NPS-AM-24-004

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USN and USMC Landing Ship Medium Acquisition Case Study

December 2023

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Department of Defense Management

Naval Postgraduate School

Prepared for the Naval Postgraduate School, Monterey, CA 93943

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The research presented in this report was supported by the Acquisition Research Program of the Department of Defense Management at the Naval Postgraduate School.

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ABSTRACT

The purpose of this project is to record the U.S. Navy (USN) and U.S. Marine Corps (USMC) Landing Ship Medium (LSM) program background, identify the acquisition dilemma, and provide a path forward and contract recommendations. The LSM program is a USMC priority acquisition program originating from USMC Force Design 2030 organizational changes; however, the program is managed within the USN's Naval Sea Systems Command (NAVSEA) Program Executive Offices Ships acquisition portfolio. The USMC LSM acquisition requirement is 35 ships, and the initial cost estimate for each ship was between $100 million and $150 million. However, the USN expressed concern over initial LSM deficiencies in survivability, which required additional equipment and modification to ship design and raised cost estimates to more than $350 million per ship. Differences in minimum LSM capability requirements widened the program scope between the services and compounded NAVSEA concerns over fulfilling the USMC requirement with a constrained shipbuilding budget, which delayed the procurement contract award to, at earliest, fiscal year 2025. The acquisition team must tailor, combine, and transition between acquisition pathways to deliver the LSM to the warfighter by 2030, in order to meet USMC requirements while also reducing per-unit costs through capability trade-offs to meet shipbuilding budget constraints.

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ABOUT THE AUTHOR

Maj Sam Irvine attended Platoon Leaders Course-Combined (OCS) during the summer in-between junior and senior year of college. After OCS Maj Irvine returned and graduated from Drake University with a Bachelor of Science in Business Administration. Following his commissioning in 2012 Maj Irvine attended The Basic School and Logistics Officer Course. Maj Irvine's operational assignments include Logistics Officer, 1st Battalion, 5th Marines from August 2020 to June 2022; Company Commander, Maintenance Management and Motor Transport Officer, Marine Corps Security Force Regiment from June 2017 to February 2020; Platoon Commander and Assistant Operations Officer, Combat Logistics Battalion 2 from August 2013 to May 2017. Maj Irvine deployed with the Logistics Combat Element for Special-Purpose Marine Air Ground Task Force-Crisis Response Africa 16.1/16.2 and supported Operations OAKEN STEEL and ODYSSEY LIGHTNING. Also, he deployed aboard the USS America with Battalion Landing Team 1/5, 31st Marine Expeditionary Unit, for a western Pacific patrol. Maj Irvine's follow-on orders are to 2d Marine Logistics Group to serve as a Contingency Contracting Officer.

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ACKNOWLEDGMENTS

I am grateful for my wife, Melissa, for her encouragement and support throughout, and her care for our newborn daughter, Cameron Joanne. Also, I would like to thank Doctor Mortlock and Professor Yoder for their advisership, instruction, and assistance to complete this project.

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LIST OF ACRONYMS AND ABBREVIATIONS

AoA	Analysis of Alternatives
ASN(RDA)	Assistant Secretary of the Navy for Research, Development, and Acquisition
AUKUS	Australia–United Kingdom–United States
CAPE	Cost Assessment and Program Evaluation
CD&I	Combat Development and Integration
DASN Ships	Deputy Assistant Secretary of the Navy for Ship Programs
DoD	Department of Defense
EMD	Engineering and Manufacturing Development
FY	Fiscal Year
IDIQ	Indefinite Delivery, Indefinite Quantity
INDOPACOM	Indo-Pacific Command
LAW	Light Amphibious Warship
LCAC	Landing Craft Air Cushion
LCS	Littoral Combat Ship
LCU	Landing Craft Utility
LHA	Landing Helicopter Assault
LMV-M	Littoral Maneuver Vessel-Medium
LPD	Landing Platform Dock
LRIP	Low-Rate Initial Production
LSM	Landing Ship Medium
LST	Landing Ship, Tank
MCA	Major Capability Acquisition
MDAP	Major Defense Acquisition Pathway
MEU	Marine Expeditionary Unit
MLR	Marine Littoral Regiment
MSV-H	Maneuver Support Vessel (Heavy)

MSV-L	Maneuver Support Vessel (Light)
MTA	Middle-Tier Acquisition
NAVSEA	Naval Sea Systems Command
NDAA	National Defense Authorization Act
PDR	Preliminary Design Review
PEO	Program Executive Office
POM	Program Objective Memorandum
PP&O	Plans, Policies, and Operations
TMRR	Technological Maturation and Risk Reduction
USCG	U.S. Coast Guard
USMC	U.S. Marine Corps
USN	U.S. Navy

I. INTRODUCTION

The purpose of project is to study and analyze the U.S. Navy (USN) and U.S. Marine Corps (USMC) Landing Ship Medium (LSM) program background, identify the acquisition dilemma, and provide pathway and contract recommendations. The LSM program is a USMC priority acquisition program with an acquisition objective for 35 ships originating from USMC Commandant General Berger's (2023a) USMC Force Design 2030 organizational and equipment changes. USN leadership expressed concern over initial LSM deficiencies in survivability, which required additional equipment to rectify, thus adding to the ship's design, increasing LSM capability, and raising cost estimates over $350 million per ship (O'Rourke, 2023b). Differences in acquisition ship capability requirements widened the program scope between the USN and USMC compounded Naval Sea Systems Command (NAVSEA) concerns over fulfilling the USMC requirement with a limited shipbuilding budget, which delayed procurement contract award to, at earliest, fiscal year (FY) 2025 (O'Rourke, 2023b). The acquisition team challenge is to tailor, combine, and transition between acquisition pathways to deliver the LSM to the warfighter before 2030 while also reducing per-unit costs through capability trade-offs to meet shipbuilding budget constraints.

The USMC's Force Design 2030 requirement identified a need for 35 additional amphibious connectors larger than a Landing Craft Air Cushion (LCAC) or Landing Craft Utility (LCU) and smaller than a Landing Platform Dock (LPD) (Berger, 2023a). Figures 1, 2, and 3 depict an LCAC, LCU, and LPD to show the vessel size difference and capability limitations between ship-to-shore LCU/LCAC connectors and larger amphibious LPD warships.

Figure 1. An LCAC Moving USMC Vehicles to Shore. Source: Eckstein (2023).

Figure 2. An LCU Transporting Marines to Shore. Source: United States Navy (2019).

Figure 3. LPD-18 USS New Orleans Underway with an LCAC in the Background. Source: Eckstein (2022).

Newly formed Marine Littoral Regiments (MLRs) operating as stand-in forces in the Pacific lack tactical mobility and maneuverability to move company-sized forces and equipment between Pacific islands (Berger, 2023a). The LSM provides the USMC with a low-signature ship attached to the MLR that can deliver a reduced company of Marines, weapons, and supplies to shore and is larger and more effective than current smaller LCU and LCAC connectors assigned to Marine Expeditionary Units (MEUs) (Oakley et al. 2023b, p. 171). The LSMs will augment larger amphibious vessels assigned to support MEUs in the Pacific theater, such as the LPD and Landing Helicopter Assault (LHA) (Berger, 2023b).

The initial cost estimate for each LSM was between $100 million and $150 million (O'Rourke, 2023b). Also, the USMC was motivated to move quickly with the acquisition program and desired procurement contract award in FY2023 Quarter 1 (O'Rourke, 2023b), however the acquisition program baseline and initial operating capability requirement date for the initial ship was not publicly released information. Currently, the program is behind the USMC desired schedule, and without proper risk management, the program could slip further due to issues solidifying acquisition quantity

and vessel requirements between the services (Oakley et al., 2023b, p. 171). This project presents a measurement and analysis of the requirements scope enlargement, with the goal of identifying the minimum viable product to meet the USMC light amphibious vessel need to transit Pacific littorals. Further, the USMC requirement outlines the need for additional medium amphibious connectors as a priority to meet increasing operational demand in the Indo-Pacific Command (INDOPACOM) and expects the first LSMs in the fleet by 2028 to meet Force Design 2030 implementation timelines (Feichart, 2023, p. 1). Given budgetary constraints, shipbuilding backlogs, limited industry participation, and other issues, the risk of further schedule slip is high (O'Rourke, 2023a). However, five finalist shipbuilders received LSM concept design review contracts to create digital prototypes and could be viable manufacturers during the production phase even though they are not all traditional Navy amphibious shipbuilders (Quigley, 2022). The goal of this research is to identify program management solutions and make recommendations to manage cost, schedule, performance, and manufacturing risk through the adaptive acquisition framework pathways beyond the major defense acquisition pathway (MDAP). Additionally, this project expands the focus outside of traditional amphibious shipyards to identify other shipbuilders and shipyards capable of producing smaller vessels, thereby quickening the pace of production (Royal Institution of Naval Architects, 2021). Also, this project documents how creative contract solutions in production contract awards could manage programmatic risk while also increasing industry participation.

A. PRIMARY RESEARCH QUESTIONS

The primary research questions are: How can the LSM acquisition team manage program risk despite schedule delays and a limited shipbuilding budget? Additionally, what acquisition pathways and capability trade-offs are best suited to reduce program costs?

B. SECONDARY RESEARCH QUESTIONS

The secondary research questions are: Is it feasible to increase commercial shipbuilding interest and participation by soliciting and awarding various multi-year procurement contracts to different shipbuilders? How many shipbuilders are required to

reduce the risk of schedule delays and produce 35 ships quickly to meet the USMC requirement?

C. RESEARCH METHODOLOGY

This project uses mixed methods research to document and analyze findings and provide recommendations. Recorded within the case study are the acquisition program history, key stakeholders, acquisition dilemma and challenges, and follow-on analysis used to make program and contract award recommendations. All research is consolidated to answer the acquisition dilemma, which is how the program will tailor, combine, and transition between acquisition pathways to deliver the LSM to the warfighter while also reducing per-unit costs through trade-offs to meet shipbuilding budget constraints (O'Rourke, 2023a). Currently, this acquisition dilemma does not have a clearly defined or published solution that meets the warfighter requirement to acquire the LSMs in conjunction with the USMC's Force Design 2030 organizational modernization strategy occurring between 2020–2030 timeline (Feichart, 2023, p. 1). In the absence of a plan, this project presents a potential answer to the dilemma questions to reduce program risk and a recommended solution to deliver the ship to the warfighter on schedule and without excessive costs.

D. RESEARCH LIMITATIONS AND ASSUMPTIONS

Research into specific LSM acquisition strategy, requirements, and schedule documentation was limited to previously released public information on the program while it was still in development and planning phase. The researcher was unable to obtain copies of key LSM programmatic documents including the initial capabilities document, material development decision, acquisition strategy, program schedule, and acquisition baseline requirements. The researcher requested key documents from the LSM program office but did not receive a response, so the researcher was limited to using other credible sources to form the program background information, stakeholder analysis, and acquisition dilemma. The researcher assumes publicly released program information on LSM design and requests for information solicitations through System for Award Management (sam.gov) including the LSM circular of requirements (System for Award Management, 2020b), 2020

LSM Industry Day Brief (see Appendix A), and LSM Industry Day Question and Answer (see Appendix B) documents accurately describe program minimum requirements and insight into the acquisition strategy. Further, the researcher assumes program background and acquisition dilemma information collected from Congressional Research Service and Government Accountability Office LSM reports are unbiased and precise.

E. SUMMARY AND OVERVIEW

The purpose of this project is to study and analyze the USN and USMC LSM acquisition program to provide acquisition pathway and contract management recommendations. The LSM requirement originated from the USMC Commandant's Force Design 2030 plan and LSMs will provide tactical mobility for new MLRs operating in the Pacific. Further, this research aims to identify minimum viable program requirements, identify opportunities to increase industry participation, and recommend contract solutions to deliver ships quicker while reducing per-unit production costs. This research was limited by lack of access to key program documents, so publicly available LSM acquisition information was used.

The following chapter investigates the LSM program background including the existing capability gap, vessel requirements, and development history. The next chapter outlines the stakeholder analysis, which studies USMC, USN, U.S. Army, domestic shipbuilders, ship engineering and design firms, international shipbuilders, and Congressional positions and impact on the LSM development. The subsequent chapter illustrates the acquisition dilemma the LSM confronted to manage cost, schedule, performance, and manufacturing risk. Next, the analysis chapter charts a path to answer the primary and secondary research questions. Finally, the recommendations chapter provides additional programmatic and contract suggestions to reduce program schedule and per-unit procurement costs.

II. BACKGROUND

> I woke up this morning, checked what's the readiness rate. It's 32 [percent]. We can't live with that. We can't live with a 32 percent readiness rate. And over the last decade it's below 50 percent.
>
> —38th Marine Corps Commandant General David Berger (in Kenney, 2023, p. 1)

A. AMPHIBIOUS CAPABILITY GAP AND LSM REQUIREMENTS

USN amphibious L-class ships (e.g., LPD, LHA) are crewed by Navy sailors and used to transport Marines with weapons, equipment, and limited supplies to facilitate expeditionary operations in littoral areas (O'Rourke, 2023b, p. 5). For reference, Figure 4 depicts an LHA, which is the largest type of USN L-class ship and unlike other amphibious vessels does not possess a well deck.

Figure 4. LHA-6 USS America Conducting a Replenishment-at-Sea. Source: DVIDS (2020).

The FY2023 National Defense Authorization Act (NDAA) directs that the minimum necessary amphibious fleet shall consist of 10 amphibious assault ships (LHA/ Landing Helicopter Dock [LHD]), and 21 LPDs (Berger, 2023b). The L-class ships are organized into Amphibious Readiness Groups and combine with MEUs to provide overseas naval deterrence and response capability equipped to support combatant

commanders. Kenney (2023) reported that the deployable USN amphibious fleet averaged 46% readiness over the past decade. In 2023, deployable L-class amphibious ship readiness reached its lowest recorded point, at 32%. The USN attributes these operational availability issues to a ship maintenance backlog, which is a fleet-wide problem. The lack of availability impacted the USMC's ability to respond quickly with a MEU in 2022 to the Russian invasion of Ukraine and provide humanitarian aid to Turkey and Syria earthquake victims (Kenney, 2023). Currently, the USN amphibious fleet is unable to meet the National Defense Strategy requirement to consistently provide 31 amphibious ships to ensure MEU forces for combatant commanders (Berger, 2023b, p. 16–17).

Force Design 2030 introduced a new force structure by transforming two infantry and one artillery regiments into three new MLRs possessing balanced infantry, fire support, low altitude air defense, and logistics battalions organic to the new formation. These forces are designed to operate dispersed within the first island chain of the Pacific Islands, including Senkaku (Japan), Ryukyu (Okinawa), and the Philippines, providing land-based sea lane control and sea denial capabilities. The MLR structure promotes decentralized company-level operations within the area of operations to reduce detectability. USMC wargames identified that the MLR requires organic sea mobility to enable small company-size movements between the numerous friendly Pacific first island chain nations. Sea mobility provides the MLR with the ability to blend into dense commercial shipping routes using comparably sized vessels, thus limiting detectability among similar commercial vessels, which increases the MLR's survivability during conflict. The LSM is envisioned to fulfill tactical sea mobility in politically and militarily contested Pacific environments while complementing L-class amphibious ships by offering a new remote island connector capability (Berger, 2023b, p.13). This platform offers a lower risk of escalation when maneuvering in gray zone areas to facilitate security cooperation, humanitarian assistance, and MLR logistics support mobility (Berger, 2023b, p.13). According to Gen Berger (2023c),

> After extensive research and wargaming, we calculated a need for nine LSMs to support a single regimental sized unit. The DON's Amphibious Force Requirements Study over the last two years validated this number, articulating a requirement of no fewer than 18 LSMs to support littoral

> maneuver. Given that current force structure plans call for three MLRs, we require 35 LSMs to account for operational availability and mobility for those units. We anticipate an initial request for 18 of the 35 LSMs we seek will be a step toward enabling us to more effectively counter adversaries' strategies, support and reinforce alliances and partnerships, and do so at a relatively low cost. (pp. 13–14)

The USMC requires 35 LSMs to support three MLRs within the INDOPACOM area of operations (Berger, 2023b, p. 13). The USN expressed interest in procuring a minimum of 18 LSMs, yet this provides approximately half of what is needed to compete in gray zone littorals (Berger, 2023b, p. 13). In 2020, the USMC's and USN's LSM ship requirements were relatively simple, inexpensive, could be based on commercial ship design (O'Rourke, 2023b). Figure 5 depicts an LSM concept design based on the following vessel requirements and specifications outlined in the System for Award Management (2020b) LSM Circular of Requirements, Appendix A Industry Day brief, and this information was consolidated by O'Rourke (2023b) into:

- length of 200–400 feet
- maximum draft of 12 feet
- displacement of up to 4,000 tons
- ship's crew of no more than 40 USN sailors
- ability to embark at least 75 Marines
- 4,000–8,000 square feet of cargo area for the Marines' weapons, equipment, and supplies
- stern or bow landing ramp for moving the Marines and their weapons, equipment, and supplies from the ship to shore (and vice versa) across a beach
- modest suite of C4I equipment
- 30mm gun system and .50 caliber machine guns for self-defense
- transit speed of at least 14 knots, and preferably 15 knots
- minimum unrefueled transit range of 3,500 nautical miles
- tier 2+ level of survivability (i.e., ruggedness for withstanding battle damage), a level broadly comparable to that of a smaller USN surface combatant (e.g., a corvette or frigate), that would permit the ship to absorb a hit from an enemy weapon and keep the crew safe until they and their equipment and supplies can be transferred to another LSM
- ability to operate within fleet groups or deploy independently
- 10-year minimum and 20-year expected service life

Figure 5. An LSM Concept Design. Source: Grady (2023).

Key to the LSM design are mobility and survivability to hide among commercial shipping lanes and surrounding Pacific Islands. The capability to move forces, equipment, and supplies between small commercial ports and remote island beaches is crucial to fill the MLR amphibious vessel gap. The LSM is a fraction of the size of L-class ships, and initial requirements described a desire for it to resemble commercial shipping vessels navigating the same maritime arena. Hubbard (2023) described the LSM as a "transport vessel in the tradition of vessels like the Landing Ship, Tank (LST) of World War II [WWII] vintage. LSTs were designed to bring materiel from American factories at home across oceans and deposit this equipment on a foreign and often hostile shore" (p. 68). The LSM, like the LST, was initially envisioned as an inexpensive vessel able to deploy dispersed surface forces across the INDOPACOM theater. Like the LST, the LSM provides intra-theater tactical lift able to fulfill multiple transportation requirements in conjunction with larger L-class ships (Hubbard, 2023). The LSM is required to be less detectable than L-class amphibious ships and able to operate in a channel distribution system to move people and things between vessel platforms to dispersed remote island end points (Hubbard, 2023). Figure 6 depicts a World War II

LST conducting a remote beach landing to offload personnel, vehicles, and equipment like what an LSM will be used for throughout INDOPACOM.

Figure 6. World War II LST Conducting a Beach Landing. Source: Ussery (2008).

The LSM capability forecasts a vessel able to support a "dispersed, agile, constantly relocating force" (Apte et al., 2021, p. 305) operating in accordance with the Expeditionary Advanced Base Operations concept. As a medium-sized ship, the LSM is required to conduct amphibious landings on beaches to offload Marines, equipment, and supplies while also possessing greater carrying capacity, range, and survivability in comparison to LCUs and LCACs. Bridging a capability gap between existing L-class ships and small ship-to-shore connectors, the LSM is the required vessel to meet the future of littoral warfare, limiting susceptibility to enemy long-range missile targeting and enabling dispersed maneuvering of Marines, equipment, and supplies while also having similar capabilities to the LST to conduct amphibious landings in remote locations. Apte et al. (2021) described the LSM requirement as a "risk-worthy vessel (defensible enough that risks are not excessive or cheap enough that we can afford to lose it) with priority for personnel survivability" (p. 306), which is a different perspective

from L-class ships operating from over the horizon locations. Further, the LSM requirement is more than a medium-range connector and is reminiscent of small LPDs capable of "conducting up to 11-day missions without replenishment" (Apte et al., 2021, p. 307) with a 10,000 square-foot cargo area possessing the capacity to store approximately 500 pound per square foot.

The Deputy Commandant of Marine Corps Combat Development and Integration (CD&I), Lieutenant General Karsten Heckl, described the LSM as a shore-to-shore connector not requiring a pier or another ship (Easley, 2022). CD&I is the USMC's requirements generation, experimentation, and wargaming command responsible in part to define what the USMC needs from the LSM to be effective in the INDOPACOM region. LtGen Heckl described the LSM as a priority for modernization efforts despite budget constraints delaying production and USN leadership concerns about survivability in a conflict (Easley, 2022). In 2023, CD&I leased a commercial stern vessel to deploy with 3d MLR for experimentation in the INDOPACOM area of operations to reaffirm minimum viable product LSM requirements and demonstrate urgency of need (Easley, 2022).

B. PROGRAM DEVELOPMENT

The USN's LSM program, previously named the Light Amphibious Warship (LAW) program, received a Material Development Decision, and entered the Material Solution Analysis phase of the major capability acquisition (MCA) process with a procurement goal between 18–35 LSMs awarding initial production contracts in FY2025 (O'Rourke, 2023b). The initial capabilities document outlined the validated threshold requirements for the ships (System for Award Management, 2023b), which progressed the program towards completion of a draft Analysis of Alternatives (AoA) (Oakley et al., 2023b, p. 171). As of 2023, the LSM program office had completed the AoA but had not yet received Department of Defense (DoD) approval of the AoA, and why the Office of the Secretary of Defense (OSD) had not yet approved or denied the AoA study was not known information (Oakley et al., 2023b, p. 171). According to DoD Instruction 5000.85, Section 3.5, without AoA approval, the acquisition program is unable to proceed to the MCA Milestone A decision to develop the system further in the Technological

Maturation and Risk Reduction (TMRR) phase (Office of the Under Secretary of Defense for Acquisition and Sustainment, 2020). Figure 7 displays the 2023 LSM program schedule progress from concept, system development, and through production.

Figure 7. LSM Acquisition Timeline as of June 2023. Source: Oakley et al. (2023b, p. 171).

While the AoA study plan is pending approval on the most viable option and whether the program should proceed on the MCA path through the Milestone A gate, the LSM program office awarded concept design contracts to five production-capable shipbuilders with the option to award a follow-on Preliminary Design Review (PDR) contract (Shelbourne, 2021). PDR is programmed to occur after completing Milestone A and occurs in the TMRR phase. By conducting the PDR in the TMRR phase the Program Executive Office (PEO) assumes risk that their AoA study validates the necessity to proceed in developing and producing a new amphibious ship design over repurposing existing USN, Maritime Sealift Command, or U.S. Army watercraft to meet the sea transportation requirement. O'Rourke (2023b) described the issue with proceeding without LSM AoA approval by stating that the "key requirements of the new vessels are very similar to the capabilities of vessels operated by U.S. Army Transportation Command" (p. 22). There is seeming parity between the USMC requirement and the capabilities that legacy U.S. Army Transportation Command watercraft systems could provide without the need, cost, and time to develop a complementary LSM system. Further, O'Rourke (2023b) recommends that "the Navy and Marine Corps should delay any new construction and immediately acquire some of these existing vessels to drive experimentation and better inform their requirements for the LAW program" (p. 22). O'Rourke's (2023b) recommendation to delay production and further explore requirement parity with existing Army Transportation Command watercraft systems could benefit the USN and USMC to reduce LSM design risk through further experimentation with existing watercraft.

In 2021, the LSM program office awarded concept studies design contracts to five shipbuilders and engineering design firms with the interest, capability, and capacity to compete for the development and manufacturing contracts (Shelbourne, 2021). These shipbuilders and engineering design firms included Fincantieri, Austal USA, VT Halter Marine, Bollinger, and TAI Engineers. Prior to the concept design award, there were 11 industry teams working with NAVSEA and competing for the design and follow-on production contract award (Eckstein, 2021). One of the 11 firms included SeaTransport and Figure 8 displays its LSM concept design.

Figure 8. SeaTransport's Proposed LSM Concept Design in Foreground. Source: Shelbourne (2021).

The concept studies research and development contract winners will use the requirements to produce five ship designs, which will include engineering analyses and trade-off studies to assist in TMRR phase progression (Royal Institution of Naval Architects, 2021). The USN's preliminary concept design contracts were awarded to Fincantieri, Austal USA, Bollinger, VT Halter Marine (acquired by Bollinger in 2022), and TAI Engineers, and were projected to down-select to the winning design selection in FY2023 (Shelbourne, 2021). The winning concept would receive a follow-on preliminary design contract to refine technology maturation and reduce risk in preparation to enter the Engineering and Manufacturing Development (EMD) phase post–Milestone B. The

concept designs were viewed as important in completing the acquisition strategy and solidifying production requirements and acquisition costs. The USN did not disclose the value of the five concept design awards, yet the combined costs were advertised to be less than $7.5 million (Shelbourne, 2021). Additionally, in the FY2024 budget, the USN programmed $14.7 million for research and development to refine the five awarded preliminary design review contracts through prototyping.

The LSM AoA materiel concept solution approval and subsequent Milestone A decision enables the program to progress into the TMRR phase. As outlined previously, the program has conducted TMRR preliminary concept designs and is prepared to award a winning PDR contract. Since 2021, the USN and USMC requirements and acquisition team projected enthusiasm and willingness to begin initial production as early as FY2022 (Eckstein, 2021). However, capability and requirements differences between the services delayed initial production by at least 2 fiscal years as the services refined the concept studies against minimum requirements and negotiated viable trade-offs to meet forecasted cost constraints and schedule delays. Shelbourne (2021) reported on the delays, stating that the "Navy planned to buy 28 to 30 LAWs starting in fiscal year 2023, but the Trump administration's proposal for a fiscal year 2022 shipbuilding blueprint, released in December, had showed the service buying the first LAW in 2022" (p. 1). Additionally, Shelbourne (2021) described LSM planning, programming, budgeting, and execution funding as an issue, for the "Navy only sought the research and development funding in the recent FY2022 request" (p. 1). The USMC's aggressive acquisition requirement timeline did not match the USN's desire to refine and develop the concept studies through research and design funding and did not program procurement appropriation funding to meet the expected fiscal year 2022 initial production goal.

Rear Admiral John Gumbleton, deputy assistant secretary of the USN for budget, commented on the LSM development as part of the USN's fiscal year 2023 budget by stating, "The Marine Corps and the Department are getting the requirements tight on that ship before we choose to put it in our [shipbuilding appropriations account]. So, there is funding in R&D for LAW" (O'Rourke, 2023b, p. 17). In 2021, USN shipbuilding leadership was reluctant to move rapidly to meet USMC expectations and was interested in reducing the risk through research and development funding. In contrast, Major

General Tracy King, former director of expeditionary warfare for the Office of the Chief of Naval Operations (OPNAV 95), proclaimed that the LSM acquisition schedule was "aiming at lead ship construction in FY '22, it's going to be late in FY '22, but I still consider that pretty fast" (Eckstein, 2021, p. 1). The clear business case differences and program requirement issues between the general and flag officers' varied communication on the LSM slowed the acquisition pace due to expanded cost projections. O'Rourke (2023b, p. 16-17) outlines the developing program schedule risk, stating that "another issue for Congress concerns the date for procuring the first LAW. As noted earlier, previous USN plans envisioned starting procurement of LAWs in FY2023. Compared to this, the USN's FY2023 five-year shipbuilding plan in effect defers the start of LAW procurement two years, to FY2025." O'Rourke (2023b) highlighted the LSM program delays without addressing any risk mitigation strategies the USN planned to implement to prevent further schedule issues. Further, the schedule delays and proposed increased per-ship procurement costs require further cost–benefit analysis and enhanced Congressional oversight into a negatively trending program.

Currently, the USN is planning for Low-Rate Initial Production (LRIP) beginning with procurement contract award in March 2025, with the first LSM estimated cost at $187.9 million (O'Rourke, 2023b). Using a single ship builder, the follow-on manufacturing contract award for the second LSM would occur in FY2026 and cost $149.2 million, while the third and fourth ships would be procured in FY2027 and cost a combined $297 million, or $148.5 million per ship (O'Rourke, 2023b). The LRIP fifth and sixth LSM procurement contract awards are scheduled for FY2028, costing an estimated combined total of $296.2 million, or around $148.1 million per ship (O'Rourke, 2023b). Included in the cost estimate for the lead ship are the detailed design and nonrecurring engineering costs, which is traditionally how the USN generates ship cost estimates for the first procurement (O'Rourke, 2023b).

Compared to larger LPD and LHA amphibious ships, the LSM's reduced size enables a greater number of shipyards and shipbuilders to manufacture it. O'Rourke (2023b) states, "the Navy's baseline preference is to have a single shipyard build all the ships, but the Navy is open to having them built in multiple yards to the same design if doing so could permit the program to be implemented more quickly and/or less

expensively" (p. 2). The LSM concept is a modified commercially produced stern landing vessel design that can be built at many U.S. shipyards, creating greater production capacity beyond the limited larger L-class shipyard producers (Royal Institution of Naval Architects, 2021). With the USN's proposed LRIP acquisition strategy, the time between procurement contract award and delivery is estimated at 3.5 years for the first ship, so a FY2025 contract award will deliver the lead ship to the fleet in FY2028. The USMC's newest formation, the MLR, requires the LSM capability now to provide sea-mobile stand-in forces for INDOPACOM. Former Commandant of the Marine Corps Gen Berger (2023b) described the current problem set in Congressional testimony by stating,

> We have adapted to this challenge and are developing bridging solutions to experiment with LCU-1700s and leased Expeditionary Fast Transports (T-EPF) and Stern Landing Vessels. While these platforms will inform the eventual employment of the LSM, they will fall short of desired capabilities if called upon in an operational setting. Our modernized expeditionary forces need a comparably modern mobility platform to bring the full weight of their capability to bear on competitors or adversaries, particularly in littoral regions. (p. 14)

The USMC CD&I is leading LSM experimentation by leasing a commercial stern landing vessel for 3d MLR to utilize and validate requirements throughout the INDOPACOM theater. Optimistically, the first LSM will complete production in 2028, and without program and contract management intervention, the fleet will not be fully operational and capable of effectively supporting MLRs until at least a decade later. In the interim, pressure to achieve the USMC's high priority need for additional amphibious ships can only be fulfilled by commercial vessel leasing options and existing alternative legacy Army Transportation Command watercraft. These solutions will be all that are available in the near term to meet an increasing need for light sea transportation in INDOPACOM.

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III. STAKEHOLDER ANALYSIS

The LSM program stakeholders range from military senior leaders, end users, operational planners, contracting officers, program managers, adjacent service programs, the defense shipbuilding industry, commercial shipbuilders, international shipbuilders, and Congress authorizing the appropriations. All the stakeholders impact the program's further development, funding, and delivery to the warfighter. Outlined in detail is each key player in the LSM program ecosystem.

A. THE USER: USMC WARFIGHTER

The USMC possesses limited power and influence over the LSM shipbuilding acquisition program speed and cost due to budgetary funding and management control residing within the USN (Hovey, 2022). USMC Force Design 2030 implementation was predicated on divesture and speed of transition, yet ship acquisition is a longer process due to budgetary appropriations planning and programming processes and large systems complexity. Shipbuilding is allocated a unique 5-year procurement availability period, which is 2 years longer than traditional procurement funding.

The driving force propelling the LSM acquisition requirement is the equipment end user, the USMC. Advocating on behalf of the tactical warfighters are USMC general officers who, through research and wargaming activities, identified a critical amphibious transport equipment capability gap (Berger, 2023). A task-organized fleet of nine LSMs fulfills the USMC need to move a regimental-sized unit engaged in phase zero campaigning activities between INDOPACOM islands (Berger, 2023). Senior USMC leadership refers to the Department of the Navy's amphibious force requirements study as validation for the LSM requirement to fulfill a littoral movement capability gap (Berger, 2023). The USN amphibious requirements study outlines 18 LSMs as the minimum vessel requirement to support USMC campaigning activities throughout INDOPACOM (Berger, 2023). However, the USMC advocated for 35 LSMs as the minimum needed, accounting for three fleets each consisting of nine LSMs supporting three MLRs and eight additional LSMs in reserve in the maintenance cycle.

To fulfill national strategy and INDOPACOM combatant commander needs for stand-in amphibious forces throughout the Pacific first island chain, the USMC developed a Force Design 2030 organizational strategy to redesignate three regiments into task organized MLRs. The USMC identified an external capability gap that required the need for organic, amphibious mobility to deter, compete with, and contest China in a strategic pacing challenge. Gen Berger (2023b) relayed the importance of acquiring additional MLR littoral mobility in Congressional testimony and described the USN's FY2022 to FY2025 procurement delay decision as a setback to MLR deployment in support of INDOPACOM. Senior USMC leadership remained focused on hastened acquisition speed to meet the warfighters' MLR amphibious mobility requirements. From the USMC perspective, the USN did not possess or maintain adequate amphibious fleet readiness to meet the requirement, so the LSM acquisition was identified as the mechanism to move persistent and dispersed MLR forces throughout the Pacific theater (Berger, 2023).

> While our posture has become more robust in the Indo-Pacific, fewer of our forward-deployed Marines are serving afloat with the fleet. In 2018, 16,000 Marines served aboard ships, but in 2022, just 12,660 did so—a 20% decrease. The principal reason for this decline was the lack of amphibious warfare ship availability. (Berger, 2023b, p. 1)

Further, LSMs are viewed by USMC planners as complementary to L-class amphibious warfare ships by providing shorter duration shore-to-shore mobility without the need of additional LCAC or LCU connectors (Berger, 2023). The USMC envisioned the LSM as being capable of engaging in security cooperation, humanitarian assistance, disaster relief, and logistics support (Berger, 2023). Mullen (2022) expounded on the LSM logistics support capability and identified a potential usage for medical mass casualty events in remote, forward-deployed INDOPACOM islands. The LSM could serve as a mobile triage vessel providing higher levels of care to Marines in remote geographic locations, which provides the USMC greater medical capability than previously available to units dispersedly deployed.

Senior Marine leadership is adamant for timely LSM acquisition and operational employment in INDOPACOM. Berger (2023b) envisioned the LSM as useful in maritime gray zone campaigning operations in the Pacific because its smaller size and

characteristics reduce the risk of escalation in comparison to larger, more imposing L-class ships. In the interim, the USMC planners adapted to the capability shortfall by using temporary mobility solutions for the MLR to experiment with stand-in forces using wargaming-developed concepts. One solution is using existing USN LCU-1700s and leased commercial stern landing vessels to facilitate MLR movement and experimentation (Berger, 2023). These temporary solutions are limited in number and scale and are not intended for operational employment to mitigate the USN's decision to delay system acquisitions. Gen Berger (2023b) identified the leased and borrowed vessels as inferior to the capability the LSM could provide, and the operational need remains for the acquisition of a modern mobility platform.

Driving the LSM requirement necessity within the USMC is Deputy Commandant CD&I, LtGen Karsten Heckl, who oversaw USMC wargaming, research, and requirements coordination. CD&I develops USMC amphibious ship requirements and provides inputs to USN research, development, and acquisitions. Within CD&I is the Maritime Expeditionary Warfare Division, which manages amphibious vessel requirements generation, including the sub-branch focused on connector vessels (Hovey, 2022). Another CD&I branch is the USMC Warfighting Lab, which led the USMC amphibious fleet design requirements wargaming and analysis that assessed a new necessity for innovative technologies (Hovey, 2022).

LtGen Heckl viewed the LSM as vital for operating in INDOPACOM because it does not require a pier to deliver Marines from shore to shore (Easley, 2022). The biggest hindrances for USMC CD&I to deliver 35 LSMs to the warfighter are the federal budget constraints and an increasing cost per unit (Easley, 2022). CD&I views the ship as a utilitarian vessel capable of moving Marines, equipment, and supplies throughout the Pacific theater without the need for enhanced survivability, which reduces the production cost and timeline. Through leased commercial vessel experimentation, CD&I intends to validate the minimum viable product requirement, which does not possess enhanced USN survivability systems modifications.

Other LSM stakeholders outside CD&I include the USMC Plans, Policies, and Operations (PP&O) Future Operations Branch and the Marine liaison element at

NAVSEA. The PP&O future operations branch coordinates a weekly sync between USN and USMC stakeholders to plan and resolve common-interest amphibious shipping issues (Hovey, 2022). The weekly syncs also track amphibious fleet readiness and provide a means to communicate vessel issues between the fleet and supporting establishment organizations (Hovey, 2022). The Marine liaison element at NAVSEA consists of liaison officers embedded into USN acquisition program offices procuring amphibious ships (Hovey, 2022). USMC PP&O participation in syncs with the USN and the NAVSEA program office liaison element are useful for amphibious vessel information and awareness tools, yet the USMC does not control budgetary or requirements generation from these nodes.

One other important USMC resource sponsor within the Office of the Chief of Naval Operations staff is the expeditionary warfare director (OPNAV N95). This position is led by a USMC brigadier general who is responsible for advocating for USMC amphibious warfare interests by defining requirements, integrating those requirements into plans, and programming the budget through the POM process (Hovey, 2022). OPNAV N95 is a significant impact stakeholder advocating for defining USMC amphibious shipping requirements and coordinating directly with senior USN acquisition decision-makers for budgetary planning and programming support (Hovey, 2022).

B. THE BUYER: U.S. NAVY

The USN is the principal DoD agent responsible for procuring ships and led the acquisition of the LSM program. Within the USN are many component organizations dedicated to requirements generation, defense acquisition system management, and research and development. Parallel to USMC CD&I is the USN's OPNAV N81 Assessment Division, which analyzes fleet warfighting capabilities and plans to advise USN leadership on priorities and trade-offs (Hovey, 2022). In the amphibious fleet composition and procurement planning, OPNAV N81 assists with cost–benefit analysis in allocating resources to specific vessel platforms. Working in conjunction with OPNAV N81, OPNAV N80 is responsible for POM shipbuilding future-year defense spending planning and uses OPNAV N81 requirements prioritization documentation as well as prioritization communications with USN and USMC stakeholders during the budget

programming phase to formally allocate future resources to shipbuilding projects (Hovey, 2022). To mitigate competing interests between stakeholders, the USN's N9 Warfare Systems sponsor, and N91 Warfare Integration Directorate consolidate viewpoints into a singular prioritization message for the POM budgeting cycle. Coordinating with the N9 is the deputy chief of naval operations for integration of capabilities and resources (N8), who aligns resources to amphibious programs (Hovey, 2022). N8 and N9 possess budgetary planning power, and stakeholder misalignment with their resource prioritization will delay procurement programs due to failure to receive future-year budgetary funding.

After the OPNAV staffs shape future funding for prioritized USN ship requirements, the program planning and execution duty transitions to NAVSEA, which is a USN systems command responsible for shipbuilding design, development, delivery, and life-cycle maintenance (Hovey, 2022). NAVSEA is the largest of five USN systems commands, with over 80,000 civilian and military personnel assigned to it (Hovey, 2022). Within NAVSEA are five Program Executive Offices (PEOs), and PEO Ships is accountable for the amphibious vessel program office. PEO Ships reports to its higher headquarters NAVSEA for in-service ship support, and it reports all other issues to the assistant secretary of the Navy for research, development, and acquisition (ASN[RDA]; Hovey, 2022). PEO Ships is a key acquisition management stakeholder, for it is accountable and responsible for the subordinate LSM amphibious connector program office, which manages the LSM through its design, development, construction, delivery to the fleet, and life-cycle maintenance.

Finally, the deputy assistant secretary of the Navy for ship programs (DASN Ships) plays a pivotal role as they illuminate the path for the ASN(RDA) on issues encompassing all surface ships and programs under the view of NAVSEA and PEO Ships (Hovey, 2022). Furthermore, DASN Ships conducts independent examinations into the shipbuilding industry's ability to produce ships and offers suggestions to the ASN(RDA) concerning the comprehensive cycle of ship acquisition support, inclusive of matters of ship disposal, donation, and diving and salvage (Hovey, 2022). The layered reporting and communications chain originates with PEO Ships and branches to NAVSEA, DASN Ships, and the ASN(RDA). Therefore, the complexity and time-consuming nature of ship

engineering is matched by an equally elaborate chain of individuals and organizations influencing the acquisitions process for ships (Hovey, 2022).

According to O'Rourke (2023a), the contrast between the amphibious shipbuilding objectives of the Biden administration's Pentagon team and those of the USN and USMC is rooted in divergent priorities and visions. Further, there are future fleet size and composition differences within the Department of the Navy between USN and USMC leadership. The USMC's plan for developing and acquiring the LSM has been repeatedly sidelined in the USN's budgetary considerations. Part of the issue is the USN's fleet strength dipped below the 300 battle-force ship threshold in August 2003, a figure that has since fluctuated between 270 and 300, and as of 2023, the battle-force was at 296. Projections under the USN's FY2024 budget submission indicate fleet acquisition and maintenance funding supports 293 warships in FY 2024 and falls to 291 at the end of FY 2028. Sustaining a large warship fleet is expensive in terms of future replacement acquisition and life-cycle maintenance costs, which necessitates program trade-offs to meet prioritized fleet requirements.

O'Rourke (2023a) stated USMC and USN leaders were entangled in another disagreement due to a USMC request to add 35 new LSMs to enable Marines to navigate island chains more swiftly while presenting less of a target, a vision never fully embraced by USN leadership. O'Rourke (2023a) further detailed that disparate viewpoints among the top echelons of the Pentagon and USN leadership chains are not unusual. The author also states shipbuilding has historically been a political issue due to the astronomical costs involved in ship development and construction, as well as the overall fleet size and composition. O'Rourke (2023a) chronicled that during President Trump's administration, National Security Advisor Robert O'Brien and Defense Secretary Mark Esper supported a naval warship fleet of 355 vessels yet oversaw consecutive budgets that slashed resourcing for new ship construction. O'Rourke (2023a) noted that in early 2020, Secretary Esper denied the USN's proposed future shipbuilding plan, asserted control over the proposal development, and delayed the plan authorization until a month before President Biden assumed office.

Fabey (2023) documented that in December 2017 the Trump administration proposal of a 355-ship fleet was approved for the USN's vessel end strength objective. However, this projection does not mirror the budgetary and production reality facing the OSD and USN senior leaders. Since 2019, Fabey (2023) contends the OSD and the USN have desired to develop an achievable alternative to the 355-ship force-level objective that aligns with the National Defense Strategy (NDS) and matches future fleet force design. However, Fabey (2023) clarified there is no consensus on a singular plan, and USN leadership outlined three proposed budgetary and fleet size options for congressional approval with only one option achieving production capacity to construct 355-ships. The other two fleet size options outline constrained budget realities paired with a limited shipbuilding capacity, and a need for greater resource allocation beyond the Future Years Defense Program (FYDP) to achieve fleet readiness goals (Fabey, 2023). Also, these shipbuilding plan options assume that the shipbuilding industry will rectify the backlog in construction and ensure timely and budget-conscious production of future ships (Fabey, 2023). This ideal assumption envisions the maritime industrial base realizing its full potential with the assistance of investment not captured in the USN budgetary proposals and without future congressional funding constraints (Fabey, 2023). At the low end of the budgetary proposal range assuming restrained growth is a marginal increase in the two battle-force fleet options beyond the FYDP, which stems from the initiation of two new programs, one of which is the LSM.

The USN and the OSD provided Congress with a trio of alternative fleet and budgetary proposals (Decker, 2022b). Two of these three operate on the assumption of no budget growth and project a formidable fleet increase of 363 battle-force ships by the year 2045 (Decker, 2022b). To obtain this count, the USN anticipates a requirement of an additional $75 billion beyond the FYDP. As the USN embarks on a transformative journey towards a hybrid force, integrating more unmanned systems and the capabilities of artificial intelligence, this increases the necessity to eliminate technical uncertainty before the delivery of concrete budgetary request figures (Decker, 2022b). The objective is to reduce these risks, ultimately leading to tightened funding ranges and more precise fleet cost solutions within the 10-year budget window (Decker, 2022b). The fundamental distinction between the two lower ranges, which operate on the assumption of no real

budget growth, can be traced to the number of unmanned ships (Decker, 2022b). The first option envisions a fleet of 318 ships by fiscal year 2045, while the second, adopting a more aggressive stance towards unmanned systems, projects a fleet of 322 ships. The difference, while seemingly modest at just four ships, is characterized by the level of autonomy achieved through unmanned systems.

The USN intends to continue its experimentation with manned–unmanned teaming over the ensuing years, thus paving the way for scaling these systems in the 2030s, including procuring LSMs within the proposed shipbuilding plan. The inclusion of new ship production platforms like the LSM, Next Generation Logistics Ship, and unmanned systems partly explains the USN's choice to include budgetary ranges in its future fleet projections (Decker, 2022b). Despite these platforms' immense potential, they also entail a certain level of developmental risk. The plan suggests that as prototyping and experimentation reduce technical and concept-of-operations uncertainty and higher-fidelity cost models become available, the budgetary and fleet size ranges will align to a more precise figure (Decker, 2022b). In terms of ship procurement numbers, the lower ranges would witness an uptick outside of the FYDP owing to the LSM and NGLS programs (Decker, 2022b). However, the USN believes these smaller ships, while being critical enablers of the USMC Force Design 2030, may not deliver a comparative degree of universal naval capability to the fleet like the USNs larger vessels with more onboard systems and greater survivability do. Although the USMC expressed a great deal of urgency for this capability, the LSM procurement funding has been delayed to FY2025 (Decker, 2022b). Table 1 shows the 5-year LSM procurement funding plan and displays all other USN shipbuilding acquisition plans.

Table 1. FY2024–2028 Five-Year Shipbuilding Plan. Source: O'Rourke (2023a, p. 10).

	FY24	FY25	FY26	FY27	FY28	Total
Columbia (SSBN-826) class ballistic missile submarine	1		1	1	1	4
Virginia (SSN-774) class attack submarine	2	2	2	2	2	10
Gerald R. Ford (CVN-78) class aircraft carrier					1	1
Arleigh Burke (DDG-51) class destroyer	2	2	2	2	2	10
FFG-62 frigate	2	1	2	1	2	8
LHA amphibious assault ship				1		1
LPD-17 Fight II amphibious ship						0
Medium Landing Ship (LSM)		1	1	2	2	6
John Lewis (TAO-205) class oiler	1		2	1	2	6
Next-Generation Logistics Ship (NGLS)			1	1	1	3
Submarine tender (AS[X])	1		1			2
TAGOS(X) ocean surveillance ship		1	1	1	1	4
TOTAL	**9**	**7**	**13**	**12**	**14**	**55**
Projected total size of Navy	**293**	**286**	**285**	**285**	**291**	

Source: Table prepared by CRS based on FY2024 Navy budget submission.

The Navy fell below 300 battle force ships (the kind of ships that count toward the quoted size of the Navy and the Navy's 355-ship force-structure goal) in August 2003, and has generally remained between 270 and 300 battle force ships since then. As of September 25, 2023, the Navy included 295 battle force ships. As shown in **Table 3**, the Navy projects that under its FY2024 budget submission, the Navy would include 293 battle force ships at the end of FY2024 and 291 battle force ships at the end of FY2028.

Additionally, within the OSD, the Director of Cost Assessment and Program Evaluation (CAPE) holds a significant role, much like OPNAV N81. CAPE provides a neutral, meticulous evaluation of DoD projects, ensuring that resource allocation within PPBE aligns with the nation's optimal defense needs. However, without CAPE concurrence, CAPE can stall the USN and USMC LSM acquisition due to program cost and performance issues. This budgetary power is largely due to CAPE's integral function in the programming phase of PPBE through its direct reporting arrangement with the Secretary of Defense and its preeminent position in scrutinizing department POMs (Hovey, 2022).

C. U.S. ARMY

The U.S. Army possesses a large fleet of aging watercraft capable of transporting soldiers and equipment short distances and conducting beach landings. Under the U.S. Army's Maneuver Support Vessel initiative, two new watercraft variants are being developed for operations in the Indo-Pacific region. The Army Program Executive Office for Combat Support and Combat Service Support (PEO CS&CSS) launched the

Maneuver Support Vessel (Light; MSV-L) prototype at Vigor LLC's Vancouver, WA, facility, which marked the introduction of a new and improved class of Army watercraft (Higgins, 2022). Vigor was awarded a 10-year contract in 2017 to produce up to 36 of these MSV-L craft that are intended to replace the Vietnam-era Landing Craft Mechanized-8, which is like the USN LCU vessel. The MSV-L is 117 feet long, is crewed by eight soldiers, has a top speed of 21 knots fully loaded with soldiers and equipment, and has a maximum range of 360 nautical miles (Higgins, 2022). Further, the MSV-L is designed to transport either an M1 Abrams tank, two Stryker combat vehicles, or four Joint Light Tactical Vehicles (Luckenbaugh, 2023). After initial testing, the Army determined the MSV-L baseline requirements necessitated modification to address design changes and cost increases with projections for initial operational capability in 2028 (Roque, 2023). Figure 9 shows the MSV-L concept design and resemblance to USN LCUs in service.

Figure 9. U.S. Army MSV-L Concept Design. Source: Vigor (n.d.).

BGen Samuel Peterson, U.S. Army PEO CS&CSS, highlighted collaboration with the USN and USMC in defining the larger Maneuver Support Vessel (Heavy) (MSV-H) requirements (Roque, 2023). The MSV-H is planned to be up to 400 feet in length, have a top speed of 18 knots, carry as many as 175 soldiers and their equipment, possess a crew of approximately 30, and be capable of beach landings (Luckenbaugh, 2023). The Army

expressed an openness to selecting multiple shipyards in 2024 to develop virtual prototypes and a desire to begin low-rate initial production in 2028, with the first delivery in 2030. The MSV-H design specifications closely resemble the USN LSM vessel; however, the MSV-H provides slightly greater speed and carrying capacity. Notably, the MSV-L design lacks the defensive systems and survivability features the USN desires to incorporate in the LSM design, which increase the LSM's cost per ship (The Maritime Executive, 2023). The similarities between the two programs in meeting INDOPACOM warfighter requirements, as well as the program maturities, create the possibility for a joint solution to provide universal life-cycle operations and sustainment, enhanced budgetary resources allocation, and more industry competition to meet joint demand.

D. DESIGN AND SHIPBUILDER FINALISTS

Post–World War II, the U.S. shipbuilding industry peaked in 1963 with 10 private companies operating 20 shipyards and building 24 warships. In 2017, there were only four private companies building six warships (Parrish, 2020). Further, the public shipbuilding industry once supported and operated by the U.S. government was shut down due to budgetary reasons, and remaining facilities focus on maintenance and repair of nuclear ships (Parrish, 2020). The combination of reduced private and public shipbuilders and increasing systems complexity of modern vessels created a production backlog, cost overruns, and quality control issues when building modern USN ships (Parrish, 2020). One primary theory on the Post–World War II shipbuilding industry deterioration focuses on the varied USN vessel production contract demand and schedule creating a boom or bust cycle for private companies (Parrish, 2020). When the USN new vessel demand subsided because of policy changes or budgetary constraints, it placed private shipbuilders in a financial strain, preventing financial stability to weather slow business cycles (Parrish, 2020). There was no financial incentive to maintain costly shipyards and staff a specialized workforce without the security of steady, long-term USN shipbuilding contracts. Reduction in defense contract business forced the marketplaces to consolidate from many competitors to a few larger producers. The reduction in the number of shipbuilders has reduced the specialized workforce and worsened the USN's negotiating power to solicit competitive contracts.

Chief of Naval Operations Admiral Mike Gilday underscored the prevailing challenges in expanding the USN's fleet size and pinpointed the limitations in industrial base capacity, as well as confidence in consistent federal procurement funding, as leading impediments (O'Rourke, 2023a). Specifically, ADM Gilday emphasized the need for proactive communication from the USN to shipbuilders signifying their production goals and funding certainty so the latter can adequately prepare and invest in infrastructure and capacity expansions. ADM Gilday's remarks emphasize the pivotal role the USN must play in setting clear vessel requirements and production expectations; otherwise, industry will not risk large-scale investments without substantial confidence in consistent business (O'Rourke, 2023a). For the LSM shipbuilding project, NAVSEA formally solicited and held industry days, which were attended by 11 interested companies competing for the vessel's concept design contract (Eckstein, 2021). In July 2020, the USN issued LSM concept design contracts to 15 shipbuilders and naval engineering design companies (O'Rourke, 2023b). The firms that secured these contracts included Austal USA, BMT Designers, Bollinger Shipyards, Crescere Marine Engineering, Damen, Hyak Marine, Independent Maritime Assessment Associates, Nichols Brothers Boat Builders, SeaTransport, Serco, St. Johns Shipbuilding, Swiftships, Technology Associates (TAI), Thoma-Sea, and VT Halter Marine. The primary objective behind these studies was to furnish insights into operational frameworks, assess technical uncertainties, and provide cost projections pertaining to further the LSM development.

1. Austal USA

Austal USA is relatively new American naval shipbuilder that has managed to carve out its own niche within this competitive defense industry market (Parrish, 2020). Austal International is headquartered in Australia and made its first venture into the U.S. market in 1999 with its U.S. subsidiary, Austal USA, setting up a production shipyard in Mobile, AL (Parrish, 2020). Austal USA produced and delivered the Expeditionary Fast Transport to the USN and, in 2005, expanded its portfolio by securing a contract to build USN Littoral Combat Ships (LCSs; Parrish, 2020). Since contract award, the company has built 10 LCSs and demonstrated the ability for a multinational shipbuilder to successfully enter the U.S. defense shipbuilding industry (Parrish, 2020). Austal USA

further emphasizes that it is predominantly large corporations with various profitable subsidiaries that can sustain the boom or bust naval shipbuilding demand and competitive contract cycle. Additionally, Austal USA actively advanced its commitment to erect two new dry docks aimed at bolstering its maintenance ability in San Diego, CA (Decker, 2022a). These docks propose a dual public–private ownership structure, with one dock meant exclusively for the USN and Austal USA overseeing the other. Concurrently, the firm has outlined plans for an innovative ship repair hub in San Diego, tailored specifically for proprietary dry dock operations (Decker, 2022a). Austal USA is positioned as one of the prime contenders to manufacture the LSM program and is prepared to compete to manufacture and deliver the ship to the fleet (Decker, 2022a).

2. Fincantieri

Fincantieri is an Italian multinational corporation that ventured into the U.S. naval shipbuilding sector in 2008 by acquiring the Marinette Marine shipyard in Marinette, WI, from the Manitowoc Corporation (Parrish, 2020). Historically, the Marinette shipyard was under private ownership until 1999, when the Manitowoc Corporation acquired it. The shipyard predominantly supplied support vessels, patrol boats, and landing crafts to the USN and was one of the primary USN LCS manufacturers along with Austal USA (Parrish, 2020). Recently, these multinational shipbuilders have demonstrated a capability to expand operations through U.S. shipyard acquisitions, which has increased naval new vessel manufacturing competition and the capacity to produce a greater number of ships.

3. Bollinger Shipyards LLC

Spanning a 75-year history, Bollinger Shipyards LLC stands as the largest privately owned American shipyard and vessel builder producing U.S. Coast Guard (USCG) cutters, USN patrol boats, salvage vessels, and research ships, among other steel and aluminum maritime ships (Bollinger Shipyards, n.d.). With 13 shipyards strategically positioned across Louisiana, Bollinger has unparalleled access to the Gulf of Mexico, the Mississippi River, and the Intracoastal Waterway. The company's size and location make it the predominant American vessel repair firm within the Gulf of Mexico area (Bollinger Shipyards, n.d.). Since 1985, Bollinger's naval manufacturing portfolio has consisted of

over 180 vessel deliveries to the USCG and USN. Additionally, Bollinger has consistently produced commercial offshore supply vessels tailored for oil and gas exploration endeavors (Bollinger, n.d.). The offshore supply vessel commercial ship design aligns with the LSM acquisition strategy to procure an existing commercial vessel capable of naval modifications.

4. TAI Engineers

TAI Engineers (n.d.) is a maritime engineering and design firm that aims to minimize risk, maximize ship capability, reduce operation and sustainment costs, and streamline the construction process. TAI's core business provides professional services in ship design, structural, mechanical, and electronics engineering. Further, TAI proclaims it is an expert in program management, construction, logistics, estimating, purchasing, and meticulously managing every aspect, from design and cost estimating to construction and testing of new vessels (TAI, n.d.).

5. VT Halter Marine

In 2022, Bollinger Shipyards acquired VT Halter Marine and S.T. Engineering, which expanded Bollinger's new manufacturing, design, and repair capacity in the Gulf of Mexico region (Bollinger Shipyards, 2022). Bollinger's acquisition of VT Halter Marine strengthened its defense industrial position and increased its participation in the LSM concept design and development process. Further consolidation within the American shipbuilding industry constricts market competition in defense contracts while also providing opportunity for larger firms to achieve greater economies of scale in their manufacturing facilities and supply chains. This acquisition and industry consolidation increases Bollinger's capability to compete for large naval shipbuilding contracts with the expansion of two former VT Halter Mississippi shipyards, warehouses, and access to a larger workforce.

E. ADDITIONAL INTERESTED SHIPBUILDERS AND DESIGN FIRMS

In July 2020, NAVSEA awarded concept studies to 15 shipbuilders and shipbuilding design firms with the goal of determining cost estimates, mitigating technical risk, and assisting with concepts of operation (O'Rourke, 2023b). After

receiving the studies in November 2020, 11 of the interested shipbuilders were not awarded additional concept design contracts; those shipbuilders were BMT Designers, Crescere Marine Engineering, Damen, Hyak Marine, Independent Maritime Assessment Associates, Nichols Brothers Boat Builders, SeaTransport, Serco, St. Johns Shipbuilding, Swiftships, and Thoma-Sea (O'Rourke, 2023b). These 11 shipbuilders and design firms offer additional production capacity and demonstrated initial interest to assist in developing the LSM vessel.

1. Nichols Brothers Boat Builders (Shipbuilder)

Located in the Pacific Northwest, Nichols Brothers Boat Builders (NBBB; n.d.), is a subsidiary of Ice Cap Holding LLC and a custom American shipbuilder. Established in 1964, NBBB traces its roots trace back to Whidbey Island, WA, and proclaims its pride in possessing a committed and dedicated workforce focused on quality vessel craftsmanship. Previously, NBBB constructed the MANU'A TELE, a multi-purpose cargo vessel capable of open ocean transport and for use transporting civilian cargo between the Pacific islands of Tutuila, Fiji, and Tonga. The commercial vessel can navigate the complicated coral reef terrains and tight docking spaces of that area and was tailored to service the islands for both passenger and cargo transport. This firm's successful littoral commercial manufacturing capability and willingness to compete in the LSM concept design demonstrate that it is a prospective shipbuilding partner.

2. St. Johns Shipbuilding (Shipbuilder)

St. Johns Shipbuilding (n.d.) is a vessel manufacturer located in Putnam County, FL, on the St. Johns River. The facility boasts connectivity to the Mid-Atlantic, New England, the Caribbean, and the Gulf Coast. The manufacturer is proficient in both aluminum and steel vessel constructions and has collaborated with prominent engineering firms. St. Johns has served both commercial and government clients manufacturing landing craft, offshore supply vessels, barges, tugs, ferries, and cargo vessels, and has provided repair and maintenance services. The shipyard infrastructure includes an 850-ton dry dock, 500-ton crane, extensive waterfrontage, a spacious fabrication shop, and the ability to manufacture an LSM-equivalent vessel.

3. Swiftships (Shipbuilder)

For over 8 decades, Swiftships (n.d.) has been a frontrunner in the maritime manufacturing sector specializing in the design, construction, and sustainment of advanced military and commercial vessels. Swiftships shipyards are in Louisiana and Texas, and the company is globally recognized for end-to-end engineering, innovative shipbuilding solutions, comprehensive life-cycle support, and its capability of conducting platform conversions for distributed maritime operations (Swiftships, n.d.). Since 1942, the shipbuilder has supported naval manufacturing, creating vessels for defense operations, law enforcement border protection, and humanitarian missions. Swiftships has produced LCUs and designed autonomous military vessels, and it can convert commercial platforms to meet unmanned/military standards using its Fast Supply Vessel platform, which is similar in concept to the vision of the LSM.

4. Thoma-Sea (Shipbuilder)

Thoma-Sea (n.d.) is a premier shipbuilder based in Louisiana and capable of building platform supply vessels that are 140 feet to 300 feet in length and similar in design to the LSM. Thoma-Sea does not use the traditional berth-built method, but instead takes advantage of modern innovation to manufacture major ship segments individually, such as the bow or stern, and later integrate them at the berth. The shipbuilder leverages this method of manufacturing to produce and assemble the vessels at indoor facilities, which protects materials from the elements. Thoma-Sea's various innovative facilities enable them to concurrently produce vessels for multiple customers and could provide the LSM program additional manufacturing capacity.

5. Damen (International Shipbuilder)

Damen (n.d.) is a third-generation family shipbuilding business located throughout shipyards in the Netherlands. Damen Naval, a subsidiary division of Damen Shipyards Group, has manufactured over 400 global naval vessels, providing support throughout the entire production and life-cycle process. Damen offers the international customer a three-tier strategy to meet their shipbuilding requirement by offering Damen

standardization designs, local building options with manufacturing partners, and engineered-to-order vessels, which adapts standard ships to customer-specific needs.

6. BMT (Design Firm)

BMT (n.d.) offers naval architecture and maritime engineering, orchestrating design and validation for emerging naval platforms while managing modifications to existing naval vessels. Predominant in maritime design through life-cycle support, its reach extends from Europe and North America to strategic defense endeavors in Australia and Southeast Asia. BMT proclaims its firm is committed to timely and budgeted delivery because of vast experience, technical acumen, enduring alliances, impartial counsel, and unwavering reliability. Further, BMT caters to vessel owners, port operators, and shipbuilders, with services ranging from ship design to maritime consultancy, simulations, and inspections.

7. Crescere Marine Engineering (Design Firm)

Crescere Marine Engineering is a maritime design firm located in Scappoose, OR. The firm is a small business that possesses less than 10 employees, and its services cover engineering and research. Little information is publicly available about this firm, and estimates place the business's age at 6 years and revenue at less than $1 million annually (Buzzfile, n.d.).

8. Hyak Marine (Design and Consulting Firm)

Hyak Marine (n.d.) is a maritime design and consultancy firm based in the United States and assisting American and international transportation firms. Hyak Marine specializes in the construction and charter of vessels, and its current fleet includes three state-of-the-art ocean tugboats now chartered to prominent U.S. shipping giants and a fuel tank barge for a major U.S. fuel distributor. Prioritizing tailored vessel solutions, Hyak Marine devises specialized vessel blueprints and funds and thoroughly oversees shipyard construction. Hyak Marine advertises that it can provide attentive design and construction management to save the customer costs and time.

9. Independent Maritime Assessment Associates (Design Firm)

Independent Maritime Assessment Associates is a United Kingdom–based naval design and engineering small business. There is little publicly available information and no company website for the firm; however, the Cage Report (2017) shows the business incorporated in 1991 and is registered with the U.S. federal government to compete for contracts.

10. SeaTransport (Design Firm)

SeaTransport (n.d.) asserts that it is an innovative ship designer offering comprehensive services that span from conceptualization to completion, including advanced structural design, classification and statutory approvals, and intricate detailing. It regularly designs and engineers marine vessels such as ferries, bulk carriers, and research vessels, and its proficient project management staff features a portfolio of global collaborations with prominent shipbuilders. Furthermore, SeaTransport's military solutions are rooted in commercial craft adaptations and present pragmatic answers to modern military challenges. Its patented stern landing vessel, a testament to innovation, epitomizes a successful adaptation of commercial designs into versatile naval platforms, seamlessly integrating with existing naval operations and complying with both commercial and naval standards.

11. Serco (Design and Program Management Consultant)

Serco (n.d.) is a large design and program management consulting firm located throughout North America; it has over 9,000 employees and collaborates with various governmental bodies and commercial clients. Serco's expertise extends from conceptualization to delivery, seamlessly navigating acquisition challenges. Serco offers agile and responsive solutions for defense programs ranging from combat capability enhancement to strategic planning and budgetary planning. For over 40 years, Serco has been instrumental in the design and procurement of critical naval assets for both the U.S. and Royal Canadian Navies by assisting them in delivering on-time and within budget. Serco consultancy extends to the USN NAVSEA amphibious ships and platforms'

program offices and provides engineering and program management input into the LSM program.

F. ADDITIONAL DEFENSE INDUSTRY SHIPBUILDER CAPACITY

There are other large defense and commercial American shipbuilders with shipyard capacity that either did not compete or were not awarded an initial LSM program concept studies contract. These firms currently produce naval warships, large commercial landing craft vessels, and possess a skilled manufacturing workforce capable of producing the LSM. With the right investment incentives, they could be influenced to compete for a share of the LSM production contract.

1. General Dynamics

General Dynamics traces its roots back to World War II, when it operated as the Electric Boat Company, a prominent submarine manufacturer, which expanded by purchasing Canadair, an aircraft manufacturer (Parrish, 2020). This merger marked the inception of General Dynamics as the parent corporation, overseeing the multifaceted production of acquired businesses. General Dynamics later bought shipbuilders Bethlehem Steel and Bath Iron Works shipyards (Parrish, 2020). The postwar period witnessed a decline in production, resulting in Bethlehem Steel defense contract operations' termination in the 1960s (Parrish, 2020).

Bath Iron Works, an established independent shipbuilder since 1884, contributed an impressive 73 ships to the USN from 1945–1995 (Parrish, 2020). In the 5-year period preceding its 1995 acquisition by General Dynamics, Bath sustained the annual production of two USN destroyers and frigates (Parrish, 2020). Post-acquisition, its focus shifted primarily towards frigates, and industry analysts attributed Bath's strategic shift and subsequent merger to declining defense spending (Parrish, 2020). These mergers coordinated by General Dynamics illustrate the decline and consolidation of the U.S. naval shipbuilding industrial base since World War II. The incorporation of Bethlehem and Bath Iron Works into the General Dynamics parent organization highlights the consolidation trajectory of the U.S. naval shipbuilding industrial base (Parrish, 2020).

Historically, the shipyards General Dynamics owns and operates could increase production to meet LSM manufacturing capacity constraints.

2. Huntington Ingalls

Huntington Ingalls Industries is a comparatively recent entrant in the shipbuilding industry, although it used strategic acquisitions like those of General Dynamics to gain greater market share (Parrish, 2020). Huntington Ingalls operates two shipyards, one located at Newport News, VA, and the Ingalls Shipbuilding location in Mississippi. The company's production portfolio encompasses the construction of submarines, aircraft carriers, and amphibious naval transport vessels (Parrish, 2020). Emerging as the Chesapeake Dry Dock and Construction Company following World War II, the Newport News shipyard was privately held until Tenneco acquired the yard in 1968. The Newport News shipyard was spun off as an independent company in 1996 and was then acquired by Northrop Grumman in 2001 (Parrish, 2020). Ingalls Shipbuilding in Mississippi built many naval vessels during World War II and, in 1961, was acquired by Litton Industries (Parrish, 2020). Litton further expanded its shipbuilding portfolio in 1999 by acquiring Avondale Industries and its Louisiana shipyard. However, despite growth through strategic acquisitions, Litton experienced major defense contract management issues, which resulted in $1.3 billion in debt and in 2001 was sold to Northrop Grumman (Parrish, 2020).

Northrop Grumman's merger and acquisition over Newport News, Ingalls, and Avondale shipbuilders propelled the corporation to become the largest U.S. shipbuilder (Parrish, 2020). However, in 2011, due to its size, Northrop Grumman decided to spin off its shipbuilding division as an independent entity, Huntington Ingalls Industries, and subsequently sold the Avondale shipyard to Avondale Marine (Parrish, 2020). Although Huntington Ingalls mirrored General Dynamics in size and capability, this move consolidated the industrial base, with Ingalls, Avondale, and Litton now unified under the Northrop Grumman umbrella. Huntington Ingalls has produced many amphibious naval vessels and like General Dynamics possesses the shipyard capacity to expand its amphibious vessel manufacturing to produce the LSM if incentivized to ensure sustained business.

3. Eastern Shipbuilding Group

Eastern Shipbuilding Group (n.d.) was founded in 1976 along the Florida Gulf Coast to manufacture commercial fishing vessels and has since expanded operations to produce offshore supply vessels like the LSM specifications and the USCG Offshore Patrol Cutter (OPC). The 2016 USCG contract award to design and fabricate the OPC demonstrated the manufacturer's ability to build to naval specifications and deliver to USCG production schedules. The OPC created new opportunities for the firm for future government vessel production and provided the USCG with a formidable new ship. Since its founding, Eastern Shipbuilding Group has built a diverse fleet of over 350 vessels, including the OPC, offshore supply vessels, research vessels, and fishing vessels. Eastern Shipbuilding Group is a proven naval vessel manufacturer and could provide the LSM program with additional shipyard production capacity.

4. Conrad Shipyard

Conrad Shipyard (n.d.) constructs steel and aluminum vessels for both commercial and government customers from the Louisiana Gulf Coast region. The company has set itself apart by housing most of its construction operations within a 230,000–square foot manufacturing space outfitted with overhead cranes, which prevents weather disruptions and ensures production remains on schedule. Conrad Shipyard has produced various vessels, including ferries and offshore support vessels, which resemble commercial specifications of the LSM. Conrad Shipyard could provide the LSM program with additional manufacturing capacity to meet demand.

G. INTERNATIONAL INDUSTRY PARTNERS

Only soliciting American shipbuilders misses an opportunity to engage the more robust vessel manufacturing markets in Asia, Australia, and Europe. A joint venture prospect exists to build the LSM in a manner like the combined Australia–United Kingdom–United States (AUKUS) agreement to share nuclear submarine production technologies and industry capacity between these allied countries (Moyse, 2023). An Australian-designed stern landing vessel like the LSM concept is already in production at an Asian shipbuilder at a commercial cost of $20–25 million per ship before military

modifications (Moyse, 2023). The cost to produce a similar medium transport ship internationally is significantly less than the domestic American shipbuilding cost, in part due to lower labor costs. Moyse (2023) challenges the United States to integrate with the Australian military shipbuilding design and production companies to achieve greater economies of scale and further the AUKUS agreement beyond sharing nuclear submarine production and technology. The possibility to expand beyond the limited American shipbuilders could provide the LSM program with lower per-unit manufacturing costs and increased production capacity in the Pacific theater.

1. Hyundai Heavy Industries

Hyundai Heavy Industries is the world's largest shipbuilder and is headquartered in South Korea (Yamada et al., 2019). With its acquisition of Daewoo Shipbuilding and Marine Engineering, Hyundai Heavy Industries increased in size to double that of its competitor Samsung Heavy Industries and is now one of two large manufacturers in Korea. Hyundai Heavy Industries managed to achieve global prominence in part due to South Korean government investment and support. This dominant position enabled Hyundai Heavy Industries to accept large orders and leverage its scale using universal ship designs to drive down costs and outcompete other shipbuilders (Yamada et al., 2019). Hyundai can produce as many as 10 large ships in only a few months due to its operation size and economies of scale in production (Yamada et al., 2019). Partnering with Hyundai Heavy Industries to produce the LSM in a joint AUKUS venture could provide incentive to manufacture the ships quickly under a common design and at a competitive price.

2. Birdon and Echo Marine Group

The Australian Army is sponsoring an acquisition program called the Littoral Maneuver Vessel-Medium (LMV-M), and prime contractor Birdon is building a prototype with assistance from naval architects Incat Crowther that is being manufactured at Echo Marine Group located in Australia ("New Landing Craft," 2023). The LMV-M is a ship concept like the USN LSM that is designed to operate in the Pacific as a littoral, riverine, and open ocean landing craft. The joint venture prime contractor Birdon (n.d.) is

a multinational private corporation with business operations in Australia, the United States, Europe, and Asia. The company advertises a specialty in shipbuilding and repair and has won U.S. defense contracts, including a $1.187 billion contract to design and deliver 27 USCG waterway commerce cutters. The vessel is manufactured at Echo Marine Group (n.d.) which is an Australian-owned shipbuilder that has fabricated Australian naval ship components as a subcontractor. The joint venture to produce the LMV-M prototype provides the USN with a usable prototype to evaluate against its LSM concept designs and an opportunity to partner with an AUKUS shipbuilder to leverage economies of scale to produce a joint venture medium transport landing ship between allied nations. Figure 10 displays the Australian LMV-M concept design with proposed capability to conduct beach landings.

Figure 10. Australia's LMV-M Concept Vessel. Source: "New Landing Craft" (2023).

3. BAE Systems

Originating from British roots and expanding its reach globally, the naval ships division of BAE Systems (n.d.) specializes in naval vessel architectural structural design and construction. BAE Naval Ships' reach extends beyond the United Kingdom and is advantageously positioned across approximately 40 nations serving international markets. BAE Naval Ships division produces surface vessels, submarines, and advanced armament

systems such as torpedoes, radars, combat control systems, while also providing maintenance and ship upgrade services (BAE Systems, n.d.). Additionally, as an AUKUS country allied naval shipbuilder, BAE Systems could provide the LSM program with supplementary international shipyard capacity, which enables the USN to produce more vessels beyond American shipyard capacity constraints.

H. CONGRESS

Congress wields budgetary control, which is central to DoD procurements demonstrated by service chiefs' and combatant commanders' routine congressional engagements and the directed inquiries during the NDAA proceedings (Hovey, 2022). When planning new shipbuilding programs, the congressional interests traverse both national defense needs and the promotion and safeguarding of vital industrial assets in congresspeople's represented states and districts (Hovey, 2022). Given the post–World War II downturn in U.S. domestic commercial ship manufacturing, any shipbuilding initiative requires alignment with industry's capability to produce new ships in addition to current contracts and utilization of all other capable domestic producers beyond the traditional four large naval manufacturing contractors. The LSM program creates several potential review areas for Congress, including the USN LSM acquisition strategy and funding requests (O'Rourke, 2023b). Congress has the power to accept, deny, or modify USN LSM acquisition plan budget requests, and this decision could affect the USN, the USMC, and the health of the U.S. shipbuilding sector (O'Rourke, 2023b).

Additionally, Congress is concerned about constrained naval shipbuilding budgets preventing the service from reaching its target fleet size, resulting in the loss of five battle-force ships from now through FY2028 (LaGrone, 2023). ADM Gilday acknowledged that budgets below inflation-level increases would impede plans. Senator Lindsey Graham focused his questions to Secretary of the Navy Carlos Del Toro on whether budget limitations or shipyard capacity posed greater obstacles for naval expansion and asked,

> "Do we have a shipbuilding industry problem, or do we have a budget problem?" Sen. Lindsey Graham (R-S.C.) asked Del Toro.

> "We have a shipbuilding industry problem, currently Senator," Del Toro said (LaGrone, 2023, p. 1).

This additional layer of scrutiny might revolve around the industrial ramifications of where the LSM is manufactured. Previously, USN amphibious vessels were produced in Pascagoula, MS, at the Ingalls shipyard, a subsidiary of Huntington Ingalls Industries (O'Rourke, 2023b). However, because of the LSM's smaller vessel size and adaptation from a commercial design, the LSM can be manufactured at many different U.S. shipyards. Further, it is worth investigating whether the USN's forecasted procurement costs are reasonable and accurate. A few important questions for Congress to consider include:

> What implications might the LSM program have for the distribution of Navy shipbuilding work among U.S. shipyards?
>
> How many jobs would the LSM program create at the shipyard that builds the ships, at associated supplier firms, and indirectly in surrounding communities?
>
> In a situation of finite defense resources, what impact, if any, would funding the procurement of LSMs have on funding available for procuring other types of amphibious ships, and thus on workloads and employment levels at HII/Ingalls, its associated supplier firms, and their surrounding communities? (O'Rourke, 2023b, p. 24)

The House Armed Services Committee's report for the 2024 Fiscal Year Defense Authorization outlines a proposed defense budget emphasizing the benefits of multiyear and block-buy procurement for timely production and cost efficiency (O'Rourke, 2023b). This evaluation will explore the viability of a collaborative Army–Navy procurement effort for the Maneuver Support Vessel (MSV) and LSM programs, examining aspects like cost benefits, contracting methods, and potential force capability impacts (O'Rourke, 2023b). Additionally, the Senate Armed Services Committee report on the 2024 Fiscal Year Defense Authorization mandates a collaborative report by February 29, 2024, from the secretaries of the Navy and Army to scrutinize the potential of a joint Army–Navy initiative to create a set of watercrafts supporting both USMC and Army maritime operations (O'Rourke, 2023b). The joint and collaborative report aims to evaluate if a common vessel design could fulfill both military branches' needs and will also delve into the pros and cons of such a collaborative procurement strategy (O'Rourke, 2023b). These

congressional reports underscore the continued focus on exploring joint Army–Navy procurement pathways with an emphasis on cost-efficiencies, reduced redundancies, accelerated multi-year procurements, and joint force capability interoperability. Another area Congress might consider is the feasibility of repurposing Army Logistics Support Vessels to satisfy some of the USN's LSM needs rather than commissioning entirely new vessels. These vessels are over 30 years old, though, so the operation and sustainment costs of these older vessels may exceed the LSM procurement costs.

I. SUMMARY

There are many key stakeholders involved directly and indirectly in the LSM development impacting its progress or possessing capability and capacity potential to influence and benefit the acquisition program. The main end user and driving force for the LSM requirement is the USMC, which needs the vessels to support its new Force Design 2030 modernization strategy and improve amphibious mobility throughout INDOPACOM. However, the USMC has limited influence over the program's timeline and budget which are controlled by the USN. The buyer is the USN, which manages the acquisition process through various organizations like OPNAV, NAVSEA PEO Ships, and the ASN(RDA). There have been disagreements between the USN and USMC leadership over procurement priorities, vessel minimum requirements, and fleet size goals which have delayed the LSM program. The U.S. Army has its own similar MSV-H program in development which could present opportunities for collaboration with the USN to define joint requirements and combine procurement contract award to gain economies of scale. Additionally, in 2020 there were 15 shipbuilders and design firms awarded initial concept study contracts. Key remaining LSM concept design partners include Austal USA, Fincantieri, Bollinger Shipyards, and TAI Engineers. There is also additional domestic and international shipbuilding capacity at firms like General Dynamics, Huntington Ingalls, Eastern Shipbuilding Group, and Conrad Shipyard. Also, the Australian LMV-M program presents a collaborative opportunity within the AUKUS agreement to leverage design, development, production, and sustainment activities between allies producing similar vessels. Additionally, Congress controls budget appropriations and has expressed concerns over constrained shipbuilding budgets and

industrial base capacity. Finally, Congress is exploring potential joint Navy-Army procurement options for the LSM and MSV programs. In summary, the LSM program has a complex web of military, industry, and Congressional stakeholders influencing requirements, budget, procurement strategy, and production capacity. Effective collaboration and alignment between these groups will be key to delivering the capability on time and within budget.

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IV. ACQUISITION DILEMMA

During World War II, the rapid production and availability of Landing Ship Tanks (LSTs) played a pivotal role in transporting troops, equipment, and supplies in the European and Pacific theaters (Phillips, 2023). These vessels were designed to carry heavy cargo, up to 431 troops, and 510 tons of vehicles, and conduct amphibious beach landings. After the war, the DoD recognized the naval utility value of these ships, and, until 2002, the LST remained in service. However, after the LST Newport-class decommissioning, a logistical void surfaced that couldn't be appropriately filled by modern, smaller, or less capable connectors or medium-size vessels (Phillips, 2023). Despite evolving warfare dynamics and technologies, there is still a need for modern multi-functional LSTs that provide the naval services with additional capability to conduct amphibious operations, humanitarian missions, and evacuation operations (Phillips, 2023). The LST's historical significance is amplified by its World War II production efficiency due in part to its modular assembly and design, which enabled large-scale production at 18 shipyards that produced over 1,000 LSTs in only 3 years (Phillips, 2023). Surprisingly, many of these vessels originated from inland shipyards located in Illinois, Indiana, and Pennsylvania because of the ship's smaller size, modular design, and ability to navigate inland rivers to reach the oceans (Phillips, 2023). Figure 11 depicts the versatility of LSTs during World War II in loading various vehicles and supplies, which provided a vital littoral transportation vessel capable of amphibious landings for the Operation Overload D-Day invasion.

Figure 11. World War II LSTs Onloading Equipment and Supplies in England in Preparation for Operation Overload. Source: Ussery (2008).

With the LSM, the USN aims to provide a modern adaptation of the World War II–era LST for transporting Marines and equipment throughout INDOPACOM. The LSM acquisition requirement has become complex, as institutional resistance within the naval establishment questions the LSM's utility, survivability, limitations, and potential impact on existing amphibious ships (Hooper, 2023a). In a major war, LSMs would be susceptible and slow targets, just like World War II LSTs were, though the LST's versatility outweighed its vulnerability (Hooper, 2023a). Additionally, the modest 40-person LSM crews led by junior officers conflict with current naval personnel shortfalls. A 35-LSM fleet would require 280 junior naval officers, further challenging recruitment, and would deviate junior officers from traditional surface warfare officer career pathways (Hooper, 2023a). Contrary to common sense, commanding an LSM as a USN lieutenant (O-3) could put junior officers at a disadvantage in terms of remaining competitive for promotion due to their peer group gaining greater warship systems experience while serving aboard actual warships (e.g., destroyers; Hooper, 2023a).

O'Rourke (2023b) described that the USN's LSM program experienced significant delays, with the detail design and construction contract award pushed from fiscal year 2023 to fiscal year 2025. O'Rourke (2023b) further summarized the 19-month slippage stems from ongoing engagement with industry to refine requirements and delays approving the program's AoA, which remains unapproved by the OSD. Though the AoA is still pending, O'Rourke (2023b) detailed that the LSM program continues working toward a contract award in 2025 and aims to shorten development time by modifying an existing commercial ship design rather than creating a new design. The LSM program seeks to streamline the schedule by eliminating certain oversight reviews, which risks senior leaders lacking information necessary for making sound decisions (O'Rourke, 2023b). The USN has engaged industry on LSM concepts since 2020 through multiple rounds of studies with numerous participating designers and shipbuilders. The USN aims to rapidly iterate designs to meet evolving requirements and provide feedback on requirement impacts. A full competition is expected for the detail design and construction request for proposals.

Key LSM program elements, including survivability requirements and procurement quantity, are still undefined, which the USN continues developing through an iterative process with industry to balance survivability with affordability (O'Rourke, 2023b). The USMC proposed acquiring 35 LSMs, but the USN wants only 18, so total acquisition strategy quantities are unclear (O'Rourke, 2023b). Without a finite total ship acquisition quantity and concurrence on commercial ship design modification requirements, the LSM vessel procurement cost ranges from $150 million per ship to produce the minimum viable product the Marines want and, due to the lower cost, ensure the maximum number of ships possible is procured to around $350 million per ship to add the Navy's desired survivability features and align the LSM closer to L-class amphibious ship survivability and systems technology (O'Rourke, 2023b). At its core, the disagreement over LSM capability systems and survivability reflects differing attitudes toward risk tolerance between the USN and the USMC. The USN is extremely reluctant for its vessels to suffer catastrophic battle damage. In contrast, the USMC acknowledges that losses of Marines and equipment, while regrettable, are an unavoidable hazard that occurs when fighting and winning battles (Larson, 2022).

Critics of the LSM program stress that the USMC values ship procurement and delivery speed by requesting appropriation funding before the final requirement is determined, which is reminiscent to the flawed LCS program (Baird et al., 2022). Deviating from major capability acquisition processes and milestones greatly increases program risk and can lead to requirements creep. LCS construction began before testing prototypes, which led to cost overruns and unmet operational needs after 20 years of design and program management failures, ultimately resulting in terminating future production and retiring ships early (Baird et al., 2022). Currently, the LSM AoA is not approved, yet the FY2024 shipbuilding budget states that the first LSM construction contract would be awarded in March 2025. The LSM cannot afford to repeat LCS program mistakes beginning low-rate initial production before establishing the program baseline and capabilities thresholds.

Also, the USN prefers a single shipyard that manufactures all LSMs but would allow a multi-yard approach if it accelerated schedule or reduced costs (O'Rourke, 2023b). Key design considerations reflect these trade-offs, including a maximum 12-foot draft, which facilitates transit in shallow waters and beach landings, and ample cargo space, as open deck storage differs from most current amphibious ships. The modest speed of about 15 knots, compared to 22 knots for larger amphibious ships, allows for a less expensive and more fuel-efficient propulsion system (O'Rourke, 2023b). The 20-year service life is less than the 30–45 years that is typical for bigger amphibious ships but enables a lower cost for this smaller ship class. The services are working to strike the right balance between affordability gained through simplified designs and survivability requirements aimed at enhancing fleet capabilities.

The LSM survivability is questionable due to its slow speed and limited maneuverability, which makes it susceptible to enemy detection when transiting contested seas and vulnerable to missile strikes (Jenkins, 2022). Further, any direct hit on the lightly defended ship would likely result in unrecoverable catastrophic damage (Jenkins, 2022). Adding enhanced survivability features increases the per-unit procurement and operations and maintenance cost, resulting in the necessity to trade-off other features or reduce the number of ships procured. It is inevitable that the final cost of building the new ship will be far higher than initial estimates, as more unforeseen

expenses and requirements will most likely emerge during the long construction process. Additionally, given the new naval ship class's record of cost overruns and delays, there is considerable uncertainty about when this capability will be delivered to the fleet (Jenkins, 2022). The acquisition team challenge is to deliver maximum value to the warfighter by establishing an achievable acquisition program baseline given anticipated cost overruns, budgetary constraints, and the desire for a hastened shipbuilding schedule.

Nevertheless, recent public comments indicate compromise was reached on LSM speed, affordability, and survivability requirements and costs after completing preliminary concept designs (O'Rourke, 2023b). In April 2023, the USN and USMC communicated that they were close to reaching agreement on the requirements and costs for the LSM program (O'Rourke, 2023b). BGen Marcus Annibale, the director of expeditionary warfare on the chief of naval operations staff, indicated there was progress in drafting the capability development document and it was pending authorization (O'Rourke, 2023b). The author further reported Vice Admiral Scott Conn, the deputy chief of naval operations for warfighting requirements and capabilities, acknowledged initial disagreements with USMC stakeholders over LSM minimum capabilities and the total unit costs but recognized the services are in unison on the importance of procuring these smaller ships. Additionally, LtGen Heckl, deputy commandant of CD&I, explained that by working together with VADM Conn and BGen Annibale they found common ground on survivability and vulnerability features to incorporate into the LSM design (O'Rourke, 2023b). LtGen Heckl also noted that the original concept emphasized low cost, larger quantities, and a commercial-style design (O'Rourke, 2023b). However, discussions led to greater capability and survivability requirements from the USN and OSD, which increased costs, and now the program is returning to the initial size and cost goals (O'Rourke, 2023b). The author also added that BGen Annibale announced that after the capability document is signed, PEO Ships will host an industry day to explain LSM goals and gather insights that may improve the official requirements. The services aim to finalize LSM program details and move forward on the acquisition path (O'Rourke, 2023b). The services found common ground on survivability features to add while keeping the size and cost closer to initial goals, but the final cost estimate and features are not yet public information. The program is proceeding with a draft

capabilities development document toward an industry day for further full and open contract procurement planning. On May 17, 2023, the USN issued a request for information to shipbuilders about the LSM program and asked interested firms to provide responses on several production capacity and investment topics. According to O'Rourke (2023a), those questions included the following:

- Do you have the resources and production capacity available to be awarded 4 LSM ships per fiscal year?
- If so, how can your shipyard support production of 4 LSM hulls per year?
- If not, what is the maximum number of LSM ships that can begin production each year?
- If not, are there investment or shipyard improvements that can be done to enable increasing production capacity to 4 LSM hulls per year? (p. 5)

This request for information showed the USN's interest in manufacturing multiple LSMs per year and, given the USN's previously stated acquisition strategy to produce 18 LSMs, this four-ships-per-year rate would complete production within 5 years of accelerated production. This is a key insight into the goals and willingness of the acquisition team to accept increased risk to achieve greater production speed for the warfighter.

In the 2023 GAO Annual Weapons System report Oakley et al. (2023b) describe the current LSM (referred to as the LAW) program status as,

> Since our last review, the Navy delayed the detail design and construction contract award for LAW from fiscal year 2023 to fiscal year 2025. According to Navy officials, this change was due to ongoing efforts to engage with industry and refine program requirements, as well as delays in gaining approval of the program's analysis of alternatives (AOA)—a key document to help DoD and the Navy decide if a new ship class is needed. As of January 2023, the Office of the Secretary of Defense had yet to approve the AOA, which is at least a 19-month delay in the planned approval since our last review.
>
> Although an approved AOA has yet to confirm the need for LAW, the program continues to work toward a detail design and construction contract award and is looking for opportunities to shorten LAW's development time. For example, the program plans to modify an existing parent ship design, instead of creating a new one, and has been assessing potential designs with five companies since 2021. The program also plans

> to seek approval to streamline its schedule by eliminating certain early acquisition oversight reviews. We previously found that eliminating such reviews can increase the risk that senior acquisition and warfighting leaders lack information needed for sound investment decisions.
>
> Currently, several key program elements remain undefined. In particular, the Navy is still determining LAW's requirements. In alignment with leading principles for iterative development, the Navy is making changes to draft requirements based on industry feedback and ongoing AOA efforts. DoD has also yet to determine LAW's total procurement quantities. The Marine Corps suggested 35 ships, but the Navy proposed acquiring only 18. The Navy cannot estimate LAW's costs until it defines requirements and quantities. (p. 171)

Oakley et al. (2023b) received the following summarized comments from the LSM/LAW Program Office,

> We provided a draft of this assessment to the program office for review and comment. The program office provided technical comments, which we incorporated where appropriate. It stated that the Navy is following a deliberate requirements process to determine its needs for the LAW program. It noted that the Navy endorsed the AOA in March 2022 and is awaiting the sufficiency review by the Office of the Secretary of Defense. It added that it is incorporating the analysis results and feedback from the five industry preliminary designs into the upcoming Capabilities Development Document. (p. 171)

The LSM program faces several acquisition options and decision points which include finalizing the vessel requirements, procurement quantity, and maturing the commercially modified design (Oakley et al., 2023b, p. 171). The USN is validating requirements to balance between affordability and adding enhanced survivability capabilities (Jenkins, 2022). Secondly, determining whether the design and construction contract will be awarded to a sole shipbuilder or multiple concurrent shipbuilders (see Appendix B). The USN has assessed shipbuilder production capacity and investments needed to produce 4 LSMs per year signaling a desire for rapid production (O'Rourke, 2023a). Finally, determining the best acquisition path forward to manage cost, schedule, performance, and manufacturing risk. The program is planning to modify an existing commercial ship design rather than develop a completely new design, which aims to shorten development timelines and there was openness to streamlined oversight reviews

which could accelerate schedule (Oakley et al., 2023b, p. 171). The following are key questions for senior leaders deciding the LSM path forward:

- What is the right quantity of LSMs to procure to balance costs and meet operational requirements?
- What specific survivability enhancements and other capabilities should be included in the design? What trade-offs are acceptable?
- Is an accelerated schedule appropriately balanced against increased oversight risks? Are there sufficient off-ramps if issues emerge?
- How will requirements stability be maintained as the program proceeds? What are the risks of requirements creep?
- Should a joint procurement approach with the Army for a common "Medium Littoral Ship" be further explored? What are the potential benefits and drawbacks?
- Are the industrial base impacts to shipyards properly considered regarding the distribution of work? How can capacity challenges be addressed?
- Is the program's estimated budget realistic given the historical shipbuilding cost growth? What fiscal guardrails are prudent?

In summary, the LSM program faces key decisions on balancing performance capability, schedule, costs, and manufacturing risks as it proceeds toward a production contract award. Careful oversight is necessary to avoid past shipbuilding program pitfalls.

V. ANALYSIS

The researcher used the Harvard Business case study analysis method to analyze the LSM program dilemma (Weinstein et al., 2020). This is a six-step decision-making approach involving identifying the problem, alternatives, criteria, analysis, decision, and implementation (PACADI). This framework helps to solve and analyze the acquisition dilemma issue, make decisions, and develop an acquisition strategy (Weinstein et al., 2020). The PACADI method starts with a summarized situational analysis highlighting the key case facts.

A. SITUATIONAL ANALYSIS

The USMC has an urgent requirement for 35 new medium-sized amphibious ships to enhance the maneuverability and mobility of its new MLR formations operating in the Indo-Pacific region. However, the LSM program managed by the USN has experienced delays and disagreements with the USMC over capability requirements and priorities. The initial timeline and budget have slipped with the construction contract award now planned for 2025 versus the original target of 2023. Key issues are finalizing the vessel's requirements including survivability features, procurement quantity, and total program cost. The quantity desired differs between the USN (18 ships) and USMC (35 ships), while the estimated vessel cost has also increased from the initial $100M-$150M up to $350M. The LSM program faces challenges balancing cost, schedule, and performance goals amidst a complex stakeholder environment.

Additionally, the LSM program aims to modify an existing commercial ship design to shorten development timelines. However, eliminating standard oversight reviews could increase program risks. The current schedule delays and projected cost growth require careful oversight to avoid prior unsuccessful USN shipbuilding program pitfalls (e.g., LCS). Key decisions include validating requirements and quantities, assessing budget realism, mitigating development risks and requirements creep, leveraging existing commercial vessel designs, exploring joint Army-Navy procurement options, and feasibility to award construction contracts across multiple shipyards.

B. PROBLEM

There are three important decisions facing the LSM program phrased as questions:

- What is the best materiel solution option to satisfy the warfighter requirement given the LSM AoA is not approved?
- Which acquisition path forward will best manage cost, schedule, performance, manufacturing, technological, and program risks?
- Whether a sole manufacturer or multiple shipbuilders is the best option for the program?

Addressing these decisions will address the research questions seeking to identify a tailored solution to develop and deliver the vessel to meet the warfighter's unique performance requirements, manage cost constraints, meet the user demand signal, while avoiding unnecessary risk. There are several acceptable materiel solutions, acquisition pathways, and shipbuilder decisions to suit the LSM requirement and each offers different benefits and assumes varied levels of risk based on the sensitivity analysis of weighted qualitative evaluation criteria. These issues directly impact the primary problems because the award decision will impact manufacturing capacity, schedule flexibility, performance capability, total cost, and will either avoid or assume greater program risk.

C. ALTERNATIVES

The first problem analyzed identified four distinct options to solve the warfighter's medium size amphibious ship capability gap. The first option was to do nothing and use the existing program of record amphibious ships to support littoral transportation. The second option was to use the U.S. Army's MSV-H program which is in development and designed to solve a similar requirements problem in the INDOPACOM theater. The third option was to acquire commercially available vessels which meet most of the performance capabilities required and are commercially available off the shelf. The final option evaluated was to pursue the LSM development without an approved AoA, which was pending approval at OSD.

The second important problem identifying the best LSM acquisition pathway offers six alternative options to analyze against select evaluation criteria to decide on the

path forward. The six options include either utilizing MCA and entering at Milestone A, MCA and entering at Milestone B, MCA and entering at Milestone C or transition to Middle Tier of Acquisition (MTA) Rapid Prototyping and Fielding, a hybrid approach using MTA Rapid Prototyping and entering MCA at Milestone B to accelerate development while AoA is pending, or use MTA Rapid Prototyping to enter MCA at Milestone C.

Other alternative pathways including Urgent Capability Acquisition, Software Acquisition, Defense Business Systems, and Acquisition of Services are not appropriate solutions. Urgent Capability Acquisition is a path meant for development to take weeks, and fielding measured in months with a maximum two-year program deadline. The LSM is using commercial designs but will have naval survivability modifications which will take longer than a few weeks to develop and years to fully produce, so this path is not appropriate. Software Acquisition is meant for agile iterative technology development and procurement. The LSM will use software but using an agile approach to developing shipbuilding programs is not an effective method. Finally, Defense Business Systems and Acquisition of Services are not used for major defense programs, so they are not valid alternatives.

The third problem offers three alternative options to award production contracts. The first option is to consider only using one shipbuilder to produce the LSM. This option has precedent in other shipbuilding programs, for it is easier to manage and maintain oversight over one manufacturer. The second option is to award production contracts to multiple domestic shipbuilders. This enhances manufacturing competition, capacity, and flexibility to meet warfighter demand, and historically was the path to produce LSTs during World War II. The final option is to award production contracts to multiple domestic and international shipbuilders. This alternative provides the most manufacturing capacity to quickly produce ships yet is overall more difficult to manage a global production network.

D. CRITERIA

The five most important evaluation criteria for Table 2 LSM AoA Pending OSD Approval decision included cost, schedule, performance, manufacturing, and program

risk. In Table 3 LSM Acquisition Pathway the decision of which path forward includes six criteria consisting of cost, schedule, performance, manufacturing, technological, and program risks. In Table 4 Design and Construction Contract Award and Management there were six criteria evaluated including cost, schedule, manufacturing, program, security, and industrial base. These measures are the basis for LSM program management and provide the best indications to decide which alternative options are best suited for implementation. Additionally, to remove qualitative bias a decision matrix is used to rank unweighted and weighted criteria to determine a clear quantitative winner.

In Table 2 the researcher found that program risk was the most important weighted criteria given the pending LSM AoA status hindering progression through MCA pathway. The overall program risk increases if LSM development continues without an approved AoA which details the requirements validation solidifying the programs requirements. Without oversight and validation, the program is high risk for requirements variance throughout development and production. The second most important evaluation criteria were cost, for one of the unsolved program issues is reducing the procurement costs. Differences in minimum vessel capability requirements more than doubled the initial cost estimates due to additional survivability modification requirements. Further, O'Rourke (2023a) describes budgetary tradeoffs as main problem for increasing naval shipbuilding capacity to meet 355-ship fleet goal. The LSM program will be under Congressional scrutiny as a multi-billion-dollar acquisition to manage costs and any budgetary issue could result in capability tradeoffs or quantity reduction. The researcher viewed cost as a highly important factor to evaluate the options and was assigned the second highest weighted value.

The third most important factor was performance because the LSM capability requirements were deemed unique otherwise the USMC would use existing USN amphibious ships, Maritime Sealift Command ships, U.S. Army watercraft, or purchase existing commercial vessels to solve the capability gap. The need to develop a unique ship different from existing naval or commercial vessels demonstrates the value performance was for decision makers to pursue development of a new amphibious ship platform. The fourth most important factor was manufacturing risk, for encompasses deviations from production oversight, program documentation, quality, and other

traditional mitigation measures used to support program development and delivery. The LSM is prone to manufacturing risk due to developing a new ship design and desire to produce many vessels over an accelerated timeline. There is also enhanced risk in awarding construction contracts to multiple shipbuilders due to potential of manufacturing quality and schedule variance. Manufacturing risk is an important factor, yet the researcher determined it is less important than schedule and cost because the LSM is developed from an existing ship design, so the risk is avoided using a naval variation of commercially available product.

The least valued weighted criteria factor was schedule due to the program requirements fluctuating resulting in a delay in either approving or denying the AoA. The stakeholders have not solidified the justification need to pursue a new amphibious ship acquisition, so the schedule of quickly developing and manufacturing a ship is the least important decision factor. However, throughout Gen Berger's (2023a) Force Design 2030 plan the USMC emphasized organization and equipment modernization speed to compete with the pacing threat, China, in the Indo-Pacific region. Further, Feichart (2023) outlined the goal of USMC Force Design 2030 was to use 2020–2030 decade to implement the strategy and acquire newly required equipment. Although, the warfighter has communicated that acquisition speed is key to implementing their Force Design 2030 plan, the requirement has not been fully determined, so the need to hurry development and production without using MCA pathway is an unnecessary risk.

Table 3 LSM Acquisition Pathway Decision Matrix involved six criteria risks weighted from most to least important as program, performance, cost, schedule, technological, and manufacturing. Program remained the most important weighted criteria because the overall success throughout development and construction will be measured against the requirements validation, periodic oversights and reviews, and risk tolerance. Performance was deemed the second most important weighted factor due to unique requirements capabilities necessitating the LSM program development in comparison to using an alternative existing program of record or commercial vessel. The performance criteria are important to value over other factors because the path forward is key capability alignment to warfighter requirements. The third most important weighted criterion was cost due to the limited shipbuilding budget and need to pursue the most

budgetary efficient path to ensure the desired quantity of ships are produced. The fourth most important factor was the schedule because if the LSM continues through development and construction without an approved AoA this unique capability is viewed as essential. Pursuing a distinctive capability solution ahead of AoA approval elevates scheduled delivery to the warfighter importance even though overall program, cost, and performance risk also increases. The fifth most important criteria weight was technological risk due to the LSM adding survivability modifications to a commercial vessel design. There is some risk impacting cost, performance, and schedule if the technological additions have problems, so further development can mitigate this risk. The final weighted risk factor was determined to be manufacturing due to the LSM concept plan to use an existing commercial design. The manufacturing risk is lowered when using a proven technology such as a commercial design, so it was the least risky area in determining the acquisition pathway.

Table 4 Design and Construction Contract Award and Management Decision analyzed program, cost, industrial base, manufacturing, security, and schedule risk criteria. The most important weighted factor was program due to the encompassing overall system and management risks awarding to the variety of shipbuilding options. The second most important weighted factor was cost due to limited shipbuilding budget and necessity to reduce costs to prevent capability tradeoffs or reducing total quantity built. The third most important weighted criteria were impacts and risks to the U.S. shipbuilding industrial base. As previously discussed, the U.S. shipbuilding industry declined and consolidated after World War II, so promoting market competition among a greater number of firms was deemed as beneficial to the LSM and other future naval shipbuilding programs. The fourth most important weighted factor was manufacturing, for there is increased complexity in multiple shipbuilders producing the same vessel in meeting quality standards. The fifth most important weighted criteria were security risks surrounding construction. Using various domestic and particularly international shipyards increases the security risk that technological and design intellectual property could be stolen, or the ships could be tampered with. Finally, the least important construction factor was determined to be schedule due to the naval shipbuilding timeline limitations in comparison to other defense programs.

E. ANALYSIS

To evaluate the alternative options against the weighted criteria the researcher created Table 2 LSM Pending AoA Approval Decision Matrix, Table 3 LSM Acquisition Pathway Decision Matrix, and Table 4 LSM Design and Construction Contract Award and Management Decision Matrix. These tables display the alternative options ranked in each criteria column with the lowest number being viewed as the best option for each category and highest as the worst. The sum for each option is added up horizontally under the option scores unweighted and weighted columns. To calculate the weighted columns the ranked option number was multiplied by the weighted criteria row for each category and then summed under the options score. By quantitatively assigning a score for each option in the criteria category it created an unweighted total score. The weighted score provides a better indicator of which option was the best to use for the LSM program.

1. LSM Pending AoA Approval Decision Matrix Analysis

From Table 2 there were four options evaluated against the qualitative factors that had unweighted total scores ranging from 11 to 15 and weighted scores ranging from 23 to 33. The researcher analyzed each option against the individual criteria assigning each a quantitative ranking from 1 being the best option to 4 being the worst. Through ranking each option against the criteria and using the weighted sensitivity analysis the U.S. Army MSV-H program was determined to be best alternative option. In Table 2 the following analysis describes the reasoning for ranking each option against the weighted criteria.

Table 2. LSM Pending AoA Approval Decision Matrix.

LSM AoA Pending OSD Approval Decision Matrix							Option Scores (Lower is Better)	
		Risk Criteria					Unweighted	Weighted
		Cost	Schedule	Performance	Manufacturing	Program		
	Weighted Criteria	4	1	3	2	5		
Options	Do Nothing - Utilize Existing Amphibious Ships	1	4	4	1	1	11	27
	Use Army MSV-H Program in Development	3	3	2	3	2	13	23
	Acquire Commercially Available Vessels (COTS)	2	1	3	2	3	11	24
	Pursue LSM Development Without Approved AoA	4	2	1	4	4	15	33

The most important weighted factor was program risk due to the necessity to determine capability requirements, procurement quantity, and resourcing prior to proceeding to a new acquisition solution. The best option evaluated was to do nothing and use existing naval ships because until an AoA is approved it does not incur program risk to develop, buy, and build. The second-best option was to use the Army MSV-H program because it offered an opportunity to transfer risk to another program office already further along in the development and prototyping. Using an existing system possessing similar capability could lower program risk for the LSM requirement enabling the USN and USMC to program procurement resources into an Army platform in development designed to replace aging Army logistics support vessels. The third best option was to acquire commercial vessels without naval survivability modifications. An existing commercial item reduces program risk to fulfill a need but does increase performance risk due to the tradeoff naval survivability features. The worst option for program risk was to continue LSM development without an approved AoA. The risk of requirements creep aligned with issues in the LCS program increases without formal requirements validation and synchronization justifying the need to build a unique vessel.

The second highest rated criterion was the cost risk because resourcing justification is an important factor to determine the best solution given USN shipbuilding budgetary constraints. The best option to reduce cost risk is to do nothing and use existing naval ships because the USN can use amphibious L-class ships and Maritime

Sealift Command vessels to satisfy the USMC MLR requirements without adding a multi-billion-dollar LSM procurement program. The second-best cost option was to acquire commercially available vessels due to the significantly lower cost in comparison to developing and procuring naval vessels. As previously discussed, Moyse (2023) described commercial vessels manufactured in Asia could be produced for approximately $20-25-million and provide a similar transportation capability without the naval survivability features which for the LSM are forecasted to cost over $300 million per ship. The third best option to manage cost was the Army MSV-H program, for some development costs could be avoided by using their technology and system and only paying the additional procurement per unit costs. The worst option was to pursue the LSM program because there are increased cost risks associated with the LSM uncertain vessel requirements increasing additional technology maturation and prototyping costs to mitigate.

The third most important criterion was the performance risk in developing or procuring a solution for the amphibious capability gap. The best option to meet USMC performance factor was to pursue the LSM program development. The LSM performance must be a highly weighted factor otherwise USMC and USN would use existing naval or commercial ships to solve the requirements gap. The next best performance option was to use the Army MSV-H program because they are developing a like vessel designed to meet the same general amphibious transport requirements. The third best option was to acquire commercial vessels because it would solve the medium sea transportation gap yet falls short of providing naval survivability features. The worst performance option is to do nothing because the warfighter has communicated the current fleet of large and small naval vessels is inadequate to support medium multi-day amphibious lift.

The fourth most important criterion was manufacturing risk to produce a quality vessel to satisfy the capability need. The best option to reduce manufacturing risk was to do nothing because using existing naval and Army vessels requires no additional production. The second-best option was to acquire commercial vessels because it avoids manufacturing and quality management risk using an existing and proven product in comparison to retooling a shipyard to construct a new ship design. The third best option was to use the Army MSV-H program for it allows the program office to transfer risk to

the Army to manage manufacturing quality. The worst manufacturing option is to construct the LSM without an approved AoA, which increases risk of producing a vessel that does not solve the warfighter's capability gap.

The fifth and least important weighted criterion was schedule for without an approved AoA there is increasing risk to prioritize speed over developing a sound acquisition business case. The highest rated option for schedule was to acquire commercially available ships because these ships are regularly constructed and do not necessitate further development to acquire. The next best option was to pursue the LSM program because it enables the program office to control development and construction acceleration, while using cost and performance tradeoffs to prioritize time savings. The third best option was to use the Army MSV-H program because it offers a similar vessel solution but loses control over acquisition development and production speed. The worst option evaluated was to do nothing because it does not deliver a new unique requirement capability to the warfighter.

Based on the researcher's weighted criteria ranking the USMC and USN should consider using the Army's MSV-H program or form a joint program with the Army to pursue a shared acquisition requirements solution. The researcher viewed program and cost risk as more important criterion over performance, which impacted the analysis and led to determining the best materiel solution option was to partner with the Army or form a joint program to develop a universal medium amphibious vessel. However, the researcher recognized that a joint or Army led medium amphibious vessel program may not fully meet USMC and USN special capability requirements driving the LSM acquisition program, which would propel performance to be the most important weighted criteria over program and cost risks. An elevated performance weighted criteria supports the LSM program development independent of the Army program as the best way to meet USMC particular performance requirements for amphibious ships. This additional USMC and USN stakeholder assumption that performance capabilities were the most important criteria justifies the LSM program development, however, the next key decisions include determining the appropriate acquisition path forward and then whether to award construction contracts to multiple shipbuilders or a sole manufacturer.

2. LSM Acquisition Pathway Decision Matrix Analysis

From Table 3 there were six acquisition pathway options evaluated against the six qualitative factors that had unweighted total scores ranging from 16 to 25 and weighted scores ranging from 50 to 64. The researcher analyzed each option against the individual criteria assigning each a quantitative ranking from 1 being the best option to 6 being the worst. Through ranking each option against the criteria and using the weighted sensitivity analysis the hybrid MTA rapid prototyping with entry to MCA at Milestone B was determined to be the best alternative option. In Table 3 the following analysis describes the reasoning for ranking each option against the weighted criteria.

Table 3. LSM Acquisition Pathway Decision Matrix.

Acquisition Pathway Decision Matrix								Option Scores (Lower is Better)	
		Risk Criteria						Unweighted	Weighted
		Cost	Schedule	Performance	Manufacturing	Technological	Program		
	Weighted Criteria	4	3	5	1	2	6		
Options	Major Capability Acquisition (MCA) Entry at MS A	6	6	1	1	1	1	16	53
	MCA Entry at MS B	5	5	3	3	3	3	22	53
	MCA Entry at MS C	1	1	6	6	6	5	25	52
	Middle Tier Acquisition (MTA) Rapid Prototyping and Fielding	2	2	4	5	4	6	23	64
	MTA Rapid Prototyping Entry to MCA At MS B	4	4	2	2	2	2	16	50
	MTA Rapid Prototyping Entry to MCA At MS C	3	3	5	4	5	4	24	54

In determining the best LSM acquisition pathway option the management of program risk was the most valued weighted criterion. The researcher determined that using MCA entry at Milestone A would be the least risky program management option due to the necessity of possessing an approved AoA study, periodic oversight reviews, and defined milestone decisions. Entry through this pathway enables greater opportunity to reduce program risks and fully develop the materiel solution. The next best option was to pursue a hybrid option combining MTA rapid prototyping with MCA entry at Milestone B after the AoA is approved. This enables the program to continually reduce technological and development risk through MTA path and then transitioning to MCA to

continue prototyping. The third best option is to pursue MCA entry at Milestone B to enable prototyping and development. This option is slightly worse than the previous hybrid option because it loses valuable time to start prototyping after AoA approval and MCA entry. The fourth ranked option to manage program risk was to pursue a different hybrid MTA rapid prototyping and MCA entry at Milestone C. This option is worse for program management risk than the previously mentioned MTA and MCA hybrid option because it moves quicker to production without receiving enhanced oversight reviews that EMD phase provides. The second worst option is to pursue MCA entry at Milestone C because it assumes the technology is mature, development risk is reduced, and ready for production. This increases program risk because the LSM is not an off the shelf commercial product. The worst option to manage program risk is to pursue only MTA rapid prototyping and transition to rapid fielding. This option reduces oversight, does not require AoA approval, which increases program risk in failing to produce a sound business case to justify the program.

The second most important weighted criteria included the vessel performance risk, for this is a new major acquisition program with varying stakeholder minimum performance requirements. The highest ranked option was MCA entry at Milestone A because it offers the best development opportunity to reduce risk and ensure the program is ready to proceed through formal documentation and oversight reviews. The next best option was the hybrid MTA rapid prototyping with entry to MCA at Milestone B because it increases development time through using MTA until the AoA is approved and then leverages MCA to provide enhanced oversight reviews to ensure the vessel is capable to meet the warfighter's requirements. The third best option to reduce performance risk is to use MCA entry at Milestone B to enable prototyping and development after program documentation requirements enable MCA entry. This option does not provide simultaneous development as the hybrid option because it starts prototyping after AoA approval and MCA entry. The fourth ranked option to manage performance risk was to utilize a different hybrid MTA rapid prototyping and MCA entry at Milestone C. This option lacks the same level of oversight and documentation during prototyping and bypasses EMD when entering the MCA pathway. The second worst option is to pursue MCA entry at Milestone C because it assumes the technology risk is reduced and

development is complete and ready for production. The worst option to manage performance risk is to utilize only MTA rapid prototyping and transition to rapid fielding because this option reduces oversight and documentation requirements to validate development is complete and assumes performance feature integration risk has been mitigated.

The third highest rated criterion was cost growth risk due to USN shipbuilding budgetary constraints and resource platform prioritization. The options were evaluated to determine the lowest costs to develop and produce a vessel and were not evaluated against unknown factors of future performance related rework costs due to limited development oversight and time. For the LSM to reduce program costs the least expensive option was to enter MCA at Milestone C because it does not contain development costs and only requires procurement funding. The second least expensive option was to pursue MTA rapid prototyping and rapid fielding because it does not require the same development oversight as an MCA program and when combined can reduce program start-to-finish timeline. The next best cost savings option was to utilize MTA rapid prototyping with entry to MCA at Milestone C. This option reduces development requirements and reviews, which could lower costs. The fourth best option is the other hybrid MTA rapid prototyping with transition to MCA at Milestone B because it provides opportunity to accelerate development risk reduction yet will cost more to move through MCA EMD phase. The fifth ranked option to reduce cost risk was MCA entry at Milestone B because it bypasses TMRR phase yet still will undergo development costs during EMD to mature the vessel for production. The lowest ranked cost factor was MCA entry at Milestone A because the program would spend longer time and resources in TMRR and EMD phases.

The fourth highest weighted criteria included program schedule risk and the alternative options were evaluated by the timeliness in developing and delivering vessels. The quickest option to reduce schedule risk is to enter MCA at Milestone C, which enables production to start. The second fastest option was determined to be MTA rapid prototyping and rapid fielding because after development is compete the production acceleration completes delivery within five years. The third quickest option was to use MTA rapid prototyping with entry to MCA at Milestone C. This option is like the

previous two but through development and MCA fielding the timeline is longer. The fourth ranked option was to use the hybrid MTA rapid prototyping with MCA entry at Milestone B. This option eliminates TMRR phase and simultaneously prototypes until the AoA is approved, which could reduce the follow-on EMD phase too. The fifth ranked option was to enter MCA at Milestone B because it bypassed TMRR phase yet did not benefit from MTA rapid prototyping prior to entry into EMD phase. The slowest option was to enter MCA at Milestone A due to the greater amount of time spent in TMRR phase compared to the other options.

The second least important weighted criteria were the technological risk because the vessel is designed to develop and integrate existing naval survivability features into a current commercial ship design. The highest ranked option was MCA entry at Milestone A since it provides the best risk reduction opportunity through early MCA entry into TMRR phase. The next best option was the hybrid MTA rapid prototyping with entry to MCA at Milestone B because the greater time spent in developing and reducing the risk the better integrated the technology will be with the platform. The third best option to reduce technological risk was to use MCA entry at Milestone B to enable prototyping and development after program documentation requirements and an assessment that technology risk has been reduced to enable MCA entry. This option does not provide simultaneous development as the hybrid option because it starts prototyping after AoA approval and MCA entry and could be prone to additional risks. The fourth ranked option to manage technological risk was to utilize a different hybrid MTA rapid prototyping and MCA entry at Milestone C. This option lacks the same level of oversight and documentation during prototyping and bypasses TMRR and EMD when entering the MCA pathway, so it does assume greater risk. The next worst option is to pursue MCA entry at Milestone C because it assumes the technology and development risks are reduced. The worst option to manage technological risk is to utilize only MTA rapid prototyping and transition to rapid fielding because this option reduces oversight and documentation requirements to validate reduction in technological risk.

The lowest weighted criteria measured was overall manufacturing risk with the distinguishing factor among the options being development effort and time to ensure quality management in production. The best option to reduce manufacturing risk was

enter MCA at Milestone A which enables the greatest amount of risk reduction and quality management. The next best options in rank order included hybrid MTA rapid prototyping with MCA entry at Milestone B, and MCA entry at Milestone B. These two options are similar with the hybrid option providing enhanced prototyping effort prior to EMD which could reduce the manufacturing risk. The next best options were MTA rapid prototyping with entry to MCA, and MTA rapid prototyping and rapid fielding because even though there is reduced oversight, reviews, and documentation requirements there is still an effort to further develop the vessel prior to production. Finally, entry to MCA at Milestone C provides the greatest manufacturing risk because it assumes all development is complete and quality management risk has been reduced to enter production.

3. LSM Design and Construction Contract Award and Management Decision Matrix Analysis

The third decision was to analyze the optimal number of shipbuilders to award design and construction contracts. Table 4 analyzed the three simplified producer options which included awarding to a single shipbuilder, awarding to multiple domestic shipbuilders, and awarding to multiple domestic and international shipbuilders. These options were derived from Appendices A and B where the USN LSM program office expressed openness during a 2020 LSM industry day to awarding manufacturing contracts to multiple shipbuilders, while preferring to use a single shipbuilder to produce the LSM. The third option provides an opportunity to use domestic shipbuilders, leverage the largest Indo-Pacific shipyards, and partner with Australia to produce a common littoral amphibious vessel as previously mentioned in the Stakeholder Analysis chapter. From Table 4 there were three acquisition pathway options evaluated against the six qualitative factors that had unweighted total scores ranging from 10.5 to 13.5 and weighted scores ranging from 37.5 to 47.5. The researcher analyzed each option against the individual criteria assigning each a quantitative ranking from 1 being the best option to 3 being the worst, with one criterion possessing a tie measured at 1.5. Through ranking each option against the criteria and using the weighted sensitivity analysis the decision to award design and construction contracts to multiple domestic shipbuilders was determined to be the best alternative option. In Table 4 the following analysis describes the reasoning for ranking each option against the weighted criteria.

Table 4. LSM Design and Construction Contract Award and Management Decision Matrix.

Design and Construction Contract Award and Management Decision Matrix								Option Scores (Lower is Better)	
		Risk Criteria						Unweighted	Weighted
		Cost	Schedule	Manufacturing	Program	Security	Industrial Base		
	Weighted Criteria	5	1	3	6	2	4		
Options	Single Shipbuilder	3	3	1	1	1	3	12	41
	Multiple Domestic Shipbuilders	2	1.5	2	2	2	1	10.5	37.5
	Multiple Domestic and International Shipbuilders	1	1.5	3	3	3	2	13.5	47.5

The highest weighted criteria included program risk measured against which option reduced uncertainties during construction and avoided unnecessary risks. The sole shipbuilder was the best option to reduce program risk because one producer is easier for the program office to coordinate and manage in comparison to multiple vendors. The next best option to reduce program risk was to utilize multiple domestic shipbuilders and was viewed as a better option in comparison to multiple domestic and international shipbuilders because of the geographic proximity of the firms. Awarding and managing domestic shipbuilders is less risky than awarding to overseas firms in different legal jurisdictions. Also, it would be easier to communicate and supervise production located domestically in comparison to a global supply chain.

The second highest weighted criteria included cost and it was determined that multiple domestic and international shipbuilders was the best option. The Yamada et al. (2019) article described the economies of scale Hyundai Heavy Industries achieved to propel the firm as the shipbuilding industry leader, which demonstrates the economic value achieved in partnering with global shipbuilders. Indo-Pacific shipbuilders produce the most vessels at a lower labor cost, so leveraging multiple international and domestic manufacturers would provide the lowest cost option. Next awarding multiple production contracts to various domestic shipbuilders would incentivize smaller and non-traditional manufacturers to compete for a share of the vessel construction. A higher number of producers in the marketplace will reduce the overall cost and provide competitive pricing options for the program office. The researcher determined that awarding the contract to a sole shipyard would be the costliest option due to the lack of other producers competing

for future contract award options. Market competition enables the LSM program to operate as a monopsony and ensure price competition for future contract negotiations.

The next most important weighted criterion was impact to the domestic industrial base. The option that provided the greatest impact to the U.S. shipbuilding industrial base is to award design and construction contracts to multiple domestic shipbuilders. More award opportunities create greater market competition, which helps stabilize and boost the domestic industrial base. The next best option was to award to multiple domestic and international shipbuilders because it still entices domestic competition to compete and spreads the procurement award between many different shipyards and regions. The disadvantage with the second option is splitting the award to international firms who offer more competitive pricing options due to reduced labor costs. The worst option to stimulate the industrial base is to award the LSM contract to one domestic shipbuilder because it will not provide an equivalent benefit across the domestic industry.

The next most important weighted criterion was manufacturing risk, and it was found that awarding production contract to a sole source shipbuilder would reduce quality management issues the best. A sole manufacturer is easier to coordinate with, provide contract administration actions, and supervise manufacturing quality. The next best option is to use multiple domestic shipbuilders, but it does increase program manufacturing risk due to the greater number of producers and shipyards to manage. Finally, the worst option to reduce manufacturing risk is to award to multiple domestic and international shipbuilders, for it elongates supply chains, reduces oversight ability, and challenges the program office to coordinate globally to manage various manufacturing contracts.

Another key criterion was the security risk to produce the vessels between the various options. The most secure and best option was determined to be to use a sole shipyard facility because it was located domestically and was easiest to ensure oversight. The next best option was to award to multiple domestic shipbuilders; however, the security risk increases with a greater number of facilities to supervise and protect. The worst option for production security is to use multiple domestic and international

shipbuilders because it exposes greater foreign espionage and sabotage risk, which can be difficult to safeguard while in production at international firms.

The researcher determined schedule criteria was the least important weighted criterion in comparison to the alternatives. The best options to manage schedule risk included multiple domestic shipbuilders as well as multiple international and domestic shipbuilders. Each of these options accelerates the schedule due to multiple shipyards providing greater production capacity and throughput. Using multiple shipbuilders enables the program office to better control schedule and balance program risk. The sole shipbuilder lacks production capacity in comparison to multiple similar-sized manufacturers.

After evaluating the options against the criteria, the unweighted lowest sum and best option was determined to be to award the contract to multiple domestic shipbuilders. This option consistently was ranked in the middle of the criteria and the other options skewed to either best or worst for each category. When the weighted multiplier is applied to the total scores the multiple domestic shipbuilder option remains the lowest score and best option. Accounting for the unweighted and weighted criteria the decision matrix provided a clear winner given the researchers criteria evaluation and applying a weighted criteria multiplier to reflect program acquisition priorities outlined throughout earlier section of the case study.

F. DECISION

Based on the researcher's definition and weighting of the decision criteria the researcher found that the best path forward to mitigate pending LSM AoA risk and still meet the warfighter requirements was to utilize the U.S. Army MSV-H program to procure MSV-Hs for the USN and USMC. The second decision matrix framed the best path forward using the researcher's weighted criteria to tailor and transition the LSM program and found the best option was to use a hybrid MTA rapid prototyping with entry into MCA at Milestone B. Additionally, the researcher's weighted criteria and definition in the third decision matrix determined the LSM production contract should expand to include multiple design and construction contract awards to various domestic shipbuilders. These three decisions were achieved by using a decision matrix to evaluate

alternative options against unweighted and weighted program management criteria. These decisions are justified through case study analysis and provide the LSM program the best solution to deliver capability to the warfighter.

G. IMPLEMENTATION

To implement these decisions the program office will need to initiate the planning process with the U.S. Army to register an additional vessel requirement in the MSV-H program. To fund the vessels the USN will need to plan, program, and budget for the new ship acquisitions. Through USN coordination the U.S. Army program office will need to adjust their MSV-H fielding plan to factor in additional deliveries. If the LSM program is still pursued as an independent acquisition, then the program office will need to apply for MTA rapid prototyping path and plan for transition to MCA EMD phase after receiving AoA approval. This transition requires approval prior from the Milestone Decision Authority to deviate from the MCA pathway and AoA approval from OSD to validate that the LSM is a unique requirement justifying procurement resourcing. Additionally, multiple shipbuilder construction contract awards implementation requires increasing industry awareness on the expanded contract opportunity. To raise multiple award awareness the program office could communicate with shipbuilders identified in this case study who previously expressed interest or possess capability to manufacture the LSM.

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VI. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

This final section reexamines the research questions and summarizes the answers, delivers conclusions, and provides recommendations for the acquisition strategy along with recommendations independent from the primary research and analysis.

A. SUMMARY

The LSM faces acquisition strategy challenges related to cost, schedule, performance, and manufacturing risks, which this research attempted to identify, analyze, and solve. The following primary and secondary research questions are restated along with corresponding summarized solutions.

1. Primary Research Questions with Solutions

The primary research questions are: How can the LSM acquisition team manage program risk despite schedule delays and a limited shipbuilding budget? Additionally, what acquisition pathways and capability trade-offs are best suited to reduce program costs?

The researcher's analysis found the best path forward to manage risk amidst schedule delays and a limited shipbuilding budget was to tailor and transition the LSM program to use a hybrid MTA rapid prototyping with MCA entry at Milestone B path forward. Additionally, the secondary follow-on decision determined validity to award multiple design and construction contracts to various domestic shipbuilders. Using decision matrices based on the best alternative options evaluated against weighted program cost, schedule, performance, manufacturing, technological, and program risk produced determinations to use a hybrid MTA and MCA pathway with construction award to multiple shipbuilders to reduce risk in developing and delivering the LSM. The analysis justification to use a hybrid MTA rapid prototyping and enter MCA at Milestone B path as well as multiple vendors to field the LSM was primarily based on the stakeholder desire to tailor the program to meet the unique performance requirements, cost constraints, and overall mitigate program risks. Performance risk refers to additional vessel features and modifications which are additional costs and require further testing

and development to mitigate risk. Manufacturing risk tradeoff denotes the necessity to award construction contracts to multiple shipbuilders to alleviate further schedule delays by increasing manufacturing capacity and throughput. The risk in using multiple manufacturers impacts production quality management, ability to ensure oversight, more production security concerns, and difficulty administering contract management. The researcher found these risk tradeoffs were acceptable given the determined acquisition path forward focus on reducing development risk.

2. Secondary Research Questions with Solutions

The secondary research questions are: Is it feasible to increase commercial shipbuilding interest and participation by soliciting and awarding various multi-year procurement contracts to different shipbuilders? How many shipbuilders are required to reduce the risk of schedule delays and produce 35 ships quickly to meet the USMC requirement?

The current USN 5-year shipbuilding plan outlines only six LSMs programmed into the procurement budget between FY2024–2028 with delivery time to the fleet bypassing 2030. Six LSMs delivered in five consecutive FYs does not meet the minimum requirement of nine vessels to equip an MLR with amphibious transport capability. The LSM rate of production and budgetary programming must increase to meet the warfighter requirement before the vessel's utility subsides and alternative, lesser-capability solutions are sought by the USMC (e.g., leasing commercial stern landing vessels). The current shipbuilding plan is for one shipyard to produce the LSM, and after the first two units, the rate of production increases to two ships per fiscal year. At this rate, it will take 11 fiscal years to award 18 LSM procurement contracts, and fully operational capability will not occur until nearly 2040. The first LSMs built will be nearing their 20-year life cycle by the time the fleet is fully operational, which would require a constant churn of new units to replace the old fleet or lengthy depot maintenance to extend the lifespan of the earlier models. With depot maintenance shipyards already at capacity repairing vessels, it is unlikely the LSM would be prioritized over other warships, so life-cycle maintenance and fleet readiness will be a high-risk concern given the current extended production cycle. If the single shipyard manufacturing the 18 LSMs can scale production to the USN-

requested four vessels per FY, this will halve production timelines, yet it will not deliver complete value until, optimistically, the mid-2030s. With a reduced number of LSMs and extended production schedule, the LSM program will be close to 20 years in operation before delivering the USN minimum fleet. This report has found over 12 capable shipbuilders and 8 manufacturers who have already expressed interest by participating in the LSM concept design solicitation. Recompeting the production solicitation contracts to the eligible pool of manufacturers should yield multiple acceptable proposals to award multiple shipyard contracts. Using multiple shipbuilders is a necessary risk acceptance when trying to achieve an accelerated production schedule and deliver value to the warfighter before 2030.

B. CONCLUSIONS

The research implications of this project include providing stakeholders with viable acquisition strategy and path forward recommendations supported by case study research and analysis. As of this projects completion the LSM program is in development and construction contracts will not be awarded for another year. Senior leaders and stakeholders could use information and analysis gained from this report to tailor and combine the LSM program pathways to best manage cost, schedule, performance, and manufacturing risks. An additional research outcome discovered other armed services with programs building similar medium sized amphibious ships and there exists an opportunity to develop compatible systems to provide the warfighters with a universal sea transportation option.

C. RECOMMENDATIONS

To rapidly meet the USMC's requirement for new amphibious ships by 2030, the following acquisition strategy recommendation is derived from case study analysis and research to provide the LSM program the best path forward. Additionally, this section contains recommendations for future research that are independent from the primary acquisition strategy recommendation and research conducted to support this study.

1. Pursue a Hybrid Path: MTA and Enter MCA at Milestone B

The DoD faces an enduring challenge to deliver state-of-the-art capabilities; however, traditional MCA strategies fall short in procuring commercially innovative solutions in a timely manner. The adaptive acquisition framework MTA rapid prototyping pathway leverages proven technologies to expedite the delivery of new or upgraded systems (Oakley et al., 2023a). The LSM is essentially an updated World War II-era LST vessel with similar commercial designs currently being produced across many U.S. and international shipyards. The May 17, 2023, USN request for information displayed an interest in manufacturing at least four ships per year, which meets the USN's stated goal to produce 18–35 LSMs in less than 5 years, which is accelerated in comparison to other ship classes.

A solution to reduce LSM program performance risk is to increase prototyping and development pace by adopting the MTA pathway until the AoA is approved and the program can transition to MCA EMD phase. This gives the program a head start on development until the business case is approved and requirements are solidified. This is a strategy the USN has expressed interest in at its 2020 industry day and through the 2023 request for information. The 2019 adaptive acquisition framework provides greater program management flexibility to develop programs based on commercial solution availability and proven technology maturation. The MTA pathway is meant for programs that have a level of maturity that enables them to be rapidly prototyped or fielded within 2 to 5 years of program start (Office of the Under Secretary of Defense for Acquisition and Sustainment, 2019). As of 2023, the LSM program is already in its fourth year of existence and has spent considerable time refining requirements and developing naval concept designs based on available commercial ship vessels, but the AoA has not yet been approved to enable MCA program progression. The LSM would benefit from applying MTA to prototype until the AoA is approved and the program can transition to MCA to further reduce program risk prior to production. The LSM should adopt the MTA pathway to accelerate rapid prototyping in the AoA approval interim to deliver fully developed capability to the fleet. Using the MTA rapid prototyping pathway to accelerate the stalled program would enable the LSM program to quickly transition to MCA path and complete EMD oversight reviews to best reduce program, performance,

and cost risks. After completing MTA rapid prototyping, the program office can transition back to the MCA pathway to ensure oversight and development validation reviews prior to starting production. Figure 12 displays the Adaptive Acquisition Framework Pathways, which enables programs to tailor acquisition schedule based on urgency of need, risk tolerance, and type of product or service acquired.

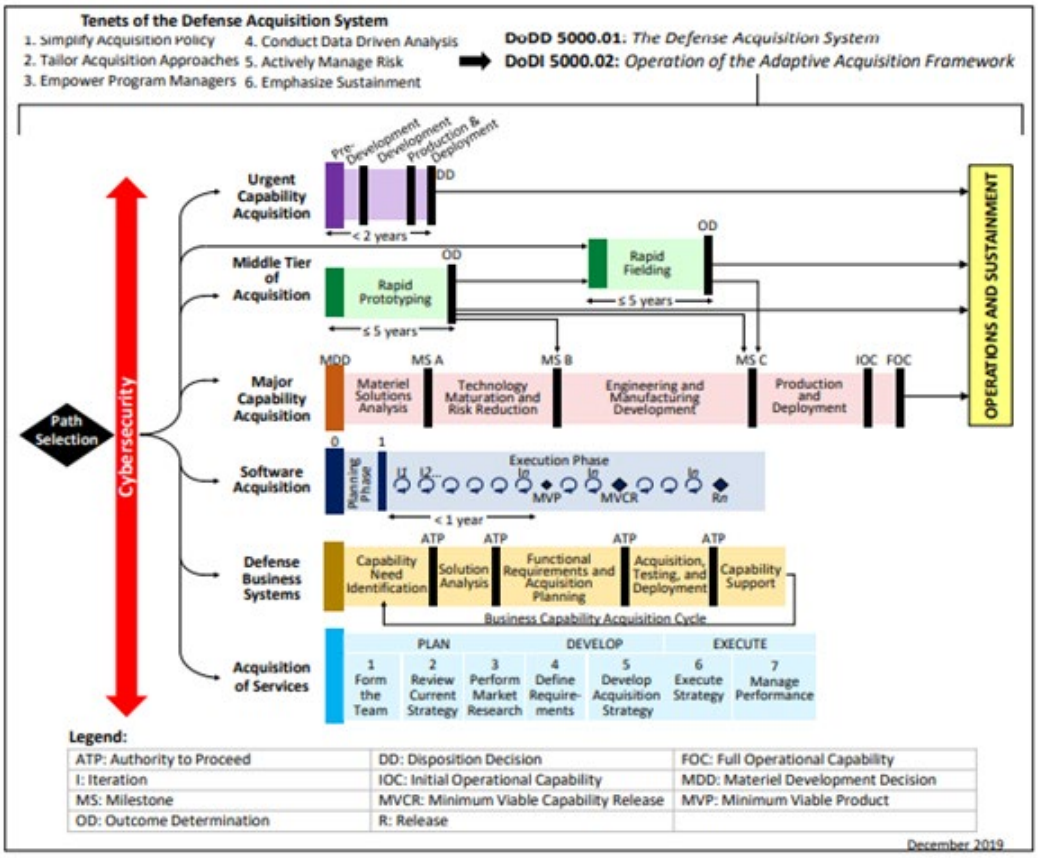

Figure 12. Adaptive Acquisition Framework Pathways. Source: Office of the Under Secretary of Defense for Acquisition and Sustainment (2019).

Rapid prototyping creates flexibility for the matured LSM designs to transition and enter MCA EMD phase to further reduce development risk before production. The MTA pathway could tailor the LSM program to rapidly prototype and advance development without falling further behind in the planned delivery schedule until business case documentation is completed. The DoD Inspector General (2021) found that MTA pathways have increased the efficiency and effectiveness of technologically mature programs, which has reduced acquisition speed by eliminating traditional MCA processes and documentation while balancing risk by applying common sense and sound business

management oversight. Emphasizing a robust business case foundation, MTA policies advocate for iterative design methodologies, timely scheduling with capabilities off-ramping if necessitated, and incorporation of user feedback (Oakley et al., 2023a). Additionally, the Government Accountability Office identified several principles MTA programs need to adopt, including attaining a sound business case, using iterative design approach, prioritizing the program schedule by off-ramping excessive capabilities when necessary, and maintaining warfighter feedback and communication to deliver a valuable product.

D. RECOMMENDED AREAS FOR FUTURE RESEARCH

The following recommendations are independent of the primary research conducted and are areas that could be examined in further research projects. The following recommended areas for future research were derived from discovering independent service acquisition programs with similar requirements and development timeline as the LSM. Additionally, the researcher identified contract negotiation and pricing research opportunities to explore whether the LSM program could utilize them to reduce inflated shipbuilding costs to pay fair market price for the vessels. Also, future research could examine the feasibility of implementing learning curve theory to the specific LSM production. Finally, manpower projects could analyze the increased manning requirement to crew the LSM and impact to USN manpower staffing goals.

1. LSM and MSV-H Integration into a Joint Program Office

This area of future research could explore whether the USN LSM and Army MSV-H programs should integrate into a joint program office to produce a universal, modern LST. Each service is independently developing a similar vessel to meet a joint capability gap for a small littoral transport ship. Combining resources, design and technology maturation, and greater congressional oversight and accountability can assist with aligning the acquisition force to develop a sound and complete business case on a joint medium landing craft vessel that can provide maximum value for the warfighter while managing program risk against cost, performance, and schedule. Congress is requesting the services to formally evaluate and report program integration utility, which

demonstrates a stakeholder desire for greater accountability over siloed acquisition programs satisfying the same requirement.

Further, the Government Accountability Office has consistently found accountability issues, with the majority of MDAPs analyzed utilizing rapid acquisition pathways because streamlined MTA programs lack sufficient oversight to identify missing business case documents and adequately manage risk (Oakley, 2021). Inadequate business cases contribute to poor cost estimates and cost overruns, delayed schedules, and the necessity to trade-off system features. A good MTA business case will consist of an approved requirements document, approved acquisition strategy, formal assessment of technology risk, formal assessment of schedule risk, and an independently assessed cost estimate (Oakley, 2021). Currently, the LSM lacks a sufficient business case due to variance in what constitutes the minimum viable product requirements, a pending AoA, a schedule delayed over 19 months, and an increased probability that survivability and defense features may require trade-off to produce adequate quantities due to varied cost estimates. The Army MSV-L program is similarly lacking a sound business case due to the stated need to re-baseline the program to accommodate design and cost overrun challenges. A joint light amphibious connector could raise the siloed programs to enhanced importance and oversight from senior DoD acquisition leaders and Congress to mandate the joint program while in its planning stage to develop a sound and complete business case.

Figure 13 displays 6 MTA programs with incomplete business documents, which unnecessarily increases program risk.

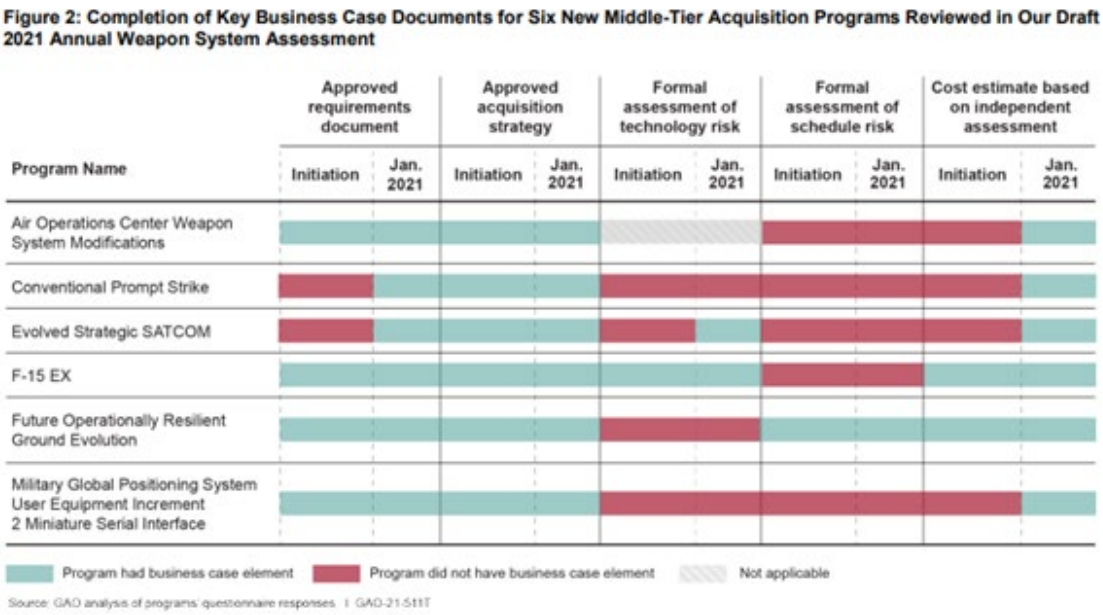

Figure 13. MTA Programs' Missing Business Case Documents. Source: Oakley (2021, p. 16).

Additionally, a joint program office could provide incentive for shipbuilders and industry to compete for a share of the consolidated joint vessel program, which boosts non-traditional defense business interest, delivers a fair market price due to a greater number of producers, and stimulates the defense industrial base capacity through additional naval program investment to compete for the contracts. Another recommendation aligned with creating a joint program office is to engage and share concept design information with Australia to mature American LSM and Australian LMV technology and reduce program risk between allies (Hooper, 2023b). Australia's LMV concept resembles the LSM vessel design, and producing a joint, modern LST between nations could enhance international shipyard capacity to produce the ships quickly and provide important life-cycle sustainment capabilities within the INDOPACOM theater. Sharing information and production capacities between nations could facilitate expansion of the AUKUS nuclear submarine agreement to include LSM–LMV ships and further relations between the two countries' militaries. Leveraging international ally acquisition relationships further opens production capacity to global shipyard markets for production and maintenance activities (e.g., the international leader South Korean Hyundai Heavy Industries shipyards).

2. Contract Management Incentives

Additionally, future research could investigate contract methods to incentivize industry to compete for and produce the LSM. Specifically, whether it can be achieved through multiple vendor awards for a minimum indefinite delivery, indefinite quantity (IDIQ) ship production with an options clause for additional ship awards based on contractors' ability to meet performance, cost, and schedule metrics. After down-selecting LSM and MSV-H concept and preliminary design reviews to one final vessel design, the joint program office should compete the production contract and keep the solicitation open for an extended period to expand the request for proposal threshold beyond large defense contractors and reach a wider number of shipyards. This case study project found at least 12 capable American shipbuilders that have shown interest in the LSM program or have built ships for the USN or USCG. Most of these manufacturers that have shown interest in the LSM have participated in the LSM concept design solicitation, have built commercial offshore supply vessels and landing craft, and would benefit from increased government business. Extending the proposal solicitation window allows firms more time to communicate and clarify requirements with government contracting officers and respond with well-developed and quality proposals, which could lead to a greater number of proposals that meet minimum cost, schedule, and performance requirements.

Secondly, awarding IDIQ contracts to multiple prime shipbuilders provides the government privity with the prime contractor to better manage program management cost, schedule, and performance risk on a fast-paced MTA pathway. Federal Acquisition Regulation Part 52.216-27 (2023) states that "The Government may elect to award a single delivery order contract or task order contract or to award multiple delivery order contracts or task order contracts for the same or similar supplies or services to two or more sources under this solicitation." The Defense Acquisition University (DAU; n.d.) further expands upon IDIQ multiple award contracts by stating that when there is a new requirement, all multiple award contract awardees are requested to submit proposals for equal consideration. The multiple award contract provides the government with a qualified base of shipbuilders to demonstrate competency to meet cost, schedule, and

performance metrics without the risk of committing to a protracted contract and while better managing performance risk by maintaining privity with prime contractors.

Successful prime contractors will be eligible for additional contract awards, and unsuccessful shipbuilders will only absorb a small fraction of the total ship allocation and be ineligible for future IDIQ awards. The DAU (2023) references ship procurements as one of the common IDIQ multiple award applications. The pros of this type of contract include the ability to create distinctive contract terms and conditions, which enhances flexibility (DAU, 2023). Additionally, IDIQ allows for additional competition and maintains market price equilibrium for each contract iteration price. Also, the IDIQ contract creates a fairly competed contractor base, which can be accessed if the need ever arises to produce a greater number of ships to replace or augment the fleet. There are also cons to IDIQ contracts, including the increased burden to manage and integrate multiple vendors with a joint program office, which increases award and evaluation lead time for each iteration. Also, IDIQ contracts increase contract management administrative costs and the complexity of providing oversight (DAU, 2023). To incentivize shipbuilders, these IDIQ awards could be structured as cost-plus incentive fee contracts, which ensure that the firms remain profitable, as costs incurred are reimbursed and the risk is transferred in part towards the government. Firms without long-term, stable government shipbuilding contracts may view IDIQ as a risky investment proposition; however, a cost-plus incentive fee contract should demonstrate the government's commitment to quality producers.

3. Apply Learning Curve to Achieve Cost Savings

Another interesting area for future research includes the feasibility to apply learning curve theory to LSM shipbuilding. The use of multiple vendors and certified pricing through cost-plus contracts, thereby reimbursing the contractors in developing the first few vessels, could provide the program office with visibility on actual materials, labor, facilities, and overhead production costs. Using various vendor information on producing the same vessel design enables the program office to analyze and develop a process improvement learning curve, which logarithmically calculates, and graphs production cost efficiencies gained from manufacturing repetition. The learning curve

concept was developed in 1936 for aircraft production, and mathematically demonstrated unit production timelines decreased for each repetitive manufacturing iteration (Gies, 2022, p. 128). Efficiencies in streamlined manufacturing processes and time to produce each unit correlate to an increased profit margin for the producer because their labor, time, and material costs decrease. For the LSM, there is merit to investigate how unit curve theory could apply because the shipbuilders have experience building vessels, are fully tooled, and will possess a universal design without further modification, so process repetition can be achieved. Each vessel award option is an opportunity to use unit curve theory to renegotiate future IDIQ orders using firm fixed price contracts with an incentive fee for meeting schedule and performance metrics, while transferring production cost risk back to the shipbuilder. The production information from each previous unit shapes the cost estimate for future ships because as the total volume of units produced doubles, the cost per unit decreases by the same constant percentage (Sokri & Ghanmi, 2017). This constant percentage decrease in cost is referred to as the rate of learning. Shipbuilders can consistently improve manufacturing efficiency by advancing job familiarization, improving production procedures, maintaining tooling set-up and workflow for each successive unit, and having product producibility, engineering support, and supply chain parts supply support in place. By capturing each vessel construction iteration of cost-reimbursable materials, labor, and overhead costs, the acquisition team can calculate a per-unit production efficiency improvement and graphically depict the learning curve slope for each successive vessel produced. This future production efficiency analysis can be used during the next iteration of IDIQ contract negotiations with the shipbuilders to demonstrate that manufacturing costs will decrease with each unit, so the government will pay less per ship to match the rate of learning. It is worth investigating whether using the learning curve method and analysis, the acquisition team can lower total program acquisition costs with each additional LSM procured.

4. Naval Manpower Shortfalls

Future projects could investigate naval manpower management impacts by fielding the LSM and degradation amidst a recruiting and retention shortfalls across other platform manning, specifically in the junior surface warfare officer cohort. Additionally,

manpower projects could review the potential positive career impacts of junior officers assuming LSM command ahead of peers serving as department heads aboard larger vessels and if this platform, with its dispersed autonomy, could be incentivized for senior leaders to only assign the best junior officers as LSM ship captains.

APPENDIX A. EXCERPTS: NAVSEA LAW INDUSTRY DAY BRIEF

Source: System for Award Management (2020A).

Light Amphibious Warship (LAW) Industry Day 2

9 April 2020

DISTRIBUTIONSTATEMENTA. Approved for public release. Distribution is unlimited. 1

What will LAW be?

LAW Primary Function: Force maneuver and force closure, including operating into small, undeveloped ports and beaches.

LAW Secondary Function: May include force sustainment, logistics and reconnaissance.

Intended to be capable of:

- Beaching on sand, gravel, shale, small stone, and man-made marine ramps.
- Supporting on/offload of all existing USMC Rolling Stock invintory to beach areas with fording depths of less than 42”
- Operating at 14 knots for a minimum of 3500 nm
- Transiting open ocean up to Sea State 5 while fully loaded
- Enduring up to several weeks-long deployments and trans-oceanic transits
- Operating within fleet groups, or deploy independently

What will LAW be?

Intended to be capable of:

- Beaching on sand, gravel, shale, small stone, and man-made marine ramps.
- Supporting on/offload of all existing USMC Rolling Stock PORs to beach areas with gradients of 1:40 or steeper, and fording depths of 42" or less
- Operating at 14 knots for a minimum of 3500 nm
- Transiting open ocean up to Sea State 5 while fully loaded
- Enduring up to several weeks-long deployments and trans-oceanic transits
- Operating within fleet groups, or deploy independently

Key Program Assumptions

The **Navy**...

- **Expects notional procurement profile to be 3/6/10/9 starting in FY23**
- **Expects to leverage Industry's commercial design with few tailored Navy requirements to meet mission**
  - Adapted Commercial Design
  - Alter Commercial Design
  - Build to Print with Historic Design
- **Desires to drive down life cycle costs:**
  - The crew manning requirement identified is the maximum acceptable manning value
    - Further reductions through technology are encouraged

LAW Industry 1 Day Recap/Update

Key Program Assumptions

The **Navy**…

- **Anticipates a 6-8 month Detail Design and 24 month production Duration**
- **Will choose between one of the 3 COAs**
  - Adapted Commercial Design
  - Alter Commercial Design
  - Build to Print with Historic Design
- **Expects to leverage Industry's commercial design with few tailored Navy requirements to meet mission**
- **Desires to drive down life cycle costs:**
  - The crew manning requirement identified is the maximum acceptable manning value
    - Further reductions through technology is encouraged

LAW Industry Day 1 Recap/Update

Key LAW Attributes

The **Navy** considers the following attributes to be the acceptable levels :

	Attributes		Min	Max
	Cargo Area	8000 sqft	✓	
	Deck Loading	450 lb/sqft	✓	
	Service Life	10years	✓	
	Transit Speed	14 kts	✓	
	Manning Accommodations	40 Navy crew 75 Marine	✓	✓
	Range (Minimum operating range at transit speed w/ 10% fuel reserve)	3500 NM	✓	
	Crane (boat and cargo)	13 tons	✓	
	Cargo Fuel	90,000 gal	✓	✓
	Overall length	200 ft	✓	

LAW Industry Day 1 Recap/Update

Objectives of the RFI

The **Navy** desires to:

- **Understand Industry's parent designs and their ability to meet the minimum attributes provided in this brief**
- **Understand the sensitivities/drivers to the parent design when modified to meet minimum attributes**
- **Understand Industry's existing production capacity/ capability, and/or ability to partner to meet desired quantities in the required timeframe**
- **Understand any additional drivers to non-recurring engineering, production, and operating/support costs**
- **Evaluate information obtained from RFI for possible follow on Preliminary Design effort in late FY20/early FY21**

LAW Industry Day 1 Recap/Update

Information Requested

The **Navy** requested that interested parties:

- **Identify specific attributes for which the minimum attributes can be exceeded for minimal cost increases**
- **Identify any specific attribute that is either a significant cost driver, and/or drives a significant design change**
  - With a description of the issue and preferred alteration, including the NRE ROM cost
- **Identify any tradeoffs necessary to meet or exceed attributes**
  - Including production and cost impacts
  - If tradeoffs are required, vendors are encouraged to prioritize based on cost and production schedule impact

The **Navy request White Paper Information of ship designs w/attributes be submitted**

APPENDIX B. NAVSEA LAW INDUSTRY DAY Q&A

Source: System for Award Management (2020a).

LAW Industry Day 04 MARCH General Session Q & A

Q: Has the Government considered a Commercial design for a contested environment? Will the government take a design and militarize them?

A: Yes, this can be part of the preliminary design process. Regarding shock qualification, we do not envision making every system or item shock (901E) qualified. However, the Government may choose to invoke shock qualification for certain critical components (bow or stern ramp as examples).

Q: Do we need to have a vital generator or shock qualified generator?

A: Yes, but there is trade space here. We need LAW to be able to conduct its mission in a contested environment and that may mean vital power to the generator, but not necessarily, "shock qualified."

Q: Are there specs listed for the ramp?

A: Not at this time, we are still working through ramp requirements. Offloading USMC Rolling Stock quickly to meet mission is priority. Beaching as quickly as possible is a NON negotiable requirement.

Q: Is the Navy looking for commercial damage stability (ie: one compartment flooding) or Navy Damage Stability (ie: 2 compartment flooding criteria)?

A: This is an area of future Industry Studies the Government is contemplating that would seek Industry input on commercial- 1 compartment stability vs. 2 compartment. This requirement is still in the Government's trade space as we look at designs and cost.

Q: Does the Government envision the Program getting down to competitors bidding on one design with Navy team or systems specifications or is the expectation for Industry to build to Government specifications and requirements?

A: The Government intends for Industry to perform the preliminary/contract design and provide the Navy input on the cost drivers and producibility of the proposed specifications and requirements. The Navy views this collaborative approach to technical specifications as the best balance between cost, schedule, and capability.

Q: Has the Government considered Multiple Award Designs?

A: Yes, the acquisition approach the Government intends to follow will award multiple preliminary design efforts to support robust competition for Detailed Design and Construction. The Government is also considering non-traditional acquisition strategies such as Middle Tier Acquisition (Rapid Prototyping, Rapid Fielding). The top Government priorities are affordability and fielding the capability as quickly as possible, therefore Industry is encouraged to propose teaming ideas or acquisition strategies in their RFI white paper responses that further these goals.

Q: Is the Government considering awarding a design contract to multiple shipbuilders?

A: Yes, the acquisition approach the Government intends to follow will award multiple preliminary design efforts to support robust competition for Detailed Design and Construction. The Government is also considering non-traditional acquisition strategies such as Middle Tier Acquisition (Rapid Prototyping, Rapid Fielding). The top Government priorities are affordability and fielding the capability as quickly as possible, therefore Industry is encouraged to propose teaming ideas or acquisition strategies in their RFI white paper responses that further these goals.

Q: To help with cost analysis, is there any way you can share the intended Government Furnished Material with Industry?

A: The Government intends to have a very limited amount of GFM: a small communications suite made up from existing programs of record (similar to a MK 6 Patrol boat), a 25mm or 30mm gun system, Global Positioning System (GPS), Identification Friend or Foe (IFF), Automatic Identification System (AIS) and crew served weapons (e.g. .50 caliber machine guns).

Q: Has the Government discussed providing other major equipment (ie: shafts, props, etc.) as GFE?

A: No, the Navy is only considering C4I and weapon systems at this time.

Q: Is the Government considering all construction materials (e.g., steel, aluminum)?

A: The Government does not intend to limit the material the vessels are constructed with, however the material selected must meet the design requirements including the mandatory ability to withstand beaching the vessel (i.e single point offload to the beach).

Q: What is the required beach gradient for LAW?

A: The minimum beach gradient requirement is 1:40. Please include in RFI response the beach gradient your vessel is designed to.

Q: Is the LAW required to stern beach?

A: The Government is not dictating whether the vessel beaches by the bow or stern, only that it must be capable of single point offload to the beach (i.e., offloads without additional infrastructure such as piers or lighterage).

Q: Does the LAW require drive-through potential?

A: No, the LAW is a shore-to-shore vessel, but additional design features such as this that increase capability will be given consideration if the Navy ultimately chooses a best-value acquisition.

Q: Does LAW require a well deck?

A: No, LAW will not have a well deck. Open deck stowage is desirable/preferred.

Q: What military onload/offload requirements must be accommodated?

A: Must be capable of onload/offload of all existing USMC Rolling Stock inventory (except M1A1 Abrams tanks), including Medium Tactical Vehicle Replacement (MTVR), RT240 (Rough Terrain Container Handler) carrying a 20-foot TEU, and 11m RHIB on trailer.

Q: Is there a maximum draft requirement for LAW?

A: Yes, the maximum draft requirement is 12 feet.

Q: Is there a requirement for weapons and armament?

A: Yes, two MK 46 (30mm GWS) with control station and gun mounts which can hold pintles for common crew served weapon systems in order to provide 360 degree defense.

Q: Will the weapons be GFE?

A: Yes.

Q: What's the concept for reloading - across the beach or resupply at sea?

A: Shore to shore is the primary requirement, but additional design features (such as the ability to resupply at sea) that increase capability will be given consideration if the Navy ultimately chooses a best-value acquisition.

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