The U.S. Navy Prepares the Way for Unmanned Surface Vessels

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Overview

One of the most rapidly growing areas of innovative technology adoption involves unmanned systems. The U.S. military's use of these systems is not only changing the face of modern warfare but is also altering the process of decision-making in combat operations. These systems are evolving rapidly to deliver enhanced capability to the warfighter and seemed poised to deliver the next "revolution in military affairs."

The Department of Defense has evolved a comprehensive *Unmanned Systems Integrated Roadmap* that forecasts the evolution of military unmanned systems over the next quarter-century. Concurrently, funding for unmanned systems is predicted to rise year-over-year for the foreseeable future. Indeed, as the DoD has rolled out a "Third Offset Strategy" to evolve new operational concepts and technologies to deal with emerging peer competitors, unmanned systems have emerged as key—even critical—components of that strategy.

The U.S. Navy has a rich history of UxS development. By the turn of the century, the technology to control unmanned systems had finally matured to the point that the U.S. Navy believed it could successfully field unmanned systems in all domains—air, surface, and subsurface—to meet a wide variety of operational needs. The Chief of Naval Operations Strategic Studies Group (CNO SSG) was tasked to attempt to determine the feasibility of introducing unmanned systems into the Navy inventory. The SSG recommended that the Navy move "full speed ahead" with unmanned systems.

The U.S. Navy's commitment to—and dependence on—unmanned systems is also seen in the Navy's official Force Structure Assessment, as well as in a series of "Future Fleet Architecture Studies." In each of these studies: one by the Chief of Naval Operations Staff, one by the MITRE Corporation, and one by the Center for Strategic and Budgetary Assessments, the proposed Navy future fleet architecture had large numbers of air, surface, and subsurface unmanned systems as part of the Navy force structure.

Most recently, in his FRAGO 01/2019 order, the Chief of Naval Operations, Admiral Michael Gilday, reemphasized the Navy's commitment to the tenets of *A Design for Maintaining Maritime Superiority 2.0*, and especially the plan for a future fleet with substantial numbers of unmanned systems. Indeed, the U.S. Navy is planning for a considerable investment in unmanned systems—especially unmanned surface systems.

Recently, the Navy established a "Surface Development Squadron," to experiment with unmanned surface vehicles. This new squadron has the mandate to accelerate the integration of unmanned surface systems into the Navy Fleet. It is important that this squadron turn the U.S. Navy's commitment to buy large numbers of USVs into operational concepts for *specific* missions that these vessels should accomplish. While the Navy will buy substantial numbers of large, medium and small USVs, it has yet to evolve detailed plans of how these platforms might be used together to accomplish a variety of naval missions. Additionally, the Navy would be well-served of moving away from "one-of" USVs for singular missions and explore the utility of investing in families of similar USVs to capitalize on putting together mutually compatible hull, mechanical and electrical (HME) attributes and systems.

Shaping a Way Ahead

In his best-selling book, *War Made New*, military historian Max Boot notes, "My view is that technology sets the parameters of the possible; it creates the potential for a military revolution."[1] He supports his thesis with historical examples to show how technological-driven "Revolutions in Military Affairs" have transformed warfare and altered the course of history.

The U.S. military has embraced a wave of technological change that has constituted a true revolution in the way that war is waged. As the pace of global technological change has accelerated, the United States has been especially adept at inserting new technology to pace the threat. As Bruce Berkowitz points out in *The New Face of War*:

> Wartime experience suggests that the right technology, used intelligently, makes sheer numbers irrelevant. The tipping point was the Gulf War in 1991. When the war was over, the United States and its coalition partners had lost just 240 people. Iraq suffered about 10,000 battle deaths, although no one will ever really be sure. The difference was that the Americans could see at night, drive through the featureless desert without getting lost, and put a single smart bomb on target with a 90 percent probability.[2]

While both books cited are over a decade old, what they say about technology remains on point regarding the ways that the U.S. military has embraced new technologies. Today one of the most rapidly growing areas of innovative technology adoption by the U.S. military involves unmanned systems. In the past several decades, the U.S. military's use of unmanned aerial vehicles (UAVs)

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[1] Max Boot, *War Made New: Technology, Warfare, and the Course of History 1500 to Today* (New York: Gotham Books, 2006), pp. 318-351. See also, Bruce Berkowitz, *The New Face of War: How War Will Be Fought in the 21st Century* (New York: The Free Press, 2003).

[2] Bruce Berkowitz, *The New Face of War: How War Will Be Fought in the 21st Century* (New York, The Free Press, 2003), pp. 2-3. Berkowitz does not restrict his examples to just one conflict, noting further; "The same thing happened when the United States fought Yugoslavia in 1999 and the Taliban regime in Afghanistan in 2001. Each time experts feared the worst; each time U.S. forces won a lopsided victory."

has increased from only a handful to more than 10,000, while the use of unmanned ground vehicles (UGVs) has exploded from zero to more than 12,000. The use of unmanned surface vehicles (USVs) and unmanned underwater vehicles (UUVs) is also growing, as USVs and UUVs are proving to be increasingly useful for a wide array of military applications. The exploding use of military unmanned systems (UxS) is already creating strategic, operational, and tactical possibilities that did not exist a decade ago.

These systems have been used extensively in the conflicts in Iraq and Afghanistan, and will continue to be equally relevant—if not more so—as the United States' strategic focus shifts toward the Indo-Asia-Pacific region and the high-end warfare this strategy requires. While these unmanned systems are of enormous value today and are *evolving* to deliver better capabilities to the warfighter, it is their promise for the future that causes the most excitement. As the U.S. military buys more and more unmanned systems, it is important to devise concrete plans for the use of these systems.

Planning for Military Autonomous Systems

At the highest levels of U.S. policy and strategy documents, unmanned systems are featured as an important part of the way the Joint Force will fight in the future. The most recent *Quadrennial Defense Review* (*QDR*) notes, "Continuing a trend that began in the late 1990s, U.S. forces will increase the use and integration of unmanned systems." Elsewhere in the *QDR*, unmanned systems are identified as: "Maintaining our ability to project power." Importantly, the *QDR* highlights unmanned systems as a key part of the DoD's commitment to innovation and adaptation.[3]

The U.S. Department of Defense's vision for unmanned systems is to integrate these systems into the Joint Force. Because unmanned systems are used by all the military services, the Department of Defense publishes a roadmap to provide an overarching vision for the military's use of unmanned systems. An article published in *Inside the Navy* soon after the new roadmap's release noted, "The Defense Department's new 30-year unmanned systems plan—the first update of the roadmap in four years—aims to chart a three-decade guide for the rapidly developing field of unmanned systems technology."[4]

As the *QDR* and *Unmanned Systems Integrated Roadmap* both note, unmanned systems are especially important assets in those areas where the U.S. military faces a peer competitor with robust defenses. The *Joint Operational Access Concept* identifies, "Unmanned systems, which could loiter to provide intelligence collection or fires in the objective area," as a key capability that is especially valuable in areas where an adversary has substantial defenses that can limit access of U.S. and coalition forces.[5] And unmanned systems are a key component in executing

[3] *Quadrennial Defense Review* (Washington, D.C.: Department of Defense, 2014).
[4] Jason Sherman, "DoD's New Unmanned Systems Roadmap Charts Course for AI, Weaponization," *Inside the Navy*, September 3, 2018.
[5] Department of Defense, *Joint Operational Access Concept*, (Washington, D.C.: Department of Defense, January 2012).

the United States AirSea Battle Concept (now re-branded as the *Joint Concept for Access and Maneuver in the Global Commons*, or JAM-GC) in high threat areas such as the Western Pacific, where adversary defensive systems pose an unacceptably high risk to manned aircraft and surface platforms.[6]

The U.S. Navy Shapes a Way Ahead for Unmanned Systems

The U.S. Navy has a rich history of UxS development. During the early years of the last century, the Navy and the Army worked together to attempt to develop unmanned aerial torpedoes. However, this was a bridge-too-far given the state of technology during those years, and the project was ultimately abandoned. Other attempts to introduce unmanned systems into the Navy and Marine Corps occurred in fits and starts throughout the first half of the last century, but these met with limited success.

By the turn of the century, the technology to control unmanned systems had finally matured to the point that the U.S. Navy believed it could successfully field unmanned systems in all domains—air, surface, and subsurface—to meet a wide variety of operational needs. As with many disruptive and innovative ideas, the Chief of Naval Operations Strategic Studies Group (CNO SSG) was tasked to attempt to determine the feasibility of introducing unmanned systems into the Navy inventory.

The Navy's leadership is committed to unmanned systems. The importance of unmanned systems to the U.S. Navy's future has been highlighted in a series of documents, ranging from the revised *A Cooperative Strategy for 21st Century Seapower*, to *A Design for Maintaining Maritime Superiority*, to a Chief of Naval Operations *The Future Navy* white paper. The latter document presents a compelling case for the rapid integration of unmanned systems into the Navy fleet, noting, in part:

> There is no question that unmanned systems must also be an integral part of the future fleet. The advantages such systems offer are even greater when they incorporate autonomy and machine learning…Shifting more heavily to unmanned surface, undersea, and aircraft will help us to further drive down unit costs.[7]

The U.S. Navy's commitment to—and dependence on—unmanned systems is also seen in the Navy's official Force Structure Assessment, as well as in a series of "Future Fleet Architecture

[6] *Joint Concept for Access and Maneuver in the Global Commons* (Washington, D.C.: Department of Defense, 2017), accessed via a January 27, 2017 Joint Forces Quarterly article: https://ndupress.ndu.edu/Media/News/Article/1038867/joint-concept-for-access-and-maneuver-in-the-global-commons-a-new-joint-operati/.

[7] *The Future Navy* (Washington, D.C.: Department of the Navy, May 2017) accessed at: http://www.navy.mil/navydata/people/cno/Richardson/Resource/TheFutureNavy.pdf

Studies."[8] Indeed, these reports highlight the fact that the attributes that unmanned systems can bring to the U.S. Navy fleet circa 2030 and beyond have the potential to be truly transformational.

More recently, the Chief of Naval Operations issued an update to *A Design for Maintaining Maritime Superiority 2.0*. Issued just two years after the first version of this document, *Design 2.0* was issued for two primary reasons: to align with the recently issued *National Security Strategy* and *National Defense Strategy*, as well as to address the rapid technological changes that the Navy must embrace.

In his FRAGO 01/2019 order, Chief of Naval Operations, Admiral Michael Gilday, reemphasized the Navy's commitment to tenets of *Design 2.0*, and especially the plan for a future fleet with substantial numbers of unmanned systems.[9] Most recently, *Advantage at Sea*, America's new maritime strategy, continues the drumbeat regarding the importance of unmanned systems to the Sea Services.[10]

The U.S. Navy is planning for a substantial investment in unmanned systems—especially unmanned surface systems. For example, the Navy established a "Surface Development Squadron," to experiment with unmanned ships.[11] Future development ideas call for a "Ghost Fleet" of autonomous unmanned surface ships that could operate against an enemy force without putting Sailors in harm's way.[12] And it should come as no surprise that Congress is increasingly interested in the Navy's progress on unmanned surface vehicles, as witnessed by an increasing number of Congressional Research Service reports on USVs.[13]

NAVSEA has expressed its intention to reach an ambitious future of a fleet populated with scores—even hundreds—of unmanned vehicles, one of three key goals was to, "Integrate USVs

[8] See, for example, "Document, Summary of the Navy's New Force Structure Assessment," *USNI News*, December 16, 2016 (updated April 6, 2017) accessed at: https://news.usni.org/2016/12/16/document-summary-navys-new-force-structure-assessment, for an executive summary of this document.
[9] *FRAGO 01/2019: A Design for Maintaining Maritime Superiority*.
[10] *Advantage at Sea: Prevailing with All-Domain Naval Power* (Washington, D.C.: Department of the Navy, December 2020) accessed via *USNI News*, December 17, 2020, at: https://news.usni.org/tag/advantage-at-sea-prevailing-with-integrated-all-domain-naval-power.
[11] Megan Eckstein, "Navy Pursuing 'Surface Development Squadron,' to Experiment with Zumwalt DDGs, Unmanned Ships," *USNI News*, January 28, 2019.
[12] Kris Osborn, "Navy to Test 'Ghost Fleet' Attack Drone Boats in War Scenarios, *Defense Maven*, January 22, 2019.
[13] See, for example, Ronald O'Rourke, *Navy Large Unmanned Surface and Undersea Vehicles: Background and Issues for Congress* – CRS Report 45757 (Washington, D.C.: Congressional Research Service, October 7, 2020). While the primary focus of the report is on larger unmanned surface vehicles, it provides a comprehensive overview of the Navy's plans for large, as well as medium sized craft. For a brief summary of an earlier report, see Report to Congress on Navy Large Unmanned Surface and Undersea Vehicles, *USNI News*, June 11, 2019, accessed at: https://news.usni.org/2019/06/11/report-to-congress-on-navy-large-unmanned-surface-and-undersea-vehicles?utm_source=USNI+News&utm_campaign=24af1c52bf-USNI_NEWS_DAILY&utm_medium=email&utm_term=0_0dd4a1450b-24af1c52bf-230420609&mc_cid=24af1c52bf&mc_eid=157ead4942.

with manned host platforms, which control the USVs from a distance.[14] The Navy announced its intention to spend $2.7B into researching and buying ten large unmanned surface ships over the next five years as part of an overall plan to buy 232 unmanned surface, underwater and aerial vehicles of all sizes over the next five years.[15]

In remarks during 2019 U.S. Navy League SeaAirSpace Symposium, the Navy's Deputy Chief of Naval Operations for Warfare Systems, Rear Admiral William Merz, confirmed this commitment unmanned systems when he noted, "Every study directed or initiated from within has told us we have to move out on these [unmanned surface vehicles] capabilities…Our commitment in our last budget to the tune of almost $3 billion in just unmanned surface vessels should be enough to signal to industry we're very serious about this."[16] The U.S. Navy's commitment to unmanned systems is unlikely to wane as increasingly, these platforms continue to prove their utility in performing much of the dull, dirty and dangerous work that the Navy previously assigned to manned platforms."[17]

The Bridge to the Navy-after-Next

As the U.S. Navy continues to operate at high operating tempo in order to meet its global commitments, it is concurrently planning for "The Navy after Next." This Navy will be key to protecting the security and prosperity of the nation throughout the remainder of the century. The shape of this Navy is already evolving as ships currently in service are having their service lives extended, more of current classes of ships are being built, and as new ships are being planned.

The importance of unmanned systems to increasing the combat power of Navy fleet has been well-documented in the aforementioned "Future Fleet Architecture Studies" as well as the *Naval Research and Development: A Framework for Accelerating to the Navy and Marine Corps after Next*.[18] The *Naval Research Enterprise Addendum to the Naval Research and Development Framework* drills down to technology areas, and then to specific technologies that will enable the Navy and Marine Corps to field decisive capabilities and dominate the future littorals in a high-end fight. Unmanned surface vehicles and unmanned underwater vehicles are called out as disruptive technologies that can provide leap-ahead capabilities for the Navy.[19]

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[14] David Larter, "U.S. Navy Looks to Ease Into Using Unmanned Robot Ships With a Manned Crew," *Defense News*, January 29, 2019. ADD

[15] Eckstein, "Navy Betting Big on Unmanned Warships Defining Future of the Fleet."

[16] Megan Eckstein, "Navy Planning Aggressive Unmanned Ship Prototyping, Acquisition Effort," *USNI News*, May 15, 2019. Accessed at: https://news.usni.org/2019/05/15/navy-planning-aggressive-unmanned-ship-prototyping-acquisition-effort. For additional reporting on the U.S. Navy's plans to integrate unmanned surface vehicles into the Fleet, see, also, David Larter, "With Billions Planned in Funding, the US Navy Charts Its Unmanned Future," *Defense News*, May 6, 2019. Accessed at: https://www.defensenews.com/digital-show-dailies/navy-league/2019/05/06/with-billions-planned-in-funding-the-us-navy-charts-its-unmanned-future/.

[17] Megan Eckstein, "Navy Betting Big on Unmanned Warships Defining Future of the Fleet," *USNI News*, April 8, 2019. Accessed at: https://news.usni.org/2019/04/08/navy-betting-big-on-unmanned-warships-defining-future-of-the-fleet.

[18] *Naval Research and Development: A Framework for Accelerating to the Navy and Marine Corps After Next*.

[19] *Naval Research Enterprise Addendum to the Naval Research and Development Framework*.

The Naval Sea Systems Command, as well as the Navy laboratories that provide the technical expertise for the development of many unmanned surface and subsurface unmanned systems, have been accelerating the development of these USVs and UUVs. The Navy has partnered with industry to develop, field and test a family of USVs and UUVs such as the Medium Displacement Unmanned Surface Vehicle (Sea Hunter), MANTAS next generation unmanned vessels, the Large Displacement Unmanned Underwater Vehicle ("LDUUV") and others.

Indeed, this initial prototype testing has been so successful that the Department of the Navy has begun to provide increased support for USVs and UUVs, and has established program guidance for many of these systems of importance to the Navy and Marine Corps. This programmatic commitment is reflected in the *Navy Program Guide* as well as in the *Marine Corps Concepts and Programs* document. Both show a commitment to a variety of unmanned systems programs.[20]

Speaking at the January 2018 Surface Navy Association Symposium, the Navy's PMS-406 Program Manager, Captain Jon Rucker, spoke of the bright future for unmanned maritime systems, noting, "We have been given special authorities to do accelerated acquisitions." Captain Rucker concluded his remarks by explaining how the Navy will insert unmanned maritime systems into the fleet:

> As the technology is ready, we will insert it into the systems we're developing. In every system I show you, whether it's an unmanned surface vessel or unmanned undersea vessel, we are ensuring that we develop that modularity and have the interfaces, so as technology is ready, we can insert it into the production line—not break the production line—and ensure we stay on track to deliver that capability.[21]

The key technical phrase from Captain Rucker focused on "developing that modularity" thereby delivering new capabilities "without impact" on the production line. Subsequently, during the 2019 Surface Navy Association Symposium, the current Naval Sea Systems Command Program Manager for Unmanned Maritime Systems, Captain Peter Small, explained how NAVSEA's USV Systems Vision focused on "Enhanced, Efficient Capabilities" for large, medium, small and extra small, unmanned surface vehicles, and listed specific USVs to be fielded in near, near-to-mid, and mid-to-far timeframes. The briefing slides presented in that symposium have been replicated in

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[20] *Navy Program Guide*, accessed at: http://www.navy.mil/strategic/npg17.pdf, and *Marine Corps Concepts and Programs* accessed at: https://www.candp.marines.mil/.

[21] Jon Harper, "Navy Officials Speed Up Acquisition of Unmanned Maritime Systems," *National Defense Magazine* Online, January 11, 2018, accessed at: http://www.nationaldefensemagazine.org/articles/2018/1/11/navy-officials-under-pressure-to-speed-up-acquisition-of-unmanned-maritime-systems. See also Richard Burgess, "Navy Acquisition Chief: 'Reliably Deliver Capable Capacity,'" *SEAPOWER Magazine Online*, January 11, 2018, accessed at: http://seapowermagazine.org/stories/20180111-geurts.html. ADD

various publications such as the aforementioned *Navy Large Unmanned Surface and Undersea Vehicles: Background and Issues for Congress*.[22]

Later that same year, at the U.S. Navy League SeaAirSpace Symposium, Captain Small, noted that, "We will bring in Navy program of record weapons systems to incorporate into commercially-derived modular craft."[23] The use of the phrases "modular craft" along with "commercially-derived" clearly indicate both the need and desire for the Navy to transition currently commercially-available unmanned craft, where a single USV platform can meet *multiple missions* through the use of "mission modularity" modifications to meet the needs of each of the specific mission-related sensors and weapons systems This represents a technical challenge that commercial industry is not only ready, but eager, to meet.

But how to get there?

With this look at the commitment to unmanned systems, it is worth spending a bit of time understanding the missions the Navy and Marine Corps have planned for unmanned maritime systems, specifically, unmanned surface vehicles. Operating as they do at the air-water interface on the surface of the oceans, unmanned surface vehicles not only have their own discrete—and growing—list of current and future naval missions, but they also provide the connective tissue between aerial unmanned vehicles and subsurface unmanned vehicles as well as their manned counterparts.[24]

Like all unmanned systems, unmanned surface vehicles are critical assets in all scenarios across the spectrum of conflict and become more useful against high-end adversaries. Unmanned surface vehicles enable warfighters to gain access to areas where the risk to manned platforms is unacceptably high due to a plethora of enemy systems designed to deny access: from integrated air defense systems, to surface ships and submarines, to long-range ballistic and cruise missiles, to a wide range of other systems. These unmanned surface vehicles can provide greater range and persistence on station, leading to enhanced situational awareness of an objective area. Indeed, in a high-end fight, unmanned surface vehicles can be viewed as expendable assets once they perform their mission.

Unmanned surface vehicles are especially adept at conducting the intelligence, surveillance, and reconnaissance (ISR) mission, and are typically better suited for this mission than their unmanned aerial vehicle counterparts for a number of reasons, particularly their ability to remain undetected by enemy sensors, as well as their dwell time on station. By performing this near-shore intelligence preparation of the battlespace (IPB), unmanned surface vehicles increase the

[22] Ronald O'Rourke, *Navy Large Unmanned Surface and Undersea Vehicles: Background and Issues for Congress* – CRS Report 45757.
[23] Remarks at the 2019 Navy League of the United States SeaAirSpace Symposium, National Harbor, Maryland, May 6-8, 2019.
[24] The Navy has begun testing the connectivity between unmanned systems in all three domains: air, surface and subsurface. See, for example, Vladimir Djapic et al, "Heterogeneous Autonomous Mobile Maritime Expeditionary Robots and Maritime Information Dominance," *Naval Engineers' Journal*, December 2014.

standoff, reach, and distributed lethality of the manned platforms they support. As the unmanned option of choice, the USV, or multiple USV operating together, gain vital and necessary intelligence information without putting a Sailor or Marine in harm's way.

The importance of using unmanned systems in the ISR and IPB roles was emphasized by the deputy assistant secretary of the Navy for research, development, test and evaluation, Mr. William Bray, in an interview with *U.S. Naval Institute News* where he said:

> Responding to a threat today means using unmanned systems to collect data and then delivering that information to surface ships, submarines, and aircraft. The challenge is delivering this data quickly and in formats allowing for quick action.[25]

While the Navy is committed to buying large numbers of unmanned maritime vehicles, it has yet to come up with a convincing concept of operations for how they will be used during conflict against a determined adversary. The U.S. Congress has indicated increasing skepticism that the billions of dollars the Navy intends to invest in these platforms should continue, absent a clear understanding of their intended use. Indeed, a mid-2020 article in a defense publication reported this Congressional concern this way:

> The Navy has yet to produce a concept of operations or even a coherent public strategy to back up the investments they want to make. Further, Congress is wary of appropriating money for platforms that rely on technologies that haven't been fully developed yet.[26]

The inability of the Navy to develop a convincing CONOPS for the use of unmanned maritime systems may simply stem from a lack of imagination. As the Navy looks to allay Congressional concerns and accelerate the fielding of unmanned maritime systems, the emphasis should be on no longer thinking of each unmanned maritime system as a "one-of," but rather, to package these together as in multiple-sized and function vehicles designed for specific missions. The emphasis must remain on USV ship design that is focused on modularity to accommodate sensors, weapons and payloads for specific missions, where the platform remains constant and the modularity within the platform allows for the "modular shift" to support multiple missions.

Shaping, and executing a CONOPS for the use of unmanned maritime systems is crucial to be able to introduce these new capabilities into the fleet in a way which reinforces fleet wide warfighting innovations in the high-end fight without degrading the fleets capabilities to do so.

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[25] Ben Werner, "Sea Combat in High-End Environments Necessitates Open Architecture Technologies," *USNI News*, October 19, 2017, accessed at: https://news.usni.org/2017/10/19/open-architecture-systems-design-is-key-to-navy-evolution?utm_source=USNI+News&utm_campaign=b535e84233-USNI_NEWS_DAILY&utm_medium=email&utm_term=0_0dd4a1450b-b535e84233-230420609&mc_cid=b535e84233&mc_eid=157ead4942.

[26] David Larter, "The Pentagon Wants To Forge Ahead With Robot Warships, But Congress Wants To Slow The Train," *Defense News*, June 19, 2020.