ships.[187] Congress and the public will expect the Navy to avoid making the same mistakes in new shipbuilding programs, including its USV programs.

Building a ship-sized USV could lead to strain on the U.S. shipbuilding industrial base. The Congressional Budget Office has pointed out that over the last decade, the amount of tonnage under construction at U.S. shipyards has increased by 80 percent. The addition of unmanned vessels would further increase the demand on these shipyards.[188]

An approach to building USVs that minimizes the impact to traditional shipbuilders might be the most feasible way to quickly scale up production. This implies that newcomers to the defense industry might be better postured to add the required shipbuilding capacity. In December 2025, the U.S. Navy awarded a $392 million contract to Saronic, an autonomous vessel manufacturer and relatively new player in the defense industry.[189] To build its USVs, Saronic purchased a Louisiana shipyard, which could add shipbuilding capacity without impacting the existing shipbuilding industrial base.[190] As mentioned in chapter 2, the Leidos Group now manufactures and provides contractor support for the *Sea Hunter* MUSV and the

184 *Navy Shipbuilding: Enduring Challenges Call for Systemic Change: Hearing Before the U.S. Senate Armed Services Committee, Subcommittee on Seapower* (2025), GAO-25-108225, accessed September 22, 2025, https://files.gao.gov/reports/GAO-25-108225/index.html.

185 Tom Kington, "US Navy Nixes Constellation Frigate Program After Two Ships Half-Built," *Defense News*, November 26, 2025, https://www.defensenews.com/naval/2025/11/26/us-navy-nixes-constellation-frigate-program-after-two-ships-half-built/.

186 Mallory Shelbourne and Sam LaGrone, "Constellation Frigate 'Unplanned Weight Growth' Could Limit Service Life, Says GAO," *USNI News*, May 30, 2024, https://news.usni.org/2024/05/29/constellation-frigate-unplanned-weight-growth-could-limit-service-life-says-gao.

187 Eric Lipton, "Faced with Evolving Threats, U.S. Navy Struggles to Change," *New York Times*, September 4, 2023, https://www.nytimes.com/2023/09/04/us/politics/us-navy-ships.html.

188 Labs, *Analysis of the Navy's 2025 Shipbuilding Plan*.

189 Kajal, "1,000-Mile-Range Drone Boats."

190 Colin Demarest, "Exclusive: Saronic Will Build 150-Foot Drone Boats at Louisiana Shipyard," *Axios*, April 16, 2025, https://www.axios.com/2025/04/16/saronic-shipbuilding-louisiana-marauder-drone.

Ghost Fleet Overlord series of LUSVs. Additionally, even traditional shipbuilders working in the unmanned space are committed to ensuring that new USV design and production efforts do not impact production lines servicing legacy multimission combatants.[191]

The U.S. Navy must have a pragmatic business case in place, one that leverages mature technology to ensure that USV programs avoid the same fates as the *Constellation*, LCS, and *Zumwalt*. This is why having a solid CONOPS and a clear understanding of how USVs will contribute to fleet operations, as well as solving the challenges associated with fielding them, will be crucial.

The advantages and disadvantages discussed in this section are summarized in Table 1.

191 Based on interviews with shipbuilding executives conducted by the author in March 2026.

TABLE 1: THEORETICAL ADVANTAGES AND DISADVANTAGES OF FLEET USVS

USV Advantages and Disadvantages		
Key Trait	**Advantages**	**Disadvantages**
Endurance and Survivability	· Higher endurance expected as the result of not having life support systems onboard · More space to devote to systems that enhance survivability	· No resident crew available for at-sea repairs · Personnel are still required to come aboard for refueling and replenishment operations
Personnel	· Decreased risk to naval personnel by offloading dull, dirty, and dangerous tasks onto USVs · Able to operate at computer speed · Could result in lower manpower training requirements because training never has to be repeated	· More manpower could be required to support USV operations than would be saved by not needing a crew
Cost	· Lower cost per hull than manned units of comparable size due to simpler designs and lower survivability standards · Lower costs expected over USV lifetimes based on manpower cost savings	· Cost growth is possible as technical challenges are resolved and mass production begins · USVs will still need basing and facilities close to their operating areas, which will still incur substantial cost
Attritability	· Reasonable expectation of higher attritability and a higher risk threshold for using USVs in combat based on having no human crew in harm's way	· Attritability might be overstated, as large USVs will still be relatively expensive
Sensor Coverage	· More hulls available for distributed operations because of cheaper cost and expected ease of mass production	· USVs will likely not have comparable sensors to large multimission platforms and as a result will be less capable.
Strike	· Potential for more weapons capacity spread out among more platforms, which could allow for a more effective distributed attack	· Enduring questions remain about C2 reliability in communications-denied environments and policies governing weapons release authorities for USVs acting autonomously

Source: Created by the author.

USV Use-Cases Today

The U.S. Navy is already trying to implement several novel concepts that strongly feature USVs. Although many details are classified, available open-source information describes the Navy's current vision for its future USV fleet. None of the concepts depend solely on USVs, but all rely on them to some degree. In order from most general to most specific are the DMO, hedge force, and hellscape concepts. This section also discusses the support at the margins that USVs could provide.

Distributed Maritime Operations

CNO Navigation Plan 2022 called DMO the "Navy's foundational operating concept," and *CNO Navigation Plan 2024* described it as "dispersing the fleet while concentrating effects."[192] The concept was first published widely in a 2015 essay by three U.S. Navy admirals, who envisioned a fleet with more offensive power enabled by "an array of existing platforms and capabilities, planned capabilities in various stages of acquisition, and future capabilities resident in today's promising research-and-development programs."[193] At its heart, the concept includes spreading the Navy's sensors and weapons across a wider variety of ships and aircraft, making use of longer-range weapons and unmanned systems, and using resilient communications links to network the dispersed force.[194] As part of this plan, the Navy would not only equip USVs with weapons and sensors, but also operate them in conjunction with manned ships. This could include, for example, employing MUSVs as adjunct weapons magazines.[195] In DMO, the number of ships matters—the more ships to disperse weapons and sensors on, the better—which explains why Navy's most recent (2026) shipbuilding plan calls for 95 medium unmanned vessels by the end of the current FYDP.

Although very small USVs could serve as sensing platforms within the DMO concept, their relatively small sensor horizon would limit their value compared to larger ships or aircraft. The priority would be to build ship-like LUSVs that can fire missiles. Many concrete descriptions of DMO operations focus on the ability to coordinate missile fires.[196] Armed LUSVs or MUSVs could enhance DMO effectiveness by providing the ability to launch dispersed, precisely timed missile salvos.

192 Michael Gilday, "Chief of Naval Operations Navigation Plan 2022," U.S. Navy, 2022, p. 8, https://media.defense.gov/2022/Jul/26/2003042389/-1/-1/1/NAVIGATION%20PLAN%202022_SIGNED.PDF; and Lisa Franchetti, "Chief of Naval Operations Navigation Plan 2024 for America's Warfighting Navy," U.S. Navy, 2024, p. 14, https://www.navy.mil/Portals/1/CNO/NAVPLAN2024/Files/CNO-NAVPLAN-2024-high-res-v2.pdf.

193 Rowden et al., "'Distributed Lethality.'"

194 Ronald O'Rourke, *Defense Primer: Navy Distributed Maritime Operations (DMO) Concept*, Legislation No. IF12599 (Washington, DC: Congressional Research Service, 2025), https://www.congress.gov/crs-product/IF12599.

195 O'Rourke, *Navy Large USVs*, p. 2.

196 Dmitry Filipoff, "Fighting DMO, Pt. 1 Through Pt. 10: Defining Distributed Maritime Operations and the Future of Naval Warfare," Center for International Maritime Security, February 20, 2023, https://cimsec.org/fighting-dmo-pt-1-defining-distributed-maritime-operations-and-the-future-of-naval-warfare/.

Although the theory behind DMO offers a strong rationale for using MUSVs as missile shooters, there are still many hurdles with the concept itself. As Dmitry Filipoff pointed out, "DMO lacks sufficient coherence and concrete focus to effectively guide the Navy's development."[197] It may be premature for the U.S. Navy to focus on building MUSVs solely in the hope that they might someday contribute to the DMO concept.

The Hedge Force

Since his confirmation as CNO in July 2025, Caudle has advocated extensively for the idea of the hedge force. His *C-NOte #4: The Way We Fight* described the future fleet: "At the heart of the Golden Fleet is our ability to integrate and certify tailored forces and tailored offsets—manned and unmanned platforms, distributed long-range fires, robotic-autonomous systems, and resilient logistics—employed in accordance with the U.S. Navy's *Fighting Instructions* to operationalize the Hedge Strategy through scalable formations that manage risk, expand mass, and preserve combat advantage."[198]

The idea of the hedge strategy is derived from work by Hudson Institute senior fellows Bryan Clark and Dan Patt, who defined the concept as "a set of alternative and complementary capabilities that ensure preparedness against specific contingencies that the bulk of the force may not fully address."[199] Their proposed hedge forces would rely primarily on unmanned systems, including USVs, which they assess could be built in large numbers within one to two years. In a scenario based on defense against an invasion of Taiwan, they recommend unmanned systems inspired by mines.[200]

According to Caudle, "The strategy balances cost-effective, scalable and risk-worthy mass with advanced multi-mission platforms that can be built and sustained while taking stock in the likelihood of pacing scenarios and the severity of risk that's attached."[201] He said "hedging" is already central to what the U.S. Navy does, and employing unmanned systems as part of a hedge concept is not a significant deviation from how the navy operates today. He cited naval special warfare as a hedge against "low-intensity and irregular warfare threats" and ballistic missile submarines as a hedge against nuclear conflict.[202]

197 O'Rourke, *Defense Primer.*

198 Daryl Caudle, "C-NOte #4," U.S. Department of the Navy, January 15, 2026. "Golden Fleet" refers to the second Trump administration's future Navy force structure initiative, which involves a high-low mix including guided missile battleships (BBGs) and guided missile frigates (FFGs).

199 Bryan Clark and Dan Patt, *Hedging Bets: Rethinking Force Design for a Post-Dominance Era* (Washington, DC: Hudson Institute, 2024), p. 16.

200 Clark and Patt, *Hedging Bets,* pp. 8, 33, 41.

201 Laura Heckmann, "Top Navy Official Details New 'Hedge Strategy,'" *National Defense*, January 27, 2026, https://www.nationaldefensemagazine.org/articles/2026/1/27/top-navy-official-details-new-hedge-strategy.

202 Heckmann, "Top Navy Official Details New 'Hedge Strategy.'"

Caudle specifically saw USVs contributing to this conceptual framework. He wanted to include "attritable and easily replenishable USVs, MUSVs designed for scouting, screening, and striking, and UUVs for area and waterspace denial or countering mines."[203] These unmanned platforms will help compose hedge forces that are scalable, deployable, adaptable, and cost-effective.[204]

Hellscape

Although few details of hellscape are publicly available, press reporting indicates that the concept represents a specific instance of the hedge force strategy. "Hellscape" had been used by U.S. Pacific Command (INDOPACOM) Commander Admiral John Aquilino since the early 2020s to describe the capability to attack and hit over 1,000 targets within a 24-hour span of time.[205] It is closely related to Replicator, the DoD initiative described in chapter 2, which envisions the mass production of small, attritable unmanned systems and is modeled after Ukraine's success using these systems against Russia.[206]

The first public comments about hellscape came from INDOPACOM Commander Admiral Samuel Paparo to *The Washington Post* on the sidelines of the 2024 Shangri-La Dialogue. Paparo stated that if China attempted to cross the Taiwan Strait with an invasion force, the U.S. Navy would deploy thousands of unmanned systems, including USVs, to flood the area. This would give Taipei, Washington, and other allies time to respond with more substantial forces.[207] In Paparo's words, "I want to turn the Taiwan Strait into an unmanned hellscape using a number of classified capabilities, so that I can make their lives utterly miserable for a month, which buys me the time for the rest of everything."[208]

In practice, hellscape likely will include an array of networked drones in large numbers across all domains. Another advantage of the small USVs that hellscape will likely use is that they can be carried aboard shipping containers and prepositioned in response to a massing Chinese invasion force.[209] In total, the Navy says it plans to deploy thousands of USVs to the Indo-Pacific theater by 2030, an effort that has been closely tied to hellscape.[210]

203 Daryl Caudle, "CNO APEX Defense Keynote as Prepared," U.S. Navy, January 27, 2026, https://www.navy.mil/Press-Office/Speeches/display-speech/Article/4390298/cno-apex-defense-keynote-as-prepared/.

204 Caudle, "CNO APEX Defense Keynote."

205 Patrick Tucker, "'Hellscape': DOD Launches Massive Drone Swarm Program to Counter China," *Defense One*, August 28, 2023, https://www.defenseone.com/technology/2023/08/hellscape-dod-launches-massive-drone-swarm-program-counter-china/389797/.

206 Johnston, "Breaking Down the U.S. Navy's 'Hellscape.'"

207 Josh Rogin, "If China Attacks Taiwan, the U.S. Military Is Planning a 'Hellscape,'" *Washington Post,* June 10, 2024, https://www.washingtonpost.com/opinions/2024/06/10/taiwan-china-hellscape-military-plan/.

208 Jared Keller, "The Pentagon Is Planning a Drone 'Hellscape' to Defend Taiwan," *Wired*, August 19, 2024, https://www.wired.com/story/china-taiwan-pentagon-drone-hellscape/.

209 Johnston, "Breaking Down the U.S. Navy's 'Hellscape.'"

210 Lariosa, "Navy to Deploy Thousands of Unmanned Surface Vessels."

Questions remain about whether there would be enough systems to counter a full Chinese invasion force. Regardless, the idea of hellscape would be at least to delay the invasion by denying an instant fait accompli.[211] This makes hellscape the kind of tailored hedge that Caudle envisioned across the Navy's other geographic areas of operation.

FIGURE 15: VISUAL REPRESENTATION OF HELLSCAPE STRATEGY IN TAIWAN STRAIT SCENARIO



Source: Created by CSBA.

Enhancing Current Missions

Many other use cases for USVs involve enhancing the ability of manned assets to perform existing missions. A prime example is the LCS MCM mission module: The underlying MCM concept remains unchanged, but USVs can enhance the LCS crew's capability and capacity to complete their mission safely.

Another USV use case that could improve mission capability at the margins is the ACTUV concept described in chapter 2. Currently, the U.S. Navy employs tactical auxiliary general ocean surveillance (T-AGOS) ships as surveillance towed array sensory system (SURTASS) vessels tasked with underwater acoustic gathering.[212] T-AGOS vessels can require up to 40 personnel, and there is a limited number of ships available, making an ACTUV capability valuable. A flotilla of ACTUVs could thus bolster the end strength of the SURTASS fleet and enhance the Navy's ASW detection capabilities.

The U.S. Navy has also alluded to USVs aiding in logistics transportation. Although the program is now canceled, the solicitation for the MASC concept included a requirement for two containerized payloads weighing 36.3 metric tons each, with an additional capability of carrying 25 metric tons on deck. A high-capacity MASC with four of these payloads was

211 Rogin, "If China Attacks Taiwan."

212 "Ocean Surveillance Ship," U.S. Navy Military Sealift Command, accessed February 2, 2026, https://www.msc.usff.navy.mil/Ships/Ship-Inventory/Ocean-Surveillance-Ship/.

included in the same proposal.[213] The payloads could be used to carry missiles as part of the DMO concept, and they could also be used to resupply fleet elements or infantry forces.

USVs could augment many other capabilities. As these kinds of efforts are more evolutionary than revolutionary, they are also areas where USVs might contribute sooner than more complex concepts that may be years away from implementation.

213 O'Rourke, *Navy Large USVs*, p. 11.

CHAPTER 4

Categorizing Unmanned Surface Vessels

As the U.S. Navy develops concepts for using USVs in the fleet, it could benefit from a framework that formally categorizes them in a way that reveals useful USV CONOPS. As detailed in the introduction, some taxonomies organize USVs in terms of size: small USVs, MUSVs, and LUSVs. Others organize them in terms of the specific functions they are designed to carry out: OWA, missile salvo generation, sensing, network nodes, and logistics transport. These two regimes of USV categories are useful if the aim is to identify the physical traits and capabilities of certain USVs, but they do not help with the development of USV CONOPS. Concepts like DMO and the hedge force indeed identify roles for USVs, but USVs would be neither necessary nor sufficient components of any of these concepts if other systems or platforms—including manned platforms—could perform similar functions.

A new framework that describes USVs in terms other than size would better characterize the role they will play in the force architecture. Adopting such a framework would help the Navy identify the concepts involving USVs that have the most potential to support the U.S. Navy's mission areas. As chapter 3 detailed, USVs offer many potential advantages, but many uncertainties and challenges could prevent them from ever reaching the fleet and contributing in a meaningful way. Any useful USV categorical framework must divide USVs into categories that can be assessed in terms of both the contributions they can make to the Navy's missions and the risk that pursuing them could result in programmatic failure.

A New USV Framework

This study proposes a framework that categorizes USVs in a 2x2 matrix with two axes: longevity versus functionality (See figure 16). The longevity axis is a spectrum with single-use vessels like OWA USVs on one end and unmanned ships on the other. Longevity describes the inherent attritability of a certain type of USV design. A USV designed to

explode against a target is fully attritable, while an unmanned ship designed to shoot missiles is far less so. Functionality describes the nature of the task a certain type of USV is meant to do. This report treats functionality as a spectrum, with USVs meant for offensive strike on one end and USVs meant for supporting the rest of the fleet on the other end.

The longevity and functionality axes were chosen because they reveal broader USV CONOPS and help parse out concepts, distinguishing those that are easier to implement and those that have higher upsides.

Figure 16 shows the proposed USV framework with the four types of USVs displayed in their respective quadrants. Figure 17 shows where on this framework various kinds of existing USVs would lie. This section explains the rationale for these choices by discussing some of the USV advantages along each axis.

Why Longevity?

Longevity is a crucial trait because it distinguishes between USVs that behave like munitions and (typically) larger USVs that behave like ships.[214] This distinction is important because munitions-like USVs have several advantages over ship-like USVs and vice versa. For example, there would be less risk aversion to employing munitions-like USVs in dangerous areas because they are explicitly designed for this kind of operation. Ship-like unmanned vessels are estimated to cost at least $50 million apiece, which, although significantly less than a multibillion-dollar DDG, would still result in a significant loss if one were destroyed in battle.[215] As one author pointed out, if a platform is not designed to be expended, its perceived attritability might change depending on the use case or situation.[216] This is important because, as discussed in chapter 3, Navy officials have described ship-like USVs as attritable even though they may be reluctant to use them freely in combat.[217]

On the other hand, ship-like USVs have merits. They can bolster the fleet's end strength and add to its missile firepower, leveraging the advantages inherent to USVs discussed in chapter 3. As part of the DMO concept, they could help the U.S. Navy disaggregate its forces: Having more small, cheap combatants adds more useable missile inventory to the fleet and makes it harder for adversaries to target large portions of the U.S. Navy's offensive capability with a small number of anti-ship missiles.

214 Aaron Marchant, "Ships or Munitions? Clarifying the Discussion on Unmanned Surface Vessels," *War on the Rocks*, January 21, 2026, https://warontherocks.com/2026/01/ships-or-munitions-clarifying-the-discussion-on-unmanned-surface-vessels/.

215 Seck, "Navy to Simplify Drone Ship Plans."

216 Gray, "Attritable Naval Platforms. "

217 For example, Daryl Caudle described MUSVs as attritable in his answers to the Senate Armed Service Committee's advance questions for his CNO confirmation hearing. Daryl Caudle, *Senate Armed Services Committee Advance Policy Questions for Admiral Daryl L. Caudle, USN Nominee for Appointment to Be Chief of Naval Operations* (U.S. Senate Armed Services Committee, 2025), p. 43, https://www.armed-services.senate.gov/imo/media/doc/caudle_apq_responses.pdf.

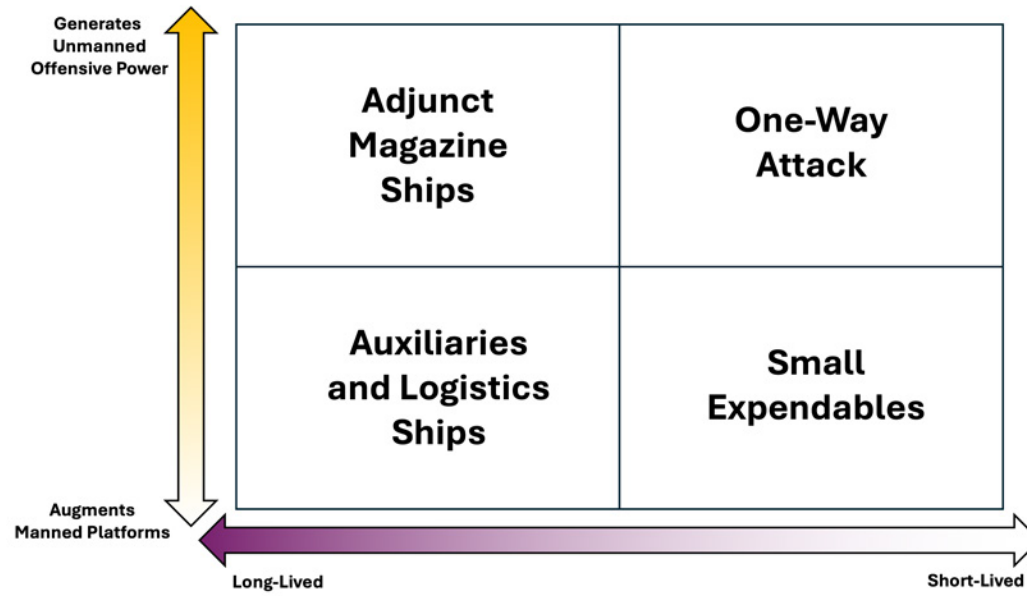
Why Functionality?

Functionality distinguishes USVs that directly generate offensive power for the fleet from USVs that support manned platforms. USVs that are meant to conduct offensive operations would fall toward the offense-focused end of the axis and USVs that augment manned platforms would fall toward the support-focused end of the axis.[218]

Functionality is a crucial trait because it can help narrow the various tasks USVs can perform. It allows an analyst to compare all USVs in terms of the extent to which they are indispensable to the fleet's offensive power. It complements the longevity axis to produce a richer framework for USV categories than one that simply defines them in terms of size or task.

This chapter provides more details about the advantages and disadvantages of each USV type, depending on where they fall on the longevity and functionality axes.

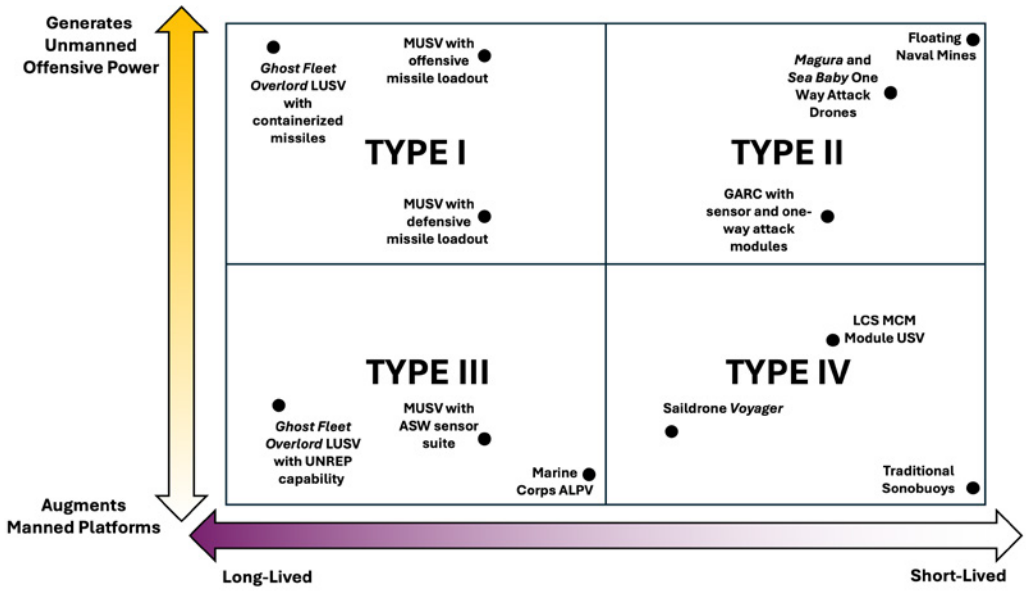
FIGURE 16: USV FRAMEWORK WITH EXISTING USV CONCEPTS



Source: Created by CSBA.

218 The assignment along the functionality axis can be subjective, given that some USVs might be designed with mission modules that could be either for offensive operations or for support. For example, a concept could use a MUSV armed with missiles both to fire those missiles and as a sensor node within a larger maritime strike network. Is this on the offense end of the axis, the support end, or somewhere in the middle? This report would place it toward the offense-focused end of the axis because the role of the USV is central to the offensive network and it could operate offensively on its own—it does not simply augment a manned platform.

FIGURE 17: NEW FRAMEWORK FOR EVALUATING USV TYPES



Source: Created by CSBA.

USV Conceptual Categories with Historical Analogies

This section defines the characteristics of each quadrant, explains where existing USVs and prototypical USV concepts could fit into the framework, and highlights previous naval innovations that share important characteristics with different approaches to USVs. These historical vignettes are not perfect one-for-one comparisons, but they can serve as points of departure for assessing the risk–reward dynamics.

Type I: Nonexpendable Offensive USVs—Adjunct Magazine Ships

Type I describes USVs that are relatively unexpendable and are built to generate offensive power. These are the missile-carrying USVs that bolster fleet end strength and contribute to the U.S. Navy's missile salvo capacity. They are meant to solve the problem of concentration. In large numbers, they will help the navy spread more of its offensive capacity across more vessels. The existing MUSV and LUSV variants—*Sea Hunter*, *Sea Hawk*, *Ranger*, and *Mariner*—would fall in this quadrant if they were loaded out with missiles or other anti-ship weapons.

The U.S. Navy acknowledges that with an estimated cost of $50 million apiece and a construction timeline of over three years, USVs of this general type would still be too

expensive and take too long to rebuild to sacrifice them in combat.[219] But because they are a fraction of the cost of manned vessels like DDGs and their loss would not lead to casualties, they would serve in the van of the fleet for scouting and strike operations.

Although they could add missile firepower to the fleet at a much cheaper cost than multimission platforms, Type I USVs likely would not include the capabilities that high-end manned platforms carry, such as ASW sensor suites and weapons, the Aegis missile defense system, or the SPY-6 radar that will be found on the Flight III *Arleigh Burke* DDGs.[220] Additionally, although Type I USVs would likely have more endurance than comparably sized manned surface vessels, they would be smaller than large manned platforms. This could mean that the rest of the fleet would be tethered to their range, assuming they would sail in formation with the Navy's manned platforms.

The types of offense-focused, nonexpendable USVs in this quadrant align well with the DMO concept, which requires many dispersed nodes that can fire missiles and create other offensive effects.[221] This harkens to the idea of arsenal ships from the 1990s, which were envisioned as a way to bolster the fleet's firepower while spreading it out among more platforms.[222] These ships would have been less capable overall than advanced multimission platforms, with hulls built to "merchant standards," but would have been equipped with over 500 vertical launch cells each to give operational commanders massive reserves of missile firepower.[223]

There are several reasons why the arsenal ship never materialized. The death of CNO Admiral Jeremy M. Boorda in 1996 meant the loss of a major supporter, and no other strong voices from within the U.S. Navy spoke up to articulate why the program was necessary. Without a major Navy proponent, the congressional defense committees terminated funding in FY98.[224] According to a retrospective report by the RAND Corporation that reviewed the program after its collapse, parochialism within the U.S. Navy's aviation community also bedeviled the program because the arsenal ship was viewed as a threat to the primacy of the

219 Interviews with U.S. Navy officers and defense civilians conducted by the author from September 2025 to February 2026. $50 million cost based on Seck, "Navy to Simplify Drone Ship Plans." Delivery timeline based on Sam LaGrone, "Navy Takes Delivery of Sea Hawk Unmanned Vessel," *USNI News*, April 8, 2021, https://news.usni.org/2021/04/08/navy-takes-delivery-of-sea-hawk-unmanned-vessel.

220 "Destroyers (DDG 51)," United States Navy, March 4, 2025, https://www.navy.mil/OLD-PAGES/Fact-Files-OLD/Display-FactFiles-OLD/Article/2169871/destroyers-ddg-51/.

221 O'Rourke, *Defense Primer.*

222 Ronald O'Rourke, *Navy Guided Missile Battleship (BBG[X]) Program*, Background and Issues for Congress No. IF13142 (Washington, DC: Congressional Research Service, 2026), p. 2, https://www.congress.gov/crs_external_products/IF/PDF/IF13142/IF13142.3.pdf.

223 Norman Polmar, "The U.S. Navy: More Bang for the Buck," *Proceedings* 122, no. 1, January 1, 1996, https://www.usni.org/magazines/proceedings/1996/january/us-navy-more-bang-buck.

224 Robert Leonard et al., *The Arsenal Ship Acquisition Process Experience* (Santa Monica, CA: RAND, 1999), pp. 83–84, https://www.rand.org/content/dam/rand/pubs/monograph_reports/2009/MR1030.pdf.

aircraft carrier.[225] Many opponents of the program were also skeptical that the ship would be survivable in conflict, given that it lacked an organic defensive capability despite being designed to carry an enormous number of valuable weapons.[226]

These are the same kinds of challenges that Type I magazine USVs could face as they begin their programs of record. The success of these adjunct magazine ships will require the U.S. Navy to surmount many hurdles—the technical challenges associated with operating ship-like USVs at sea, the steep DOTMLPF-P related challenges for ship-like platforms that require refueling and rearming, and the challenges of networking ships together in formations that operate effectively. They will need champions in the Navy to make the case for why they are worth the investment given the difficult road ahead—and to avoid the same fate as some of the Navy's other recent shipbuilding programs.

Type II: Expendable Strike Platforms

Type II USVs are also offense focused, but unlike Type I magazine ships, they are more expendable. This quadrant of the framework includes OWA USVs as well as any USV that is itself a munition. As such, they are more similar to mobile naval mines than to ships and could be employed in a similar fashion: quickly transiting to a patrol area and either detonating or persisting in that area until commanded to move or detonate.[227] Type II USVs thus would operate with a wholly different kill chain and with a different kill mechanism than Type I magazine ship USVs.

In terms of longevity, as discussed in chapter 3, Type II USVs are explicitly designed to be used in combat to attack the enemy, so there would be little downside to employing them in dangerous areas. Their expendability also means there would be fewer operational problems to consider than with unmanned surface ships, such as the challenges of repairing, refueling, and rearming at sea. The U.S. Navy would still need to maintain them, store them, and develop doctrine to employ them. However, as evidenced by Ukraine, these barriers are surmountable.

By providing the kind of tailored offset capability that Caudle referred to in his 2026 *Fighting Instructions*, Type II USVs would be particularly useful in support of the U.S. Navy's hedge strategy or as part of a sea denial concept like hellscape.[228] Not only would they augment the fleet, but they would also be at the center of its offensive capability, albeit an offensive capability very different from the missile barrages that could be generated by Type I USVs.

225 Leonard et al., *Arsenal Ship Acquisition Process Experience*, p. 85.

226 Dawn H. Driesbach, "The Arsenal Ship and the U.S. Navy: A Revolution in Military Affairs Perspective" (master's thesis, Naval Postgraduate School, 1996), p. 61, https://apps.dtic.mil/sti/tr/pdf/ADA327039.pdf.

227 For a discussion on how such munitions would be employed, see Clark, "Sea Drones in the Russia–Ukraine War."

228 Caudle, "U.S. Navy Fighting Instructions," p. 18.

Along with naval mines, this has parallels with the development of the torpedo and its associated delivery platforms in the late 19th century, which disrupted the paradigm of rifled gunfire salvo exchanges. During this era, the sine qua non for naval power was the salvo capacity of big gun battleships. Automatic torpedoes upended this dynamic by introducing a completely new kill mechanism.[229] They were asymmetric weapons because they could be launched by small, inexpensive, and relatively expendable torpedo boats, but they were powerful enough to destroy entire battleships. This is why some of the early proponents of torpedoes and torpedo platforms were the so-called *Jeune École* naval officers of late 19th-century France, who were trying to devise a strategy that could threaten Britain's much stronger Royal Navy.[230] In a similar way, Type II USVs offer a novel sea denial capability that lies outside the typical gun or missile competition.

The torpedo-centric *Jeune École* never truly offset the more powerful British fleet—the French suffered humiliation in the Fashoda Crisis of 1898 when, after raising the tricolor over the Nile, the French fleet of torpedo-armed commerce raiders opted not to attempt to resupply French ground forces in the face of Britain's Mediterranean-based battleships.[231] In a similar way, Type II munitions-like USVs could prove impotent in the face of a more powerful naval threat if they are not supported by a traditional naval force and a sound conceptual strategy. One of the problems with the French fleet was its lack of strategic coordination, and the same problem could befall U.S. employment of munitions-like USVs if it is done haphazardly.[232]

Another instructive historical case that mirrors the development of Type II USVs was the JAVAMAN Project, originally codenamed "Project Campbell," during World War II. Run by the Office of Strategic Services (OSS), the project developed remote controlled "missile craft" made to resemble fishing vessels and loaded with explosives. OSS planned to use them to sabotage enemy targets that could only be attacked with operational deception. It never had the chance to use them in combat because Japan had surrendered by the time they were ready for testing.[233]

This offers two important lessons. First, like modern Ukrainian efforts with OWA drones, the JAVAMAN project was run by a special unit and not the regular navy. This suggests that special operators might be the best equipped to deploy Type II USVs given their proficiency with deceptive action. Second, it points to how USV efforts can be overcome by events if they

229 "Automatic" refers to self-propelled torpedoes, as opposed to the rudimentary mines of the time that were also called "torpedoes."

230 Erik J. Dahl, "Net-Centric Before Its Time—The Jeune École and Its Lessons for Today," *Naval War College Review* 58, no. 4, 2005, p. 6.

231 Dahl, "Net-Centric Before Its Time," p. 118.

232 Steve Wills, "The Perils of Alternative Force Structure," Center for International Maritime Security, October 3, 2016, https://cimsec.org/perils-alternative-force-structure/.

233 *War Report of the OSS (Office of Strategic Services),* vol. 1, History Project, Strategic Services Unit, Office of the Assistant Secretary of War, War Department, Washington, D.C. (New York, NY: Walker and Company, 1976), p. 230.

are not developed quickly. The JAVAMAN project never contributed to U.S. combat operations in World War II; likewise, the U.S. military might never field effective Type II USVs if it fails to develop them before a Chinese invasion of Taiwan.

Type III: Support Ships and Auxiliaries

The third quadrant of the framework contains USVs that are nonexpendable but are not offense focused. Type III USVs perform fleet support functions that could include contested logistics tasks like transporting supplies within a WEZ—the kind of function that requires a vessel as large as a corvette but where the risk to human life is too high to use a manned platform. This could also include contested search and rescue, where a larger vessel would be required to accommodate a human passenger for a short time.

Certain types of vessels could fall under Type I or Type III depending on their payload. The U.S. Navy's MUSV is a ship-sized vessel with a modular payload that could be used for containerized missiles, logistics shipments, sensor suites, or other kinds of packages.[234] When fitted out as transport ships or sensor ships, these vessels would be categorized as Type III USVs. Similarly, the U.S. Marine Corps has experimented with using Type III USVs like the ALPV described in chapter 2 to deliver supplies ashore as part of its stand-in forces concept.[235] Given the shortage of U.S. mariners, not to mention questions about the availability of civilian volunteers in wartime, using USVs for this task could provide a significant benefit to the fleet.[236] Using Type III USVs would also allow the Navy to disperse its logistics capacity across more ships, enhancing its resilience. The technical mechanics of transferring supplies or conducting replenishment could still be relatively challenging and require manned support, but recent demonstrations have shown the feasibility of simple versions of these operations.[237]

Another fleet support use case could involve MUSVs or LUSVs serving as nodes in an acoustic sensing network, which was demonstrated by *Sea Hawk*'s maneuvers during RIMPAC 2022.[238] USVs are better suited for this task than unmanned systems in the undersea or air domains because they operate on the surface of the water and can simultaneously sense below the surface while transmitting data across the electromagnetic (EM)

234 O'Rourke, *Navy Large USVs*.

235 Aaron-Matthew Lariosa, "Marines Test Supply Drones Inspired by Narco Subs in Okinawa, North Carolina," *USNI News*, April 23, 2025, https://news.usni.org/2025/04/23/marines-test-supply-drones-inspired-by-naro-subs-in-okinawa-north-carolina.

236 For a discussion on the question of civilian mariners serving in war time, see Steven Wills, ed., *Returning from Ebb Tide: Renewing the United States Commercial Maritime Enterprise* (Quantico, VA: Marine Corps University Press, 2025), 252, https://doi.org/10.56686/9798987336267.

237 Monford, "Unmanned Surface Vessels Conduct Underway Replenishment."

238 Megan Eckstein, "US Navy Injects First-of-Kind Unmanned Experiments into Multinational Exercise," *Defense News*, August 8, 2022, https://www.defensenews.com/naval/2022/08/08/us-navy-injects-first-of-kind-unmanned-experiments-into-multinational-exercise/.

spectrum to other units.[239] Only USVs the size of a ship would be able to meet the power and propulsion requirements for employing towed sonar arrays, which may preclude smaller, expendable craft from operating them. These types of sonar arrays are required for the most advanced acoustic sensing. Thus, only ship-sized USVs would be able to conduct the kind of ASW sensing that could augment the fleet's ability to track submerged contacts at long ranges.[240]

This could augment the capabilities of the U.S. Navy's T-AGOS SURTASS ships described in chapter 3. Ship-sized USVs like the MUSV that are equipped with ASW suites could indeed prove effective at maintaining continuous track of adversary undersea forces, assuming enough of them were available. The U.S. Navy currently fields five SURTASS vessels that support the Navy's Integrated Undersea Surveillance System by conducting theater ASW passive and active surveillance.[241] Although these vessels are extremely capable, there are not enough of them to ensure wide coverage of the undersea domain, especially in the open ocean of the Atlantic or Pacific. Having more Type III vessels that could perform these tasks would be a significant boon to the U.S. Navy's ASW mission.

Type III USVs have parallels with the introduction of aircraft carriers to the U.S. Navy before World War II. U.S. naval officers initially viewed naval aviation as a means of enhancing fleet scouting capability by spotting for battleship gunfire.[242] Additionally, naval aviation was meant to defend the most important parts of the battle fleet—the battleships—from the enemy's land-based bombers.[243] These incipient concepts saw naval aviation performing functions that at first sought only to augment the way the fleet fought in combat rather than fundamentally changing it. This suggests that Type III USVs might initially serve support functions but, like the aircraft carrier, could eventually assume new roles. This type of incremental approach could reduce the risk of programmatic failure.

Type IV: Expendable Support Craft—Sensors

Type IV includes USVs that are relatively expendable and perform fleet support roles rather than offensive functions. These kinds of USVs could be sensors for MDA because they can be mass produced and deployed widely across the surface of the water to maximize sensor coverage. They would not, however, be large enough to carry containerized payloads.

239 Savitz et al., *U.S. Navy Employment Options for USVs*, p. xxi.

240 For a sense of the size of the handling systems required aboard vessels that stream towed sonar arrays, see "Towed Array Handling Systems," Curtiss-Wright, accessed February 19, 2026, https://electro-mechanicalsystems.curtisswright.com/indal/products/underwater-sensor-handling/towed-array-handling-systems.

241 Ronald O'Rourke, *Navy TAGOS-25 Ocean Surveillance Shipbuilding Program*, Background and Issues for Congress No. IF11838 (Washington, DC: Congressional Research Service, 2025), p. 1; and "Ocean Surveillance Ship."

242 Rosen, *Winning the Next War*, 68.

243 John T. Kuehn, *Agents of Innovation: The General Board and the Design of the Fleet That Defeated the Japanese Navy* (Annapolis, MD: Naval Institute Press, 2008), p. 88.

An example of what a Type IV USV would look like is the Saildrone *Voyager*, which is advertised as a very small long-endurance USV meant for interdicting illicit activity and general MDA.[244] A more abstract example is a sonobuoy, which can be deployed in various configurations by maritime patrol aircraft but only functions for several hours before running out of power.[245] Small, relatively expendable USVs with active acoustic sensors could augment the fleet's ASW capability by serving as more persistent sonobuoys. While Type III vessels would stream towed arrays, Type IV USVs could transmit active sonar and relay the data they receive to aircraft or other vessels. Much as Type II vessels are analogous to mobile sea mines, Type IV vessels could also redeploy as mobile sonobuoy fields.

Type IV USVs could form a massive network of individual nodes across the maritime battlespace, sharing sensor data with one another and with controlling stations like a MOC. Aerial assets would have a much larger sensor horizon, but operating on the surface of the water offers greater endurance.[246] Enough USVs, perhaps with overlapping sensor horizons across a wide area, could also mitigate this inherent disadvantage.

Small, highly expendable USVs would also make sense for the MCM mission given the inherent danger of minesweeping. Indeed, the MCM mission module on the LCS uses USVs of this category. Even though this mission is the Navy's most mature USV application, many challenges must still be addressed. For example, the MCM USVs deployed from LCS vessels do not yet have the ability to transmit mine position data back to the LCS and must be recovered.[247] Reliable remote data exfiltration will be necessary to make USVs of all kinds useful, and the fact that it is not yet an inherent capability for the Navy's most advanced USV program indicates that USV technology has a long development path ahead. Once this technical challenge is mastered, the MCM mission set will be a natural fit for Type IV USVs.

Further in the future, Type IV vessels could be ideal surface vessel decoys or jammers.[248] Their expendability could be used to draw fires away from more valuable units. It will take more technical maturation to lure advanced munitions away from larger targets, but this could significantly enhance the fleet's defensive capability.

244 "Saildrone Voyager: Autonomous Coastal Defense & Mapping USV," Saildrone, accessed February 11, 2026, https://www.saildrone.com/platform/voyager.

245 "AN/SSQ-53D DIFAR Sonobuoy," Ultra Maritime, 2024, https://umaritime.com/wp-content/uploads/2024/02/SSQ-53D3-Passive-Directional-Sonobuoy-Feb-2024.pdf .

246 Savitz et al., *U.S. Navy Employment Options for USVs*, p. xxii.

247 Based on interviews with U.S. Navy officers conducted by the author in February 2026.

248 Victor Sussman, "USVs Are Key in the Counter–A2/AD Fight," U.S. Naval Institute, June 1, 2020, https://www.usni.org/magazines/proceedings/2020/june/usvs-are-key-counter-a2ad-fight.

Finally, Type IV vessels could contribute to port defense. Operators at the U.S. Navy's TF 66 in the European AOR are already using the GARC for this purpose.[249] The benefit of using such expendable craft in this way is that they can be mass produced to cover a wide area for a long period of time.

An early example of a naval innovation that mirrors Type IV USVs is the airships that were meant to help with spotting and contribute to what is now called MDA. Although not as expendable as a modern sonobuoy, they were much more so than early 20th-century ships of the line. The Imperial German Navy provides an instructive case study into their use. Seeing itself as inferior in naval power to the Royal Navy, it looked for innovative technological advantages outside of traditional naval shipbuilding programs and developed a scouting system based on the proliferation of zeppelin airships.[250] Before the Battle of Jutland, Admiral Scheer of Germany's Naval Airship Service counted on his airships to warn him of approaching British forces. The airships proved ineffective in the poor weather of the North Sea, however, and they failed to contribute much to the outcome of the battle.[251]

The U.S. Navy likewise tested dirigibles for naval applications, launching the DN-1 airship in 1915, and it continued producing airships and exercising them during the interwar period.[252] In 1919, the Navy's General Board called rigid airships a "necessity for supplementing long distance scouting for the fleet."[253] As the U.S. Navy continued building them through the 1920s, rigid airships became a key element of the naval scouting force in War Plan ORANGE, the Navy's war plan against Japan.[254] With advances in carrier aviation and heavier-than-air technology, lighter-than-air options became less necessary. Fleet problems in 1929 and 1930 appeared to validate new carrier aviation tactics, techniques, and procedures, and though the airship *Los Angeles* successfully scouted an enemy carrier in Fleet Problem XI in 1931, it was simulated as being destroyed by the carrier's aircraft. This led many naval officers to question the military usefulness and cost sense of employing airships.[255] A series of fatal crashes, including one that killed Rear Admiral William Moffett, chief of the Navy's Bureau of Aeronautics, convinced the public and many naval officers that airships were dangerous. This not only led more naval officers to doubt airships' utility, but it also cost the Navy one of its most ardent airship supporters.[256]

249 Based on interviews with U.S. Navy officers conducted by the author in January 2026.

250 Douglas Robinson, "Zeppelins in the German Navy, 1914–18," *Proceedings*, July 1, 1956, https://www.usni.org/magazines/proceedings/1956/july/zeppelins-german-navy-1914-18.

251 Robinson, "Zeppelins in the German Navy."

252 "Airships & Dirigibles," Naval History and Heritage Command, U.S. Navy, accessed February 17, 2026, http://public2.nhhcaws.local/browse-by-topic/exploration-and-innovation/airships-dirigibles.html.

253 Quoted in Casey L. Miller, "'What About the Airship?': Military Innovation, Rigid Airships, and the U.S. Navy (1900–1939)" (master's thesis, Naval Postgraduate School, 2020), p. 38, https://apps.dtic.mil/sti/trecms/pdf/AD1114265.pdf.

254 Miller, "'What About the Airship?,'" p. 53.

255 Miller, "'What About the Airship?,'" p. 97.

256 Miller, "'What About the Airship?'"

Although airships are not as expendable as modern Type IV USVs, the history of their development provides some insight into sensor-like USVs that are meant to augment, not replace, main elements of the battle fleet. Type IV USVs could face the same fate that dirigibles faced after the development of heavier-than-air naval aviation. This could happen because of the proliferation of space-based assets that can provide relatively exquisite MDA for the surface of the ocean, obviating the need for sensor-like USVs. To avoid the fate of naval dirigibles, the U.S. Navy would need to lean into the advantages that only expendable sensor-like USVs can provide—extreme persistence in a patrol area, the ability to be mass produced and thus cover a large area without the adversary knowing their exact locations, and the ability to provide awareness in domains where satellites cannot easily see, such as the undersea. Like both the arsenal ship efforts of the 1990s and the airship efforts of the interwar period, much depends on the support of influential naval officers.

CHAPTER 5

Assessing Unmanned Surface Vessel Types by Naval Mission, Scenario, Risk, and Expected Value

The four quadrants of this new USV framework can help explain how USVs could contribute to the U.S. Navy's force structure. This in turn could help strategists understand the best USVs to employ for certain naval missions and by extension the best USV concepts to employ against different threats.

This chapter begins by assessing the optimal naval missions for each quadrant of the chapter 4 framework. It examines the four naval missions outlined by Admiral Stansfield Turner in his seminal essay, "Missions of the U.S. Navy": sea control, naval presence, power projection, and strategic deterrence.[257] After these assessments, the report matches optimal USV concepts to various adversaries, threats, and applications, assessing the best kinds of USVs to match against particular threats and scenarios that range from specific adversaries—e.g., China and Russia—to broader concepts like homeland defense or power projection in small wars. Finally, this chapter assesses the likelihood that the U.S. Navy will succeed at developing the various USVs described by the framework.

Matching the USV Concept Types to Naval Missions

Turner defined four missions of the U.S. Navy: strategic deterrence, sea control, naval presence, and power projection.[258] This report considers potential USV contributions to each of

257 Hattendorf and Naval War College, *US Naval Strategy in the 1970s*, p. 32.

258 Hattendorf and Naval War College, *US Naval Strategy in the 1970s*, p. 32.

these missions except strategic deterrence. It also considers the mission of sea denial within the broader context of sea control.

Sea denial is defined as "partially or completely denying the adversary the use of the sea in specified areas," and *sea control* is defined as "the freedom of action to use the sea in specified areas and for a specified time."[259] Turner used sea control interchangeably with the idea of command of the sea and explained that this concept involved the protection of shipping and overseas military expeditions.[260] For this report, sea control involves the ability to destroy any adversary forces that threaten the U.S. Navy's ability to safely use the surface of the ocean, and sea denial involves the ability to destroy any enemy forces using the maritime domain.

Power projection, to Turner, involved the use of a navy to conduct assaults on land, initially with amphibious forces. Sea control and power projection thus go hand in hand, as sea control extends from protection of shipping to the protection of amphibious forces.[261] Joint Publication 3-32 (JP 3-32) makes a distinction for power projection from the maritime domain, which "includes a broad spectrum of offensive military operations to destroy enemy forces, their logistic support, or to prevent enemy forces from approaching within enemy weapons range of friendly forces."[262] This report defines power projection as the capacity to send ground forces ashore or destroy any target on land.

JP 3-32 defines *forward presence* as "maintaining forward deployed or stationed forces overseas to demonstrate national resolve, strengthen alliances, dissuade potential adversaries, and enhance the ability to respond quickly to contingencies."[263] Turner defined presence more generally as a range of activity involving warning, coercion, and demonstrations of good will.[264] This report adopts a definition of presence whereby a navy can influence adversary actions by the physical presence of a naval asset.

Examining how each quadrant of chapter 4's USV framework fits into these missions provides insights into which concepts involving USVs the U.S. Navy could feasibly employ.

Type I: Adjunct Magazine Ships for Sea Control, Sea Denial, and Power Projection

Ship-like, offensively focused USVs would excel at sea control, power projection, and to a lesser extent sea denial because of their missile armament. Their offensive functions would mirror those of today's manned surface forces that can fire missiles. For power projection

259 "DoD Dictionary of Military and Associated Terms," p. 141.

260 Hattendorf and Naval War College, *US Naval Strategy in the 1970s*, p. 34.

261 Hattendorf and Naval War College, *US Naval Strategy in the 1970s*, p. 34.

262 "Joint Publication 3-32: Command and Control for Joint Maritime Operations," DoD, August 7, 2013, p. I–4, https://edocs.nps.edu/2012/December/jp3_32.pdf.

263 "Joint Publication 3-32," p. GL-5.

264 Hattendorf and Naval War College, *US Naval Strategy in the 1970s*, p. 35.

missions, their missiles could threaten any land targets within range. Likewise, they could hold any targets on the surface of the ocean at risk, allowing them to deny the sea to any adversary susceptible to missile fire. Both attributes could neutralize the adversary's missile batteries, which could threaten U.S. command of the sea. Also, as some authors have envisioned, missile-armed USVs could contribute to the sea control mission by providing air defense of high value platforms, such as aircraft carriers.[265]

Type I USVs would contribute to the missions of the navy differently than manned ships. As part of fleet formations, Type I USVs would likely be sent ahead of the fleet's higher-end manned platforms, if commanders were willing to use them as scouts.[266] Being in the van, they could carry relatively short-range missiles because they would operate closer to enemy targets. They could also help form the backbone of a network-centric fleet, as they would meet many of the requirements of such a force: they would be small and agile, with enough numbers to be dispersed over a large area.[267] On the other hand, Type I USVs would not contribute as much to the naval presence mission as manned surface platforms. Although their presence could certainly shape adversary behavior, they would be less likely to demonstrate U.S. national resolve than would the deployment of a manned surface asset to a theater.

Type II: Expendable Strike Platforms for Sea Denial

The expendable, munitions-like vessels designed for offensive operations in Type II would be optimized to perform the sea denial mission. They would have a more limited ability than Type I vessels to create effects on land and thus would not be able to conduct power projection operations or create the necessary conditions for sea control. In some ways, however, they could be even more effective than Type I USVs at denying the adversary the use of the sea, given the great range at which they could be employed if controlled remotely, their extreme expendability, the prospect of their mass production, and their survivability against missiles.

Although Type II USVs might not excel at the variety of naval missions Type I USVs could perform, these characteristics might make them better sea denial platforms. Although lessons about drone use in the Russo-Ukrainian War should not be overstated, Ukraine's success using small, OWA surface drones against Russia illustrates how they can be used to

265 Jordan Spector, "UxS Priority One: Defend the Carrier," *Proceedings*, March 1, 2026, https://www.usni.org/magazines/proceedings/2026/march/uxs-priority-one-defend-carrier.

266 See discussion in Chapter 3 regarding whether Quadrant I USVs would truly be considered expendable assets.

267 For a discussion on the required characteristics of network-centric fleet forces, see Stuart E. Johnson and Arthur K. Cebrowski, *Alternative Fleet Architecture Design* (Fort Belvoir, VA: Defense Technical Information Center, 2005), vii–viii, https://doi.org/10.21236/ADA450098.

great effect to deny certain crucial sea lanes even without the support of larger multimission naval platforms.[268]

Type III: Support Ships and Auxiliaries for Enabling Sea Control, Power Projection

Type III USVs would contribute the most to the sea control mission by acting as logistics support vessels and advanced ASW support vessels. Using them as logistics ships in contested environments would help keep sea lanes open when it might be too risky to employ manned vessels. Enabling better undersea sensing as ASW support vessels would also contribute to the sea control mission by ensuring that the U.S. Navy could locate, track, and if necessary engage adversary submarines, keeping other units safe from this threat.

Type III support ships would likely not contribute significantly to the naval presence mission for the same reason that Type I magazine ship USVs would not. Support-focused ship-like USVs would also not add much to power projection, except for limited cases where logistics ships aid in transporting materiel ashore in support of ground force operations.

Type IV: Expendable Support Craft for Sea Control, Sea Denial

The small, sensor-like USVs in Type IV of the framework could also contribute to the sea control mission via MCM operations, and they could contribute to ASW operations much as expendable sonobuoys do today: by enhancing the U.S. Navy's ASW capabilities and thus its ability to achieve sea control. Finally, if they could be employed as decoys or jammers, this would help keep larger, more valuable platforms safe, thus enabling control of sea lanes.

Type IV USVs could also contribute to the U.S. Navy's sea denial mission. Serving as large sensor networks for MDA or as mobile sonobuoy sensor fields, they could help the U.S. Navy control the maritime battlespace by scouting enemy forces, limiting their ability to maneuver while enabling the movement of friendly forces. Thus, like Type III platforms, Type IV USVs would enhance the missions that the manned fleet already performs by doing them in more focused ways.

Table 2 summarizes the four USV types and the missions they optimally support.

268 Clare, *Navy of Necessity*.

TABLE 2: USV TYPES AND MISSIONS OF THE NAVY

Missions of the Navy	USV Types			
	I	II	III	IV
Sea Control	●		●	●
Sea Denial	●	●		●
Power Projection	●		●	
Naval Presence				

Source: Created by the author.

Matching the USV Concept Types to Adversaries, Threats, and Scenarios

Based on this assessment, which USVs are best suited for which scenarios? The U.S. Navy has described the hedge force concept from chapter 3 in relatively vague terms; this section uses the framework described in chapter 4 to elucidate what tailored USV forces might look like given certain specific threats or scenarios.[269] This methodology could extend to any fleet concept that features USVs.

Western Pacific Amphibious Invasion Denial

In the Western Pacific, the U.S. Navy is preparing for the sea denial mission against the PRC, which fields a precision strike network designed to prevent U.S. intervention in the theater by overwhelming the defenses of U.S. warships with masses of advanced anti-ship missiles. Given the mission and the threat environment, Type II munitions-like USVs are better suited than missile-shooting Type I USVs. Type III USVs could contribute by performing contested logistics tasks, and Type IV USVs could help enhance the U.S. Navy's MDA.

Type I USVs might not be as effective against China as many believe because of the PLC's anti-ship missile advantage. China would likely have a significant advantage over the United States in a missile salvo exchange, though it is difficult to quantify this with precision. According to the 2025 DoD report on Chinese military power, China has the world's largest hypersonic missile inventory; the products of its missile industry are similar in quality to those of other top-tier producers; and it continues to advance its intelligence, surveillance,

269 U.S. Navy CNO Admiral Daryl Caudle defined a "hedge strategy" as one that consists of a "general-purpose" force and a "hedge force." The hedge force consists of "tailored offsets" that are "modular, scalable, rapidly deployable, adaptable, and cost-effective." Later, he provided examples of tailored forces that include "RAS for non-traditional sea denial," but did not provide any further details. Caudle, "U.S. Navy Fighting Instructions," pp. 20, 26.

and reconnaissance (ISR) capability so it can effectively target U.S. assets.[270] China's navy already has a significant local advantage in shipboard vertical launch system cells—typically used by analysts as a measure of relative maritime strength—over the surface combatants attached to the U.S. Seventh Fleet.[271] At the high end, 14 U.S. Navy *Arleigh Burke* destroyers in theater yields 1,344 vertical launch system cells; this compares with 2,944 cells within the PLAN (896 cells from China's eight Type 055 cruisers and 2,048 cells from its 32-Type 052D destroyers).[272] This does not count the smaller vertical launch cells on China's Type 054A/B frigates: Include these, the box-launched missiles carried aboard China's smaller naval combatants, and the PLA Rocket Force's anti-ship ballistic missiles and land-based cruise missiles, and China's total anti-ship missile advantage over the United States is even more lopsided.

The U.S. Navy would need to have a comparable number of missiles in a salvo exchange and would need to successfully target China's relevant missile shooters for the exchange not to result in a sharp defeat of U.S. forces. If Type I unmanned surface ships armed with missiles are intended to help the U.S. Navy restore missile salvo balance, they are unlikely to do so. Corvette-sized USVs are still vulnerable to being targeted from the air. Even if the U.S. Navy succeeded at building a 450-ship force by FY31 that included the unmanned combatants called for in the 2026 shipbuilding plan, that would not change the anti-ship missile salvo balance given China's massive advantage.[273] The U.S. Navy would simply not be able to build enough hulls to make much of a difference.

Type II munitions-like USVs are better suited for a sea denial mission against an adversary with a missile firepower advantage. Their lower susceptibility to anti-ship missiles presents an asymmetric, offsetting option. China would not be able to use its biggest strength against them effectively, and, like mines, they could be deployed to persist in the maritime domain until activated, which could create doubt in the minds of China's military planners.

Therefore, an optimal sea denial force for the Western Pacific would be made up of Type II USVs operating within the Chinese WEZ, allowing manned platforms to operate further away in relative safety. Any contested logistics functions that must be accomplished could

270 DoD, *Annual Report to Congress*, p. 61.

271 See discussion on evaluating U.S. Navy capabilities by the "total force battle network" found in Robert Work, *The US Navy: Charting a Course for Tomorrow's Fleet* (Washington, DC: Center for Strategic and Budgetary Assessments, 2008), p. 13; The number of U.S. surface combatants attached to U.S. Seventh Fleet was determined from "U.S. 7th Fleet Facts Sheet," U.S. 7th Fleet, accessed October 3, 2025, https://www.c7f.navy.mil/About-Us/Facts-Sheet/.

272 PLAN VLS cell numbers determined from "Luyang III (Type 052D/052DL/052DM) Class Fact Sheet," Janes, January 22, 2026, https://customer-janes-com.pentagonlibrary.idm.oclc.org/display/JFS_B684-JFS_; and "Renhai (Type 055) Class Fact Sheet," Janes, January 26, 2026, https://customer-janes-com.pentagonlibrary.idm.oclc.org/display/JFS_C455-JFS_.

273 For an instance when a corvette-sized vessel was successfully targeted from the air, see Tayfun Ozberk, "Ukraine Strikes Russian Project 21631 Buyan-M Class Corvette with Drones," *Naval News*, September 1, 2025, https://www.navalnews.com/naval-news/2025/09/ukraine-strikes-russian-project-21631-buyan-m-class-corvette-with-drones/. On the 2026 shipbuilding plan, see Cao, "U.S. Navy Shipbuilding Plan," p. 15.

benefit from Type III ship-like USVs, but these platforms would also be susceptible to the anti-ship missile threat. Type IV USVs, with their smaller hull form, would be more survivable within the WEZ and could also be an asset for MDA and fleet scouting.

Anti-Submarine Warfare Against Russia and China

In the North Atlantic, the U.S. Navy already has several allies that are experimenting with USVs to help with their maritime defense (see chapter 2). As a result, many of the supporting functions that U.S. Navy USVs could perform in a European theater conflict might be duplicative. The undersea threat from the RFN submarine force, however, may be one of the most acute challenges for which U.S. allies do not yet have a solution. Between the RFN undersea threat in the Atlantic and a possible future PLAN undersea threat in the Pacific, the U.S. Navy would benefit from employing Type III USVs to enhance ASW sensing and the dissemination of acoustic intelligence.

Russia retains a capable and growing undersea force.[274] It continues to deploy quiet, multirole submarines to the Atlantic and the Arctic Oceans from the Northern Fleet, as well as to the Pacific from Russia's Pacific coast. This includes three highly advanced *Severodvinsk*-class guided missile submarines that can carry nuclear-armed cruise missiles.[275] Not only could these deployments pose a threat to CONUS, but with a maximum sustained speed over 30 knots, even some of the U.S. Navy's best submarines find it extremely difficult to track them effectively.[276]

China is expanding its ability to conduct more submarine deployments in the open ocean of the Pacific. It recently conducted an extended exercise with RFN submarine forces, and its newest nuclear-propelled attack submarine program is meant to rival both the U.S. Navy's *Virginia*-class and the RFN's *Severodvinsk* in sustained blue-water endurance.[277]

To contend with the undersea threat from the RFN in the Atlantic and Northern Pacific and from the PLAN in the open ocean of the Pacific, the U.S. Navy could use more high-quality acoustic sensing. Type III USVs outfitted with towed sonar arrays could augment the fleet's ASW capabilities. Multiple Type III ship-type USVs could serve as high-endurance ASW

274 Jeffrey Kruse, "2025 Worldwide Threat Assessment," U.S. Defense Intelligence Agency, May 11, 2025, https://armedservices.house.gov/uploadedfiles/2025_dia_statement_for_the_record.pdf.

275 Nils Stensones, "Focus 2026: The Norwegian Intelligence Service's Assessment of Current Security Challenges," Norwegian Intelligence Service, January 23, 2026, p. 29; and Dave Majumdar, "U.S. Navy Impressed with New Russian Attack Boat," *USNI News*, October 28, 2014, https://news.usni.org/2014/10/28/u-s-navy-impressed-new-russian-attack-boat.

276 Majumdar, "U.S. Navy Impressed."

277 "China Launches First Type 095 'Sui-Class' Nuclear Attack Submarine—Satellite Imagery Confirms Stealth SSN Rivaling U.S. *Virginia*-Class and Russia's Yasen," *Defence Security Asia*, February 13, 2026, https://defencesecurityasia.com/en/china-type-095-sui-class-nuclear-attack-submarine-bohai-ssn-launch/; and Meredith Chen, "Russian and Chinese Submarines Join Forces in Pacific Patrol First," *South China Morning Post*, August 28, 2025, https://www.scmp.com/news/china/military/article/3323527/russian-and-chinese-submarines-join-forces-pacific-patrol-first.

pickets in the Northern Atlantic, for example by patrolling the Greenland–Iceland–UK Gap to monitor Russia's advanced undersea threats.

Type III USVs would be more effective than any other type of vessel for this ASW tasking. Type II and Type IV vessels, being small and expendable, would likely not have the endurance on the high seas for continuous ASW sensing operations. Type I USVs exclusively fitted out with missiles would not be an effective threat against undersea forces.

High Seas Fleet-on-Fleet Battle

Another combat scenario that the U.S. Navy could face in coming decades is a fleet-on-fleet battle against a peer rival on the high seas. With the PLAN beginning to operate multiple aircraft carriers and their retinue of warships outside the First Island Chain, such a fleet battle could occur between the United States and China.[278] China is building its fourth aircraft carrier now and has plans to reach a total of nine carriers by 2035.[279] These carriers, along with the smaller surface platforms China is building, could constitute a force on par with the U.S. Navy's battle force. One analysis predicts that by 2028 the PLAN could field more VLS cells worldwide than the U.S. Navy.[280] The PLAN's building capacity points to the possibility that China could have the first navy in years that can compete with the U.S. Navy as a peer away from the littorals.

For fleet-on-fleet engagements that occur on the high seas outside of the littorals, Type I and Type III USVs would likely contribute the most. This is because there would be a relatively high endurance requirement for vessels operating with the fleet far from base. Although more expendable USVs from Type II or Type IV could be deployed from mother ships, they might not be able to operate for long stretches due to their smaller size and could hinder the mobility of the rest of the fleet as mother ships are forced to deploy and recover them. Furthermore, one of the biggest drawbacks to operating ship-type USVs near the littorals is their susceptibility to anti-ship missiles and other forms of massed munitions, though that threat dissipates the farther operations get from shore and the effective range of missiles fired from land.

If Type I USVs could be reliably networked with the rest of the fleet and carry a significant number of anti-ship missiles, they could serve as the distributed nodes that the DMO concept calls for. The advantages of ship-like USVs—their greater endurance than manned ships of the same size, their relatively cheap cost, and their effectiveness in combat—could enhance the fleet's ability to generate offensive missile salvos against adversary ships.

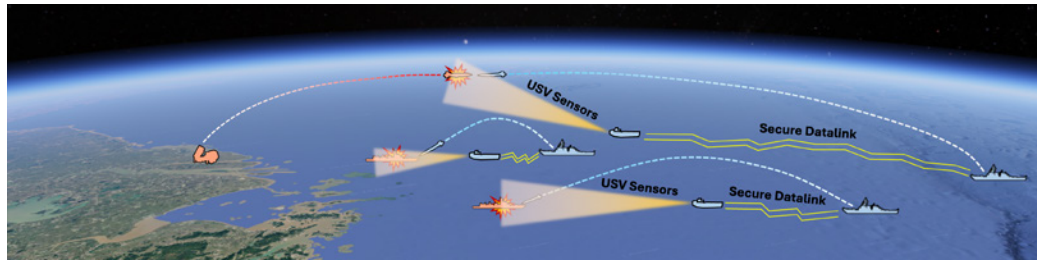
278 Ryan Chan, "China Reveals Details of Dual Aircraft Carrier Operations in West Pacific," *Newsweek*, July 1, 2025, https://www.newsweek.com/china-news-update-dual-aircraft-carrier-exercise-western-pacific-ocean-2092855.

279 DoD, *Annual Report to Congress,* p. 16.

280 Alexander Palmer et al., "Unpacking China's Naval Buildup, Center for Strategic and International Studies," June 5, 2024, https://www.csis.org/analysis/unpacking-chinas-naval-buildup.

It may not be probable that the U.S. Navy would face the PLAN in a Battle of Midway–style fleet engagement on the high seas, especially given China's preference for defeating its opponents in local wars.[281] Nevertheless, as the PLAN's carrier forces are built up and China gains more confidence operating away from the protection of its homeland anti-ship missile umbrella, the probability of such a battle might increase. Given that this kind of scenario would be likeliest to occur decades from now, the U.S. Navy would have time to build up the force it would need. In the meantime, the Navy can continue experimenting with incorporating Type I and Type III USVs into fleet formations and testing their effectiveness in exercises.

FIGURE 18: CONCEPUTAL USV INVOLVMENT IN FLEET-ON-FLEET ENGAGEMENTS



Source: Created by CSBA.

AirSea Battle

AirSea Battle is an operational concept developed in 2010 at the Center for Strategic and Budgetary Assessments that describes a high-end Western Pacific fight between the U.S. joint force and the PLA.[282] Unlike a counteramphibious assault operation focused on sea denial in defense of Taiwan, AirSea Battle envisions a wider Western Pacific conflict that involves complex ISR and counter-ISR operations in a highly contested environment. The core of the concept features counterspace operations by the U.S. Air Force to blind PLA space-based ISR assets, as well as contributions by the U.S. Navy to enhance its own scouting and ISR operations.[283] Although it calls for submarines and long-range carrier-based aviation to perform this ISR function, certain kinds of USVs could also play a role in AirSea Battle under the right conditions.

Expendable mass in the form of Type IV and to some extent Type II USVs could provide sensing and strike capability to AirSea Battle operations. The key to AirSea Battle ISR

281 Robert Holmes, "The Navy–Marine Corps Team Must Prevent an American Moskva in the Pacific," *Proceedings*, February 21, 2023, https://www.usni.org/magazines/proceedings/2023/february/navy-marine-corps-team-must-prevent-american-moskva-pacific.

282 Jan Van Tol et al., *AirSea Battle: A Point-of-Departure Operational Concept* (Washington, DC: Center for Strategic and Budgetary Assessments, 2010), https://csbaonline.org/uploads/documents/2010.05.18-AirSea-Battle.pdf.

283 Van Tol et al., *AirSea Battle*, p. xv.

operations is survivability. Although submarines would be the stealthiest and therefore some of the more survivable assets to use for ISR functions, a limited number of them would be available, they would be needed for other mission capabilities, and they would only be able to provide limited ISR capability given their masts' relatively low height-of-eye and short distance to the horizon.

Persistent but expendable USVs from Type IV could add to submarines' capability by acting as a network of linked sensor nodes, contributing to the scouting battle that AirSea Battle predicts would ensue after an initial loss of space sensing capability on both sides.[284] Type IV USVs would not be as survivable as submarines, but as a result of their small size they would still be hard to find and destroy. Thanks to their expendability and their relatively cheap expected cost, they also could be deployed in large enough numbers that losing some would not fully degrade the overall network. There would need to be enough Type IV USVs deployed to mitigate the risk of capture or destruction.[285]

Unlike Type II and Type IV expendable USVs, Type I and Type III vessels would not meet the survivability standard that AirSea Battle calls for. Such vessels could be employed in operations outside the most dangerous area of the PLA's WEZ, such as the peripheral or follow-on operations that the plan requires.[286] Type III USVs could contribute to sustaining operational logistics as part of a more robust logistics train from U.S. bases further east in the Pacific, or as ASW pickets to help localize PLAN submarines. Likewise, Type I missile-shooting USVs could contribute to distant blockade operations by interdicting merchant traffic flows. The U.S. Navy would need many operational units to carry out the core features of AirSea Battle, and the additional mass provided by Type I USVs would enable advanced, multimission units to participate in operations elsewhere.

Small-War Power Projection

As operations against Venezuela's Nicolás Maduro regime in January 2026 and Operation Epic Fury against Iran beginning in February 2026 demonstrated, there is an enduring demand for the capability to project power onto the territory of other states or against nonstate actors in short conflicts. These small-war power projection scenarios are characterized by permissive maritime environments, where the main requirement from the sea is flexible missile strikes to suppress land-based air defense, C2 nodes, or other targets to enable the rest of the joint force to carry out its mission.

284 Van Tol et al., *AirSea Battle,* p. 61.

285 Based on an interview with the principal author of *AirSea Battle* conducted February 2026, the proliferation of small craft, such as those of China's People's Armed Force Maritime Militia, and the potential for their interaction with U.S. Navy or U.S. joint force assets on the surface of the ocean, was a concern that wargames revealed after the initial publication of *AirSea Battle*.

286 See Van Tol et al., *AirSea Battle*, pp. 74–79.

The most suitable type of USV for these scenarios is Type I ships. This is another situation in which the missile inventory of Type I ship-like offensive USVs would be a "good enough" capability that could be leveraged to allow ships like DDGs to participate in other missions. Although Type IV sensor-like USVs could assist with MDA, the permissive environment of small-war power projection scenarios suggests that UAVs would be better candidates for performing maritime domain sensing based on their larger sensor horizon. Because CSGs typically have adequate inherent logistics support for these operations, Type III ship-like support USVs for logistics would likely not be necessary, either. Type II attack USVs would not have anything to target in a permissive maritime environment, so they would not be employed.

Homeland Air and Missile Defense

With the second Trump administration's Golden Dome initiative and its emphasis on homeland in the 2025 National Security Strategy, there will likely be an increased demand for naval assets that can participate in missile defense.[287] Much of the discussion about Golden Dome has focused on ground- and space-based interceptor systems, but there is also some discussion about how naval assets can help protect targets close to the coast of the CONUS or in U.S. territories.[288] The advantage that sea-based missile defense units could offer is their ability to reposition, not only because that gives them flexibility to be in the best possible position for missile intercept but also because adversaries seeking to disable missile defenses would have a harder time targeting mobile units. *USS Pinckney* demonstrated the ability to detect, track, and perform a simulated engagement of an "advanced, maneuvering hypersonic target" in a 2025 exercise, and USVs with similar capabilities could provide this capability against similar missile threats targeting the U.S. homeland.[289]

USVs could contribute from the sea in three ways. First, as missile platforms, Type I ship-like USVs could fire missiles at incoming threats. Any other missile-defeating payload such as directed energy or another kind of nonkinetic kill mechanism would also likely need to be carried aboard a ship-like platform, based on power requirements. This would require USVs to ingest targeting data from Aegis platforms, as they likely would not be capable of independent targeting.

287 Hannah Dennis, *The Golden Dome for America*, Defense Primer No. IF13115 (Washington, DC: Congressional Research Service, 2025), https://www.congress.gov/crs_external_products/IF/PDF/IF13115/IF13115.1.pdf; and Donald Trump, "National Security Strategy of the United States of America," The White House, November 2025, https://doi.org/10.1002/9781119289142.

288 See Mike Stone, "US Tests Radar That Could Link into Golden Dome to Detect China, Russia Threats," *Reuters*, June 24, 2025, https://www.reuters.com/business/aerospace-defense/us-tests-radar-that-could-link-into-golden-dome-detect-china-russia-threats-2025-06-24/; Courtney Albon, "USSF Eyes Space-Based Interceptors for Midcourse Missiles," *Air & Space Forces Magazine*, December 9, 2025, https://www.airandspaceforces.com/space-force-space-based-interceptors-midcourse/; and Joseph Trevithick, "SM-6 Missile Closer to Proving Hypersonic Weapon Intercept Capability After Aegis Destroyer Test," *The War Zone*, March 26, 2025, https://www.twz.com/air/sm-6-missile-closer-to-proving-hypersonic-weapon-intercept-capability-after-aegis-destroyer-test.

289 Trevithick, "SM-6 Missile Closer to Proving Hypersonic Weapon Intercept Capability."

Second, significant homeland defense threats come from the undersea domain. Russian submarines, including the advanced *Severodvinsk,* are highly capable and can be armed with nuclear payloads. Additionally, Russia is devising a new undersea weapon called the Poseidon that could someday serve as a nuclear-propelled, nuclear-armed strike weapon that could threaten U.S. harbors.[290] Additional ASW sensing capability could help track such threats, and Type III support USVs that can perform long-range ASW sensing could add mass to NATO ASW assets between the Russian homeland and the United States.

Finally, Type IV sensor-like USVs could help defend the U.S. Navy's ports around the homeland. If enough of these small, expendable vessels were proliferated, and if a suitable concept for port defense were developed, they could protect critical U.S. bases from infiltration or attack.

Table 3 summarizes how these scenarios fit with each USV type.

TABLE 3: USV TYPES AND SELECTED SCENARIOS

Select Scenarios	USV Types			
	I	II	III	IV
Amphibious Invasion Denial		●	●	●
High-End Anti-Submarine Warfare			●	
High Seas Fleet-on-Fleet Battle	●		●	
AirSea Battle	●	●	●	●
Small War Power Projection	●			●
Homeland & Missile Defense	●			●

Source: Created by the author.

Assessing Risk and Reward for USV Types Going Forward

All the concepts in this report are feasible ways USVs could contribute to fleet operations, but not all of them will easily come to fruition. The path to success is narrower for some than others. Furthermore, not all of them are essential to fleet operations. The U.S. Navy has suffered in recent years from the failure of several high-visibility shipbuilding programs. The public, Congress, and the Navy's leadership will likely be risk averse to betting big on complex USV programs that could have a high chance of failing, especially if manned platforms could perform the same tasks more assuredly. This chapter concludes with a

290 Norman Polmar, "Russia Introduces a New Category of Naval Strike Weapon," *Proceedings*, January 13, 2026, https://www.usni.org/magazines/proceedings/2026/january/russia-introduces-new-category-naval-strike-weapon.

qualitative assessment of the level of risk associated with implementing each type of USV in this report's framework.

The risk associated with each category of USV should be assessed by examining three areas: the complexity of the concepts associated with each USV type, which considers the challenges associated with DOTMLPF-P; the centrality of the USV to the success of the concepts they are part of; and the projected cost of the kinds of vessels in each category, which this report assumes roughly correlates with the ease of production of each kind of vessel.

The risk assessment should also include the value that the U.S. Navy would expect to gain from successfully implementing a USV concept. This will necessarily be a relative assessment, where the expected value from implementing a USV concept is compared to implementing a similar concept using a manned platform. If a certain USV type only offers marginal expected value over a manned alternative and the probability of programmatic failure is high, the Navy would be wise not to invest time, effort, and funding into this type of USV. Conversely, if the expected value is higher than manned alternatives and the probability of failure is moderate, it might be a risk worth taking because the upside of successful implementation could outweigh the risk of programmatic failure.

This report assesses each of these broad risk categories and compares the expected value of implementing the types of USVs described in chapter 4 to manned alternatives.

Complexity Risk

Complex USV concepts will have a higher likelihood of failure. They will therefore require more development and will have more variable outcomes than simpler concepts that more closely mirror how the fleet operates today.

The U.S. Navy envisions a relatively complex concept for Type I magazine USVs. As interconnected nodes within a network of missile-firing platforms, many things will need to go right to maximize combat effectiveness. For example, these vessels' C2 links and autonomy must be incredibly reliable, and sustainment must be possible in austere ocean environments. Additionally, the U.S. Navy still needs to work out doctrinal details involving how elements of the kill chain would be executed. Assuming target data is shared across a network of ships including USVs, who would be responsible for employing the USVs' weapons? How would these fires be coordinated with the manned platforms that traditionally fire upon the order of the ship's commanding officer? All these questions must be resolved in a satisfactory manner.

The success of networked Type I magazine USVs will in some ways depend on the success of the DMO concept in general. Before the U.S. Navy can develop a dispersed network of missile-shooting USVs on the surface of the ocean that can seamlessly share targeting data and concentrate fires upon command to create overwhelming effects, it must demonstrate the same network-centric warfare capabilities with manned platforms. Many uncertainties

are associated with this concept, however. Analysts have noted that DMO depends on resilient command and control, communications, trust, training, and sufficient force structure—requirements that remain difficult to achieve in practice.[291] Because of the complexity involved with this kind of networked system, there is a relatively high risk of failure.

A concept involving Type II munitions-like USVs would be complex, but not as much as concepts involving Type I magazine USVs. There are still some DOTMLPF-P challenges associated with employing munitions USVs, but they can be overcome, as Ukraine has shown. In the near term, munitions USVs would most likely be deployed from shore and would be assigned a kill box, within which they would attack targets that match preassigned classifications. The automation for this kind of task already exists, and the rest of the fleet would work around the kill box.[292] Although this concept is somewhat novel, and although important questions such who would be responsible for operating these USVs remain outstanding, it is not extremely complex or unfamiliar: There are similar concepts involving kill boxes in other domains of warfare.[293]

The Type III support USVs that perform support functions would not need novel CONOPS to be developed before contributing to fleet operations. Like other USV types, there are still many DOTMLPF-P–related challenges that the U.S. Navy must overcome to begin using these vessels, but their functions would resemble what ships already do for the fleet today: primarily logistics transport, ASW, or search and rescue. Their operating concepts would not need to be novel or complex.

Networks of sensor-like Type IV sensor-like USVs that remain on station for long periods of time will face both technical and DOTMLPF-P–related challenges. Therefore, there will be a moderately high complexity risk associated with developing them. On the other hand, a concept like the MCM mission module of the LCS would be a more incremental application of USV technology because it would only augment a manned host platform.[294] With that said, even the MCM function of very small, expendable USVs requires further development.

Generally, the risk of programmatic failure will be higher for USV concepts that depend on a network of nodes interacting with one another and with the manned fleet (Type I and Type IV) than for USV concepts that involve more stand-alone capabilities (Type II and Type III).

291 See, for example, Kimberly Jackson et al., *Command and Control in U.S. Naval Competition with China* (Santa Monica, CA: RAND Corporation, 2020), https://doi.org/10.7249/RRA127-1.{\\i{}Command and Control in U.S. Naval Competition with China}, with International Security and Defense Policy Center et al. (RAND Corporation, 2020

292 Based on interviews with experts from industry conducted by the author in February and March 2026.

293 See, for example, Gary M. Brito and W. F. Mullen, "Tactical Employment of Mortars," Headquarters, U.S. Department of the Army, and Headquarters, U.S. Marine Corps, 2019, pp. 2–14, https://www.marines.mil/Portals/1/Publications/MCTP%203-01D.pdf?ver=2019-10-31-084723-267.

294 "Littoral Combat Ships - Mine Countermeasures Mission Package," U.S. Navy, July 2, 2025, https://www.navy.mil/OLD-PAGES/Fact-Files-OLD/Display-FactFiles-OLD/Article/2167535/littoral-combat-ships-mine-countermeasures-mission-package/.

Centrality Risk

The ship-sized offensive USVs in Type I of this framework would be central to most CONOPS that involve them. They would form a significant portion of a distributed, networked force. Even if their only role was to protect the aircraft carrier from air threats, they would still need to work flawlessly. In contrast, Type II munitions USVs would not significantly change the way the rest of the fleet operates because they could be employed independently of larger fleet formations. They would provide a separate, distinct option for commanders to consider. Therefore, they would be less central to fleet operations.

Type III support USVs would not play a central role in new fleet concepts because they would augment the fleet's existing manned assets. Type III USVs would enable an incremental change in how the fleet operates, while the more radical Type I concepts would require significant coordination between manned and unmanned units to achieve the goal of timed weapons effects.[295] Introducing Type III USVs to the fleet would be less risky than betting big on Type I or II concepts.

Type IV USVs would likely not be too central to fleet operations. As MDA sensor networks, they could contribute to fleet scouting, but they would be secondary in this role to air and space assets that have a much wider sensor horizon. Similarly, although Type IV USVs like the LCS MCM mission module are the only viable surface MCM assets in the U.S. Navy, the Navy has undersea MCM capabilities that are more viable within contested environments, as recently demonstrated in the Strait of Hormuz.[296] Therefore, these MCM USVs would only augment the Navy's overall MCM capability.

Generally, the risk associated with the centrality of USV concepts to fleet operations depends on where the USV lies on the functionality axis of this report's framework. The more central a USV is to the success of fleet combat (Type I and Type II), the higher the risk associated with implementing such a concept. Conversely, the more a USV has a supporting role (Type III and Type IV), the less risk would be associated with implementing the concept.

Ease of Production and Projected Cost

Munitions USVs will be easier to mass produce, as seen by the fact that defense companies are already beginning to manufacture them at scale. Because they are smaller, cheaper, and easier to manufacture quickly, the U.S. Navy has more room to fail. This logic applies both to Type II and Type IV USVs. A program of record for a Type IV USV has already achieved IOC, which demonstrates that they can be manufactured relatively easily. Furthermore, their expected service lives would be relatively short, so they would be replaced more often than

295 Filipoff, "Fighting DMO."

296 Joseph Trevithick and Howard Altman, "Navy SEALs in Mini-Submarines Teamed with Underwater Drones in the Works," *The War Zone*, May 20, 2026, https://www.twz.com/sea/navy-working-on-teaming-seals-in-mini-submarines-with-underwater-drones.

larger vessels with longer service lives. With many potential suppliers to choose from, the U.S. Navy can afford to experiment aggressively without disrupting the production lines of its large multimission ships. Therefore, the risk related to production for the more expendable USV types (Type II and Type IV) is low, at least for individual vessels.

This last caveat is important because the success of a concept involving Type II or Type IV (highly expendable) USVs does not just depend on producing a handful of copies but rather on producing massive numbers of them. This is not necessarily true for Type I or Type III ship-like vessels. Thus, although the production-related risk might be lower for individual expendable vessels, there is probably a higher risk that the defense industrial base will not be able to produce these vessels in the numbers required. That said, because there are so many new entrants into the USV production industry, the supply of these vessels is likely to be relatively elastic and therefore responsive to extra funding.

Larger vessels will be more difficult and expensive to build than smaller expendable USVs, driving programmatic risk higher. Building ship-like USVs will take time and significant amounts of money, even if their cost is not as high as exquisite, multimission, manned naval platforms. MUSVs are not yet in production as programs of record. The U.S. Navy still has a long way to go to transition across the so-called valley of death for these vessels. The best estimate so far for a single ship-like USV is more than $50 million, but this could grow just as other recent shipbuilding cost estimates have risen. Given the Navy's recent track record with cost growth in the *Constellation*, LCS, and *Zumwalt* programs, the risk related to production for ship-like vessels (Type I and Type III) is relatively high.

Generally, the risk associated with cost and production will depend on the size and scale of the vessels that must be produced. The larger the vessel and the higher endurance it must have (Type I and Type III), with all the requisite systems included to facilitate this endurance, the higher the risk associated with production and cost. The smaller, cheaper, and more expendable a vessel is (Type II and Type IV), the more the Navy will be able to afford to take risks.

Consolidated Risk Assessments

Overall, developing concepts that feature ship-like, offense-oriented USVs in Type I would be high risk. That risk could eventually pay off by providing the U.S. Navy with a relatively cheap way to expand the battle force and thus realize its goals to further transition the fleet into network-centric warfare and DMO. The concepts would be worth pursuing if the Navy were able to adequately mitigate the risks involved, but that will take more testing over time. Type I USVs, therefore, should not be pursued as part of fleet concepts that must be realized in the near term.

Type II USVs are moderately risky bets. They have high potential upside because they could offer fleet commanders a new option for conducting sea denial operations without the need for the main battle force to be close to them. As such, they are worth pursuing. That having

been said, the U.S. Navy should be cautious. As the French found during the Fashoda Crisis of 1898, small, agile weapons can supplement the fleet's firepower but will not replace it. Recent action against Iranian fast boats in the Strait of Hormuz has shown that vessels like these can be susceptible to tactical aviation gunfire.[297]

Type III auxiliary and support USVs will also be moderately risky investments. Although the risks associated with the complexity of their concept and their centrality to fleet operations will likely be relatively low, the risk associated with production will remain high. This risk would be offset by the fact that the kinds of missions envisioned for these vessels favor the use of unmanned platforms.

Finally, Type IV USVs have a low to moderate risk. This is why the U.S. Navy and many other navies have focused their initial USV development efforts on this type of vessel. This risk could be offset by the high degree of necessity for using unmanned platforms for these missions.

Table 4 displays the consolidated risk assessment for the four USV types, and Figure 19 displays overall risk on the framework axes.

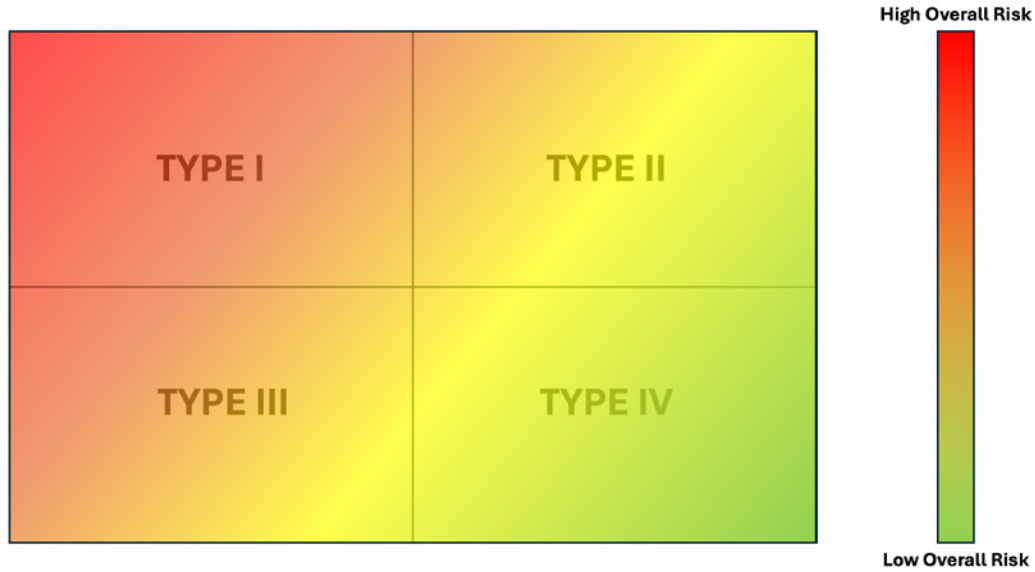
TABLE 4: USV OVERALL RISK ASSESSMENT BY TYPE OF RISK

Type of Risk	USV Types			
	I	II	III	IV
Complexity	High	Moderate	Low to Moderate	Moderate
Centrality to CONOPS	High	Moderate	Low	Low to Moderate
Production Risk	Moderate to High	Low	Moderate to High	Low
Overall Programmatic Risk	High	Moderate	Moderate	Low to Moderate

Source: Created by the author.

297 George Wright and James Chater, "US Strikes Iranian Fast Boats as Iran Attacks UAE Oil Facility," *BBC*, May 5, 2026, https://www.bbc.com/news/articles/cjwp432d0v5o.

FIGURE 19: OVERALL ASSESSMENT OF QUALITATIVE RISK FOR EACH USV TYPE



Source: Created by the author.

Expected Value Compared with Manned Alternatives

Even if a USV has a high risk of programmatic failure, it could still be worth pursuing if there is sufficient reason for using an unmanned rather than a manned platform for the required task. Each USV type can be assessed in terms of the relative value it would provide over a manned alternative. If the increase in relative value that the Navy would gain is high enough to justify the risk it would incur from trying to make a USV program succeed, it would make sense for the Navy to develop that vessel.

For Type I USVs, it is not yet certain that unmanned platforms would be necessary to expand the fleet's missile salvo generation capability. Modern merchant vessels are already automated to the point where only 20–25 crew members are required to operate them.[298] Using containerized missiles on merchant vessels could add missile magazine depth to the fleet. The PRC has demonstrated this approach with the *Zhongda 79*, a merchant vessel photographed carrying these types of containers in January 2026.[299] More study might be required to determine how this option compares to using a Type I USV in terms of both cost and endurance and whether these comparisons would outweigh needing the minimum crew required to operate a merchant. U.S. Transportation Command has estimated that

298 "Port State Control Examiner Tactics, Techniques, and Procedures (TTP)," U.S. Coast Guard Force Readiness Command, September 2019, pp. 7–16, https://www.dco.uscg.mil/Portals/9/DCO%20Documents/5p/CG-5PC/CG-CVC/Guidance/CGTTP_3-72.12_Port_State_Control_Examiner.pdf.

299 Aaron-Matthew Lariosa, "Chinese Merchant Ship Sports Electromagnetic Drone Launcher, Vertical Launching Systems," *USNI News*, January 7, 2026, https://news.usni.org/2026/01/07/chinese-merchant-ship-sports-electromagnetic-drone-launcher-vertical-launching-systems.

purchasing two cargo ships for sealift would cost $210 million, implying that if Type I USVs could be kept near the $50 million price point, it would be cheaper to employ them for magazine expansion.[300]

In the case of Type II USVs, vessels meant for OWA must be unmanned for obvious reasons.

For ships performing support functions, vessels that are completely unmanned might be necessary. For the ASW mission, although manned platforms already contribute today, the U.S. Navy would likely need to use USVs to expand the number of vessels necessary to surveil large areas of water. For logistics, unmanned platforms would be essential given the potential need to operate in contested areas.

Like Type II USVs, Type IV USVs would be highly necessary to enable the kinds of swarming network effects and dangerous missions envisioned for them. There are alternative ways of creating these effects. For example, the PRC's maritime militias, comprised of small, cheap fishing and commercial vessels, have been observed operating in barrier formations in the South China Sea. These could be used for the kinds of maritime sensing operations envisioned for swarms of small, expandable USVs,[301] but this option is not available to the U.S. Navy in the areas of the world where it operates. Furthermore, although manned platforms have performed the MCM mission for decades, unmanned platforms provide a clear advantage due to the inherent danger of the mission. Therefore, the missions envisioned for Type IV USVs make unmanned platforms highly necessary.

Generally, the relative value to be gained from using unmanned systems would be highest for vessels where there is no alternative to unmanned operations (Type II), followed by vessels that perform tasks for which the U.S. Navy has very few manned options (Type IV), followed by vessels where manned operations could be prohibitively expensive or dangerous (Type III). Type I vessels provide the lowest comparative value increase of all types given the alternative options available to the Navy (e.g., purchasing merchants and arming them with containerized missiles).

Comparing Risk to Benefit

Ultimately, the U.S. Navy must compare the overall risk associated with developing each USV type with the payoff it expects to gain from each type fully—or even partially—coming to fruition. The expected upside for each type of USV and the concepts they would most likely be part of will depend on the types of missions and threats the Navy expects to face in the future.

300 John Grady, "U.S. TRANSCOM Wants Authority to Buy 10 Used Cargo Ships," *USNI News*, March 6, 2025, https://news.usni.org/2025/03/06/u-s-transcom-wants-authority-to-buy-10-used-cargo-ships.

301 Chris Buckley et al., "Thousands of Chinese Fishing Boats Quietly Form Vast Sea Barriers," *New York Times*, January 16, 2026, https://www.nytimes.com/interactive/2026/01/16/world/asia/china-ships-fishing-militia-blockade.html.

The national defense strategy (NDS) might serve as a guideline to help practitioners determine which missions are the most valuable to pursue. The first two lines of effort in the 2026 NDS are defending the homeland and deterring China in the Indo-Pacific.[302] Therefore, the USV types that would produce the most valuable outcomes are those that enhance the U.S. Navy's sea control and sea denial capabilities in service of homeland defense, as well as sea denial capabilities in service of deterring Chinese aggression in the Western Pacific.

Concretely, this means the Navy would get the most benefit from Type I USVs that could aid with missile defense, Type III USVs that could augment ASW missions to detect undersea platforms that could threaten the homeland, and Type IV USVs that could help with port defense. Likewise, Type I USVs armed with missiles and Type II USVs used for OWA would provide the most sea denial capability in a contingency where China attempts to invade one of its neighbors by sea. Developing credible concepts using these USVs would therefore provide significant value to the fleet.

Additionally, the U.S. Navy must consider the value it would expect to gain from pursuing each type of USV relative to manned alternatives and then compare this value to the risks associated with programmatic failure for each USV type. Considering this comparison, Type I USVs pose the most risk but would only add modest relative value to the Navy's most important missions when compared with manned alternatives. On the other hand, Type II USVs present moderate risk but offer a high value prospect. Type III and Type IV USVs offer lower value but also lower risk. Given the relative value the Navy would expect to gain from pursuing each type of USV, it might be wisest to prioritize developing Type II and Type IV USVs for sea denial and Type III USVs for sea control in the context of contested logistics. More study is required to determine whether the high risk associated with Type I USVs is worth the modest expected value gained from implementing them.

Going into further detail with this risk analysis is outside the scope of this report, but this methodology could serve as a basis for future risk–reward analysis involving the U.S. Navy's planned investments in USV programs.

302 Peter Hegseth, "2026 National Defense Strategy," DoD, January 23, 2026, 16–18, https://s3.documentcloud.org/documents/26505273/u-2026-national-defense-strategy.pdf.

CHAPTER 6

Findings and Recommendations

Framing USVs in terms of their longevity and their functionality provides a novel way to categorize them and assess their usefulness. Delineating four general types of USV in the framework points out the pros and cons of each, which could help strategists understand the best ways to employ them against different threats. Summarized here are several of the findings and recommendations that were inferred from performing this analysis.

Key Findings

The U.S. Navy is serious about acquiring USVs, but it lacks the detailed, specific USV CONOPS it needs to guide development efforts. It was clear during interviews with officers who were working on designing, acquiring, and implementing USV technology for the fleet that the U.S. Navy places a high priority on this effort. Many talented, patriotic individuals want to see the Navy succeed, and they are working on solving many of the key challenges identified in this report. Additionally, Navy officials at the highest level are emphasizing the need for incorporating USVs in the fleet; there are no Luddites visible.

Nevertheless, the announcements and policy documents have lacked much detail about exactly what the Navy envisions USVs will do in the context of a larger CONOPS. The *Fighting Instructions* document released in February 2026 discusses the Navy's hedge strategy and the need for RAS, including USVs, in the Navy's force structure. It also provides examples of tasks that "tailored offsets" can perform, but it does not explain (nor is it intended to explain) exactly why USVs would be better for these tasks than other platforms, nor does it specify the types of tasks that USVs are uniquely suited to perform.[303]

303 Caudle, "U.S. Navy Fighting Instructions."

A more effective, formal framework for categorizing USVs is required to better understand how they should fit into naval force architecture. USVs have been categorized with narrow task functions or amorphous size groupings. The U.S. Navy recently merged MUSVs and LUSVs into the single MASC classification, then it canceled MASC and opting only for MUSVs. A framework that describes USVs in terms of their longevity and functionality is more appropriate because it divides USVs into groups that better describe what they can contribute to the fleet.

More real-world operation is necessary to determine where USVs provide the greatest benefit over manned platforms. Chapter 3 detailed many of the theoretical advantages that USVs purport to have over manned platforms, but whether these advantages materialize remains to be seen. For example, some advantages include USVs' potential for higher endurance and sustainment than manned platforms and the expectation that they can be cheaply produced. The need for human operators to conduct refueling and repair could negate the sustainment advantages, however, and other factors could drive up cost in unforeseen ways, as has happened in other recent shipbuilding programs. Although the uncertainty regarding realized advantage will not be resolved until the fleet begins incorporating USVs into fleet operations, there are some clear applications where USVs will be necessary. Hazardous tasks like MCM are ripe for USV employment, as are strike missions involving munitions-like vessels.

Against an adversary with whom the U.S. Navy is at a firepower disadvantage, munitions-like unmanned vessels offer an asymmetric sea denial capability that ship-like vessels do not. In the Western Pacific, the U.S. Navy is preparing for a sea denial mission against the PRC, which fields a precision strike network designed to prevent U.S. intervention in the theater by overwhelming the defenses of U.S. warships with masses of advanced anti-ship missiles. Given the mission and threat environment, munitions-like USVs are better suited for this theater than missile-shooting unmanned ships. Even if the Navy fielded a force structure that was partially composed of ship-like USVs armed with missiles, China's anti-ship missile advantage in the Western Pacific is so great that such a force structure would not have much impact on the firepower imbalance in that theater.

Solving the DOTMLPF-P problems associated with employing USVs in the fleet will be difficult for any of the USV categories described in this report; however, it will be more challenging for some categories than others. Almost every naval officer and administrative official interviewed for this report highlighted the challenges associated with fielding USVs of any type, especially with the doctrine, organization, policy, and facilities aspects of DOTMLPF-P. All USV operations will need to be supervised by trained operators; their doctrine will require that they team effectively with manned platforms; there will need to be facilities to operate them from, including forward, overseas bases; and the policy for their use needs to be in place for them to operate effectively. The DMO concept in which networked, ship-like USVs are meant to fire missiles in coordination with manned units requires more development and testing than simpler concepts where

USVs contribute to fleet operations on the margins. More ambitious concepts involve more risk to the Navy, as implementing them will not assuredly translate to combat effectiveness.

The least risky kinds of USV concepts the U.S. Navy could invest in are those that involve highly expendable vessels and those in which USVs perform supporting tasks. Expendable USVs that resemble munitions or sensors within this report's framework are expected to be relatively cheap to build. Ukraine's experience building its OWA USVs provides a basis for this expectation, and the U.S. Navy could make (and indeed already is making) targeted investments in manufacturing many of these kinds of vessels without risking significant programmatic failure. Certain tasks within the fleet that are ripe for automation today, such as MCM, ASW, and contested logistics transport, are areas where auxiliary ship-like USVs would be good candidates to take the place of manned platforms, since the doctrine and broader CONOPS associated with these missions are already in place and are well understood.

The simplest concepts that support the current fleet architecture are the most likely ones to contribute to the near-term fight. Networked USVs that take the form either of adjunct missile magazine ships or expendable distributed sensor nodes are similar in that they will likely require the longest time before they can contribute meaningfully to fleet operations. Magazine USVs must be able to coordinate fires with manned platforms, and expendable sensor USVs must be able to meaningfully contribute to scouting operations as part of a wide sensor network. Because these are concepts that must be built out and not just platforms performing individual support tasks or individual strikes for the fleet, they will most likely require more time before becoming fully integrated fleet components. On the other hand, USVs that act as munitions, ship-like USVs that perform auxiliary support roles, or expendable USVs for MCM or port defense are more feasible in the near term. A single munitions-like USV designed for OWA could be employed today, given that Ukraine and the Houthis are already performing this mission. Likewise, auxiliary ship USVs have already demonstrated a modest resupply capability in exercises, implying that they could soon serve a useful purpose in a contested environment.

USVs are the best type of unmanned system for integrated ASW operations and could be especially effective at countering the Russian submarine threat. The greatest naval threat from Russia in the North Atlantic and to some extent China outside the First Island Chain is from these nations' undersea capabilities. Russia's submarines especially are highly capable and can threaten CONUS. USVs are ideally suited to counter this threat, given their position at the air–water interface at the surface of the ocean, collecting acoustic data from below the water and simultaneously transferring it via EM signal. Neither UUVs nor UAVs have this capability. This advantage could be extremely valuable given the U.S. Navy's dearth of ASW support ships that can stream towed sonar arrays and a shortage of trained personnel to man them. Ship-like support USVs could theoretically be manufactured at lower cost than T-AGOS ships and could provide wider

mobile sensor coverage what is available today. This could prove especially useful in the mid- or eastern Pacific and North Atlantic operating areas.

Although USVs are not the optimal units for fleet scouting, they can enhance the U.S. Navy's overall sensing capability. Because they operate on the surface of the ocean, USVs have relatively short sensor horizons than UAVs or space-based assets, which can see much further in all directions thanks to their altitude. That said, because USVs can persist in an area much longer than UAVs can, they can add significant value to a maritime sensor network. If mass produced cheaply, expendable sensor USVs could be deployed in such high numbers that their coverage would be great enough to provide the offensive elements of the fleet with adequate early warning and sufficient MDA to perform detection, targeting, battle damage assessment, and other tasks within the kill chain. UAVs and satellites could focus on the most important targeting tasks while USVs performed zone defense and served as pickets on the ocean surface. A concept like this would be more challenging to implement than other support tasks but could provide significant upside in the form of better scouting than the adversary.

Recommendations

Near Term: 2026 Through 2030—The Davidson Window and the Fight Tonight

The U.S. Navy's most dangerous challenge in the near-term is the threat of a conflict with the PLA in the Western Pacific, as well as any opportunistic aggression from Russia, North Korea, Iran, or nonstate actors that would occur simultaneously.[304] U.S. commanders have spoken of the need to be ready to "fight tonight," indicating their concern that great power armed conflict could be imminent.[305] As such, the following recommendations attribute highest priority to the acute threats in regional hot spots such as the South China Sea.

Begin adopting a new framework to describe USVs in a more useful way. This report envisions USVs as adjunct magazine ships, one-way munitions, support ships, and expendable support vessels. Adopting this framework in place of the legacy categories of size or task will benefit the Navy by describing what a type of USV is for and helping it develop more robust CONOPS for the fleet as it determines how to include USVs in its force architecture.

Identify the types of USVs that require very little time to field in meaningful ways and begin building them. The near-term threat requires solutions now, so they must be compatible with the existing force architecture and bureaucratic infrastructure.

304 China's readiness to invade Taiwan in the late-2020s is often associated with comments made by commander of USINDOPACOM Admiral Phil Davidson to the Senate Armed Services Committee in 2021. *Hearing to Receive Testimony on United States IndoPacific Command in Review of the Defense Authorization Request for Fiscal Year 2022 and the Future Years Defense Program.*

305 See, for example, *Statement of Admiral John C. Aquilino.*

Munition-like USVs, auxiliary ship USVs, expendable MCM, and port defense USVs are the most promising vessel types that could contribute to the fight tonight. A good-enough solution with such vessels will be superior to doctrinal and technical perfection, as Ukraine has demonstrated with its OWA USVs. For example, instead of pursuing perfect autonomous capability, remote operation via resilient C2 links should be the focus for these USVs in the short-term. The fact that the U.S. Navy is likely including attack USVs as part of the hellscape concept could indicate that it understands the urgency.[306]

Develop and present detailed, longer-term USV concepts that serve as the basis for the Navy's USV development efforts. While the U.S. Navy pursues acquisition of USVs that can add value to tonight's fight, the development of longer-term USV concepts must continue in parallel during the short term. Today, there are ongoing efforts in doctrine writing, engineering testing, facilities procurement, manpower recruitment and training, policy approval, and long-term acquisition, but concrete CONCOPS must be devised if these efforts will pay off in the future rather than be ineffectual. Navy officials have discussed the Navy's new hedge strategy, but few concrete, detailed CONOPS rooted in ends–ways–means strategic analysis have been presented at an unclassified level to the public. These strategy-based concepts should drive the ongoing DOTMLPF-P development efforts.

SURFDEVRON ONE is working on USV development, but it is unclear from publicly available sources as to how the U.S. Navy is assessing its progress. Additionally, although the U.S. Navy has adopted the hedge strategy, it is not clear exactly how USVs will contribute. Without detailed CONOPS in place, it will be difficult for the Navy, let alone Congress or the public, to assess whether it is effectively adopting USVs into the fleet.

Accept risk in USV requirements, especially for highly expendable USV types, to keep costs low and get useful USVs to the fleet quickly. One of the biggest advantages USVs offer over manned platforms is the promise of lower costs, especially for the expendable USVs that behave like munitions or sensors. Some experts interviewed for this report nevertheless expressed frustration that the standards the U.S. Navy is requiring for USV performance in testing and evaluation—no matter the type—remain too high to allow for agile experimentation.[307] The Navy should accept lower standards of performance in exchange for good-enough systems that reach the fleet sooner and in greater numbers. This may lead to USV failure or capture, but that should be expected in the friction of maritime combat.

Ship-like USVs serving either as adjunct magazines or auxiliaries are less expendable, but the U.S. Navy must still accept that performance will not be on par with manned multimission platforms. It must avoid the requirements creep that plagued the *Constellation* class

306 Johnston, "Breaking Down the U.S. Navy's 'Hellscape.'"

307 Based on interviews with experts from industry and the U.S. Navy conducted by the author in January and February 2026.

and the excessive technical optimism that led to the problems of the LCS program. Ship-like USVs will serve as the low end of a high–low force architecture. To keep their costs down in the near term, it must be understood that these vessels will be less capable, less survivable, and less lethal than large multimission platforms. Even if this is internalized at an intellectual level by Navy leaders, the Navy must proceed with caution to avoid adding excessive requirements that could drive up platform cost.

Leverage allies and partners in the near-term to deal with acute threats in those nations' theaters. As chapter 2 of this report showed, many U.S. allies and partners see potential benefits from USV technology and are endeavoring to incorporate these vessels into their naval force structures. The U.S. Navy should assess the capabilities these allies possess today for a fight tonight and the capabilities that they could stand up easily and quickly, such as those developed by Ukraine after Russia's 2022 invasion. This could help identify gaps that could be filled in the short term with existing USV technology. For example, to support sea denial in the South China Sea, the Navy should assess the strength of Taiwan's offensive mining and attack USV capabilities and coordinate with other allies and partners in the Indo-Pacific theater. Additionally, the Navy should call on partners in Europe to begin developing their own specialists USV capabilities to counter Russian threats —especially in the undersea domain.

Medium Term: The Next FYDP and the 2030s

The medium-term threat environment continues to be characterized by the potential for great power war, with the potential for conflict in multiple theaters due to opportunistic aggression. There is enough time, however, to plan for further USV concept development and to accept more risk on USV concepts that would not immediately pay off in the short term. These recommendations consider the threat environment expected in the 2030s, which could feature the proliferation of cheaper, attritable precision weapons and advanced hypersonic missiles.

By the late 2030s, the U.S. Navy should aim to have overcome most of the DOTMLPF-P challenges associated with employing USVs. This should include having firm doctrine in place that describes exactly how it employs each type of USV described in this report's framework and how they fit into the greater fleet force organization charts. It should aim to have mature training pipelines in place to produce USV operators as well as logistics pipelines for maintenance and repair. It should aim to have shifted USV maintenance and repair away from contractor support, which is the maintenance model today. Like the early naval aviation community, the U.S. Navy should promote champions for USVs within its leadership to ensure that they do not die on the vine when they inevitably meet resistance from leaders of the manned communities.[308] The Navy should make it a goal to secure adequate facilities for basing USVs in theater and should explore technical

308 Rosen, *Winning the Next War,* p. 70.

solutions to the challenge of deploying them from larger multimission platforms. Finally, by this point the Navy must have policies in place that facilitate safe USV employment without hampering their effectiveness. Rules of engagement and guidance for autonomous operations must be in place to ensure the Navy can employ USVs to maximum effectiveness.

Facilitate mass production by establishing USV programs of record that send a clear demand signal to industry and consider narrowing the scope of that signal. Many of the advantages of all types of USVs in this report rest on the assumption that these vessels can be produced at low cost and in large numbers. A consistent theme in interviews with members of industry was the need for a clear and steady demand signal from the Pentagon for the USVs it wants. Additionally, the USV production enterprise is beginning to become saturated with interest from industry. One executive from industry pointed out that interest in this space is now so high that people "working out of their garage" are trying to get in on what they see as lucrative government contracts to produce USVs.[309] The Navy has now committed to a marketplace approach for MUSVs to allow a large number of defense industry newcomers to manufacture them, but this risks creating a patchwork force of platforms with varying maintenance standards, sustainment requirements, and levels of performance. The Navy must clearly articulate the minimum requirements for any manufacturer that wants to participate in the marketplace while maintaining a steady demand signal for these vessels over several FYDPs to ensure that they are produced in meaningful numbers.

Deploy USV formations of all categories on a macroscopic scale to understand real-world operational benefits and constraints. In recent years, the U.S. Navy has pursued the modest goal of operating single USV prototypes with the fleet; by the end of the 2030s, it should aim to scale up promising capabilities. It should consider deploying early versions of these capabilities in sufficient numbers to demonstrate where they perform well and where they fall short. This could be done in less contested theaters to test their operational feasibility. For example, expendable USVs acting as networked sensors and auxiliary USVs acting as ASW picket ships can be employed in the Caribbean Sea to monitor illicit activity.[310]

Because a great deal of the thinking associated with USV employment is theoretical, it will be crucial to inform USV doctrine with actual operations that begin to approach the imagined scale of future employment. The U.S. Navy's recent announcement that a medium-size USV will deploy with the *Theodore Roosevelt* CSG later in 2026 is a start, but this remains an experimental effort and is not the kind of significant USV operation that will

309 Based on an interview with a defense industry executive conducted by the author in February 2026.

310 The U.S.-Iran conflict of 2026 offers examples of low-intensity USV employment, as well as USV employment in a permissive combat environment. For examples, see Lariosa, "Saronic USV Rescues Two U.S. Army Pilots;" and Holliday and MacDonald, "America's Latest Weapon Against Iran."

be required to validate the assumptions associated with employing large numbers of these vessels at once, such as those related to networking or maintenance.[311]

Test the DMO concept extensively by the end of the 2030s to help decision makers determine whether adjunct magazine USVs will play a significant role in future fleet operations. The U.S. Navy cannot afford to wait until the 2040s to determine whether the most advanced versions of DMO, involving networking and coordinated missile fires, are feasible. The successful conceptual implementation of networked, ship-like magazine USVs depends on the success of DMO as a concept. Testing this concept using manned platforms—assuming the U.S. Navy is not forced to try it in combat before then—will be crucial to understanding whether it is all it is made out to be. The DMO concept remains untested today and could suffer from overly optimistic expectations about how easy it will be to target enemy units or faulty assumptions about how difficult it will be to coordinate fires between multiple units at once. If the DMO concept does not stand up to real-world testing on the scale envisioned, then ship-like magazine USVs could still be viable platforms, but they will not have as much upside for the Navy as they might appear to have today.

Long Term: The 2040s and Beyond

In the long term, the U.S. Navy could once again face a credible combat threat on the high seas as the PLAN begins operating away from the littorals of the Chinese mainland. According to the DoD, the PLAN aims to have nine operational carriers by 2035.[312] It would not be unthinkable for China to begin deploying its CSGs across the world in the 2040s and thus threaten U.S. naval supremacy over sea lanes on the high seas. The PLAN is already beginning to conduct dual carrier operations outside the First Island Chain, which could indicate it is resolved to pursue these kinds of far seas operations.[313] U.S. Navy planners can begin the work now of building USVs into naval fleet architecture with this challenge in mind.

Develop clear metrics of success for implementing the most ambitious USV plans by the 2040s. With the near certainty that the PLAN will gain greater combat capacity over the next two decades and the likelihood that it will have more potential to threaten U.S. Navy's global sea control capability, U.S. naval power will need to significantly improve to keep pace. The situation is similar to the Soviet Union's naval buildup of the 1960s and 1970s under Admiral Sergei Gorshkov, which prompted the U.S. Navy to begin designing a significantly larger fleet.[314]

311 Stancy, "Navy to Experiment with Tailored Force Pairing."

312 DoD, *Annual Report to Congress*, p. 16.

313 Chen and Tang, "PLA Navy Shifts Training Focus."

314 Hattendorf and Naval War College, eds., *US Naval Strategy in the 1970s*, p. 131.

The U.S. Navy should make it a goal to have magazine USVs acting as integrated nodes within the Navy's battle network by the time the PLAN is ready to expand its operations globally. It should set clear metrics for the fleet combat power it hopes to achieve and a deadline to achieve them by. Long-term plans that seek to keep pace with the PLAN must significantly increase the U.S. fleet's missile capacity. For example, by 2049, the centennial of the Chinese Communist Party's takeover of mainland China, the U.S. Navy could publicly plan to have over 500 ships capable of networking together, each armed with a meaningful number of long-range anti-ship missiles. Some existing plans call for a fleet of a similar size but are less ambitious in terms of offensive power, because much of the USV component of the force would remain in supporting roles rather serving as missile platforms that could threaten an enemy's fleet.[315] The Navy must seek out navalist allies in Congress and the executive branch who share the conviction that such a fleet will be required; otherwise, there will not be enough support to marshal the funding and bureaucratic resources to build such a fleet over the next several decades.

Improve USV survivability and endurance, especially for munitions-like USVs. One concern about OWA USVs is whether they will be survivable enough and have enough endurance to be effective in a Western Pacific conflict. In the long-term, transitioning these vessels from simple speedboat designs to something stealthier and more combat effective—with lower freeboard, higher speed, and longer range—will help ensure they can remain credible threats that are hard to destroy or counter. Pursuing engineering improvements in endurance, perhaps by powering these USVs with networks of charging stations or with renewable onboard charging capability, could help them stay in their patrol areas longer. Both improvements in survivability and endurance would make these USVs more lethal and less susceptible to adversary countermeasures. The challenge will be to make these improvements while maintaining low costs of production.

Final Thoughts

The framework offered by this report offers an opportunity to rethink the way USVs are typically categorized. Regardless of whether the U.S. Navy someday deploys unmanned vessels at scale, there will almost certainly be a trend toward greater automation in maritime operations. The Navy would do well to understand how that will change the fleet. Add to this the trend in other technical areas—such as secure network links, more advanced weapons, and the prospect of more mass production of cheap munitions—and the operating environment will probably look different than today whether the Navy of the future is employing zero USVs or thousands. The first step toward making sense of this future is to have a conceptual framework that gets to the essence of what USVs will do and how they will fit into the force.

315 See, for example, Galdorisi, "Concept of Operations."

As this report points out, the single data point of a contested threat environment where USVs contribute in any significant manner has been in the Black Sea as part of the Russo-Ukraine War. This aligns with the expectation that expendable USVs that behave like munitions offer great promise: They gain many operational advantages over nonexpendable platforms by the very fact that they do not need to be maintained. However, as this concept is exported to theaters with larger maritime space and as adversaries devise countermeasures against this kind of vessel, it remains to be seen whether Type II OWA USVs will continue to have all the advantages they seem to have today.

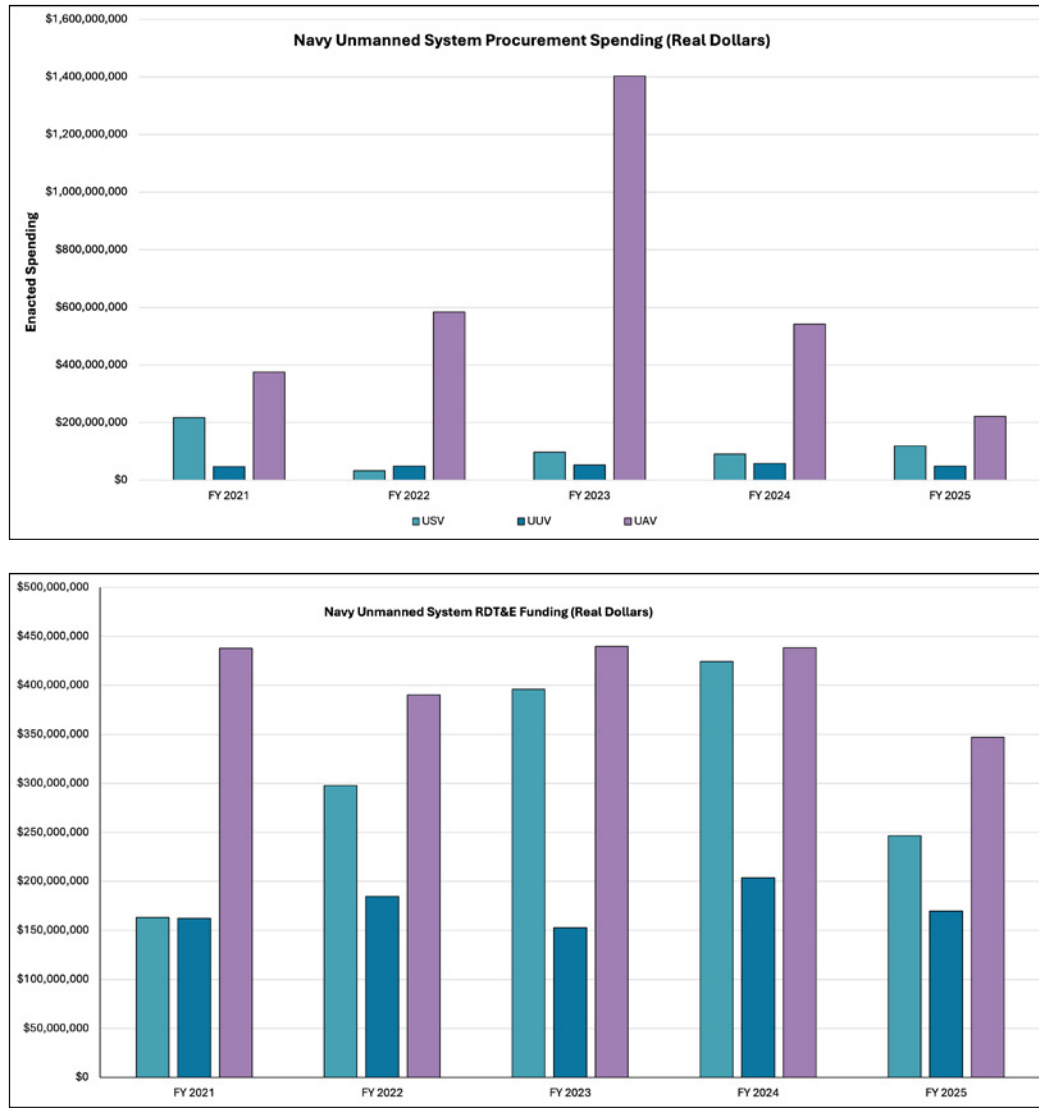
As this study concludes, it is still uncertain whether USVs will meaningfully contribute to fleet operations or whether they will be oddities in the history of defense innovation like the French torpedo fleet of the late 19th century, the rigid airships of the early 20th century, or the arsenal ship. Just as with all the types of USVs described in this report, there were theoretical advantages to employing each of these platforms or force structures. This offers a stark reminder that unless those advantages have adequate funding, strategic coherence, and champions within the naval service, even the best USV innovations could die on the vine.

APPENDIX A

USV Budget Data

Because the U.S. Navy's USV development efforts have primarily been experimental, involving several types and sizes of vessel, its investments span multiple acquisition methods. Budget data paint a partial picture of the total money DoD has invested in USV procurement and USV research, development, testing, and evaluation (RDT&E). Figure 20 compares total procurement and RDT&E funding for USVs, UUVs, and UAVs in the defense budget from FY 2021 to FY 2025.

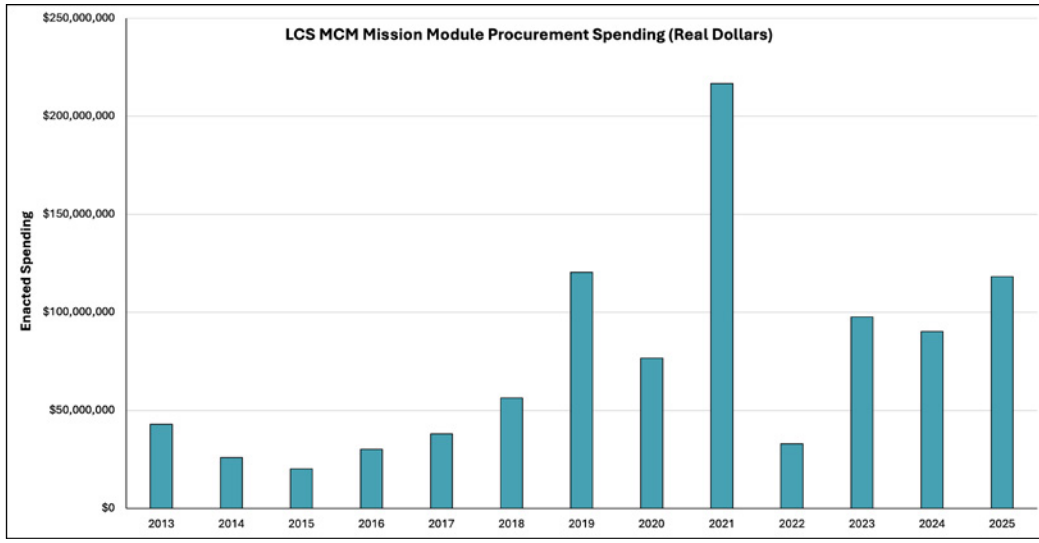
FIGURE 20: NAVY PROCUREMENT SPENDING AND RDT&E FUNDING BY UNMANNED SYSTEM TYPE



Source: Created by CSBA.

The only program of record in the budget that involves USVs is the LCS MCM mission module. Figure 21 shows total procurement by year for this program since its inception.

FIGURE 21: LCS MCM MISSION MODULE PROCUREMENT SPENDING BY YEAR



Source: Created by CSBA.

Other DoD USV-related funding efforts not listed as individual budget lines include:

- A $392 million production contract to Saronic for small USVs via other transaction authority agreements.[316]
- A $95 million contract to Leidos to manage *Overlord* LUSVs and the ACTUV MUSVs.[317]
- A $3 million investment from the small business innovation research program to fund GARC propulsion and vehicle development.[318]

316 Kajal, "1,000-Mile-Range Drone Boats."

317 Andrew Salerno-Garthwaite, "Leidos Secures $95m Contract to Manage Overlord and Medium USV," *Naval Technology*, August 21, 2023, https://www.naval-technology.com/news/leidos-secures-95m-contract-to-manage-overlord-and-medium-usv/.

318 "Airdroppable High Speed, Low Signature Craft," U.S. Small Business Administration, accessed April 24, 2026, https://www.sbir.gov/awards/165981?utm_source=chatgpt.com.

- $23 million from a DARPA prototype line of funding to build the first iteration of the *Sea Hunter* MUSV.[319]
- An indefinite delivery indefinite quantity—multiple award contract for the USV family of systems with a total ceiling of $982.1 million.[320]

319 Sandra Jontz, "DARPA Christens New Sea Robot Vessel Sea Hunter," Armed Forces Communications and Electronics Association, April 7, 2016, https://www.afcea.org/signal-media/darpa-christens-new-sea-robot-vessel-sea-hunter.

320 "Navy Awards First USV Family of Systems Contract Delivery Orders," Naval Sea Systems Command, U.S. Navy, August 28, 2020, https://www.navsea.navy.mil/Media/News/Article-View/Article/2329287/navy-awards-first-usv-family-of-systems-contract-delivery-orders/.

LIST OF ACRONYMS

A2/AD	anti-access/area denial
ACTUV	ASW Continuous Trail Unmanned Vessel
ALPV	autonomous low-profile vessel
AOR	area of responsibility
ASW	anti-submarine warfare
BBG	guided missile battleship
C2	command and control
CENTCOM	U.S. Central Command
CNO	Chief of Naval Operations
COLREGs	International Regulations for Preventing Collisions at Sea
CONOPS	concept of operations
CONUS	continental United States
COTS	commercial off-the-shelf
CSG	carrier strike group
DARPA	Defense Advanced Research Projects Agency
DDG	guided missile destroyer
DMO	distributed maritime operations
DoD	Department of Defense
DOTMLPF-P	doctrine, organization, training, materiel, leadership and education, personnel, facilities, and policy
EM	electromagnetic
FAA	Federal Aviation Administration
FFG	guided missile frigate
FYDP	Future Years Defense Program
GAO	Government Accountability Office
GARC	Global Autonomous Reconnaissance Craft
GWOT	global war on terror
INDOPACOM	U.S. Pacific Command
IOC	initial operational capability
ISR	intelligence, surveillance, and reconnaissance
JP	Joint Publication
LCS	littoral combat ship
LRMV	German Navy's large remote missile vessel
LUSV	large unmanned surface vessel
MASC	modular attack surface craft

MCM	mine countermeasures
MDA	maritime domain awareness
MMCM	UK–France maritime mine countermeasures vessel
MOC	maritime operations center
MUS	maritime unmanned system
MUSV	medium unmanned surface vessel
NAVSEA	Naval Sea Systems Command
NDS	national defense strategy
OCONUS	outside the continental United States
ONR	Office of Naval Research
OPNAV	Office of the Chief of Naval Operations
OSS	Office of Strategic Services
OWA	one-way attack
PAE RAS	Program Acquisition Executive for Robotics and Autonomous Systems
PEO LMW	Program Executive Office for Littoral and Mine Warfare
PLA	People's Liberation Army
PLAN	People's Liberation Army Navy
PRC	People's Republic of China
RAS	robotic and autonomous systems
RDT&E	research, development, testing, and evaluation
RIMPAC	Rim of the Pacific Exercise
RFN	Russian Federation Navy
ROK	Republic of Korea
SURFDEVRON	surface development squadron
SURTASS	surveillance towed array sensor system
T-AGOS	tactical auxiliary general ocean surveillance vessel
TF	task force
UAS	unmanned aerial system
UAV	unmanned aerial vehicle
UISS	Unmanned Influence Sweep System
USV	unmanned surface vessel
USVRON	USV squadron
UUV	unmanned underwater vessel
WEZ	weapons engagement zone

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