NPS-LM-25-290

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Contested Logistics Engineering of ShinMaywa US-2 in Support of DMO

December 2024

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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

This study critically examines the integration of the ShinMaywa US-2 amphibious aircraft into the United States Navy's Pacific Fleet (PACFLT) as a solution to the logistical and operational challenges posed by the Indo-Pacific's dynamic maritime environment. Utilizing the DOTmLPF-P framework, the research systematically evaluates the doctrinal, organizational, training, materiel, leadership, personnel, facilities, and policy dimensions necessary for the successful incorporation of this platform into Distributed Maritime Operations (DMO). By analyzing historical precedents, such as the PBY Catalina's role in World War II, and addressing contemporary procurement and operational challenges, the study demonstrates how the US-2 can fill critical capability gaps while enhancing logistical flexibility, operational reach, and multinational interoperability. The research provides a comprehensive assessment of supply chain readiness, personnel training, infrastructure requirements, and political considerations, emphasizing the necessity of structured integration planning. This paper advances actionable recommendations for leveraging the DOTmLPF-P framework to align the US-2's unique capabilities with the strategic imperatives of PACFLT, thereby addressing immediate operational needs and informing future amphibious platform development.

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ACKNOWLEDGMENTS

Thank you to ADML Paparo, CAPT Kalp, CAPT Cormier, and your staff at PACFLT for trusting us to take on research of this caliber. We understand the significance of something this important to accomplish the mission.

Also thank you to Mr. Raymond Jones, Mr. Keith Hirschman, and Dr. Geraldo Ferrer for your guidance throughout this journey. Your guidance helped this research take shape in a way that would not have been possible without you.

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LIST OF ACRONYMS AND ABBREVIATIONS

AOR	Area of Responsibility
ASW	Anti-Submarine Warfare
C2	Command and Control
CJCSI	Chairman of the Joint Chiefs of Staff Instruction
COD	Carrier Onboard Delivery
CSAR	Combat Search and Rescue
DARPA	Defense Advanced Research Projects Agency
DLR	Depot Level Repairable
DMO	Distributed Maritime Operations
EABO	Expeditionary Advanced Base Operations
FAR	Federal Acquisition Regulation
FMS	Foreign Military Sales
FOB	Forward Operating Base
GSE	Ground Support Equipment
IBR	Integrated Baseline Review
ISR	Intelligence, Surveillance, and Reconnaissance
JMSDF	Japan Maritime Self-Defense Force
KPI	Key Performance Indicator
MDA	Milestone Decision Authority
NOC	Naval Operations Concept
PACFLT	Pacific Fleet
PERT	Program Evaluation and Review Technique
PM	Project Manager
R&D	Research and Development
SAR	Search and Rescue
SME	Subject Matter Expert

TRL	Technology Readiness Level
US-2	ShinMaywa US-2 (Japanese amphibious aircraft)
VRC	Fleet Logistics Support
VRM	Fleet Logistics Multi-Mission
WWII	World War II

I. INTRODUCTION AND OVERVIEW

A. INTRODUCTION

The United States military faces an increasingly complex challenge in the Indo-Pacific region as China's amphibious fleet expands and the geographical operating area becomes more intricate. The vast geographical scope and operational complexity of this region, combined with the strategic importance of maritime dominance, demand a shift in U.S. military strategy. Traditional Naval support, such as supply ships and MH-60S helicopters, are increasingly questioned for operations in contested environments, particularly when operating across vast oceanic expanses and dispersed areas (Bengigi et al., 2020). As a result, there is a pressing need for more agile and suitable platforms for the problems the U.S. Navy faces. Amphibious aircraft, capable of rapid deployment and broad operational range, present a promising solution to these challenges (Mills & Phillips-Devine, 2020).

This study explores the feasibility and strategic advantages of reintroducing amphibious aircraft into the U.S. Navy's fleet, specifically in support of Distributed Maritime Operations (DMO) in the Indo-Pacific region. By applying the doctrine, organization, training, material, leadership and education, personnel, facilities, and policy (DOTmLPF-P) framework, this research studies the integration of an aircraft with capabilities similar to the Japanese ShinMaywa US-2. This analysis covers logistical, operational, and political implications, providing a broader understanding of how such a platform could enhance U.S. military strategies in the Indo-Pacific.

For the purposes of this study, the DOTmLPF-P framework guides the comprehensive evaluation of the US-2's potential to support U.S. combat operations. The DOTmLPF-P involves coordinating operations, preparing training programs, allocating resources, identifying manpower requirements, assessing facilities, and evaluating international procurement policies. By examining historical uses of amphibious aircraft such as the PBY Catalina, the study also anticipates potential challenges and advantages associated with integrating modern amphibious platforms in the Indo-Pacific area of responsibility (AOR).

It is important to note that the success of this integration will depend on more than just technical and operational assessments. The political environment, including competing funding priorities and congressional concerns, will play a crucial role. This study aims to validate the need for amphibious aircraft and facilitate informed decision-making by providing decision-makers with comprehensive insights into these aspects.

B. BACKGROUND

The Indo-Pacific region has become a primary focus for the U.S. military. China's growing military capabilities, particularly its amphibious fleet, present significant challenges to regional stability. In this contested environment, current maritime assets may struggle to meet the operational demands necessary to maintain U.S. naval superiority.

Amphibious aircraft were crucial assets during World War II and more than proved their value in naval operations. The PBY Catalina, for example, was an essential platform for the U.S. Navy in the Pacific theater and was known for its durability and ability to operate in remote locations (Dorny, 2013). Despite the PBY Catalina's historical significance, amphibious aircraft were phased out after World War II as newer platforms replaced them.

Recently, the ShinMaywa US-2, a Japanese amphibious aircraft, has emerged as a viable option for enhancing the U.S. Navy's capabilities in the Indo-Pacific (Martin et al., 2023). Its unique features—such as the ability to operate in contested environments, adapt to different locations, and conduct rapid search and rescue, resupply, and redistribution missions—make it well-suited for supporting DMO and filling a current capability gap.

While integrating a foreign-developed aircraft such as the US-2 into the U.S. Navy fleet presents numerous operational benefits, it also poses challenges. A thorough analysis using the DOTmLPF-P framework will help determine whether this aircraft can effectively and efficiently meet the U.S. Navy's operational requirements. Furthermore, political factors, including congressional concerns and potential funding competition, must be addressed to ensure successful integration.

C. PURPOSE

This study examines the logistical requirements of integrating an aircraft with capabilities similar to the ShinMaywa US-2 into the U.S. Navy fleet. Specifically, the evidence assesses how such integration can support Pacific Fleet (PACFLT) DMO by applying the DOTmLPF-P framework. In addition, it examines the historical use of amphibious aircraft by U.S. and Japanese naval forces and explores potential political barriers to the acquisition process.

D. RESEARCH QUESTIONS

These primary research questions address the main aspects of the research proposal, including the need for a faster and more adaptable method of search and rescue, resupplying, and redistributing within a contested theater. The DOTmLPF-P framework is applied to address the logistical requirements of integration within the fleet.

1. What are the specific requirements and needs for integrating an aircraft with similar features to the ShinMaywa US-2 into the U.S. Navy fleet to support PACFLT DMO in the Indo-Pacific region?

2. How can the DOTmLPF-P framework be utilized to assess the potential enhancement of combat strategies through the integration of the US-2 aircraft?

3. What lessons can be learned from the historical uses of amphibious aircraft, such as the PBY Catalina, by U.S. and Japanese naval forces during World War II, and how can these lessons be applied to the current challenges faced with the integration of amphibious aircraft into the Indo-Pacific region?

4. What are the potential political barriers and congressional concerns that may impact the acquisition process of integrating an aircraft like the ShinMaywa US-2 into the U.S. Navy fleet, and how can decision-makers be provided with comprehensive insights to validate the need for this specific capability?

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II. RESEARCH METHODOLOGY

A. SCOPE

This study explores whether the ShinMaywa US-2 amphibious aircraft could effectively join the U.S. Navy's fleet. Using qualitative research methods and drawing from public sources, this research examines how this aircraft can enhance naval capabilities. Our analysis focuses particularly on the US-2's potential role in supporting fleet logistics and resupply missions at sea.

By focusing on assessing the US-2's effectiveness in naval logistics and resupply operations and through comparative analysis, this research examines the aircraft's capabilities relative to existing naval aviation assets, identifying potential complementary or replacement roles across various mission sets. The investigation emphasizes performance metrics, operational parameters, and mission-specific capabilities that could enhance naval operational reach and effectiveness.

The study examines key supply and maintenance aspects of operating the US-2. It also analyzes how to keep these aircraft serviced, supplied, and flying as part of regular U.S. Navy operations. Special attention is given to how well the US-2 could function in remote locations and challenging conditions, including its flight range and how much cargo it can carry during extended naval missions.

The strategic dimension of this research explores the US-2's alignment with evolving U.S. Navy doctrinal concepts and future warfare requirements. This includes analyzing its potential contributions to DMO, sea control missions, and joint-force capabilities. The study examines how the aircraft's unique characteristics could support emerging operational concepts, particularly in the Indo-Pacific region's complex maritime environment.

Political and acquisition considerations receive detailed attention through analysis of procurement pathways, congressional oversight requirements, and defense resource allocation dynamics. The research addresses potential legislative hurdles, budgetary competitions, and implications for the defense industrial base. This examination includes assessment of political feasibility, funding mechanisms, and alignment with broader national security objectives.

To establish contextual foundations, the study incorporates historical analysis of amphibious aircraft operations, with particular emphasis on PBY Catalina's World War II experience. This historical framework provides valuable insights into the enduring utility of amphibious aircraft in naval operations while illuminating relevant lessons for contemporary maritime challenges.

The research methodology acknowledges inherent limitations in relying exclusively on unclassified sources. While this constraint may restrict access to certain technical specifications, it ensures transparency and reproducibility in the analytical process. The study employs rigorous academic standards in evaluating available information to produce substantiated findings and recommendations.

Through comprehensive examination of these interconnected elements, this research provides a thorough analysis of the ShinMaywa US-2's potential integration into the U.S. Navy. The study synthesizes operational, logistical, strategic, and political considerations to offer evidence-based insights for defense policy stakeholders and decision-makers. This systematic approach ensures that conclusions and recommendations rest on sound analytical foundations while remaining accessible through unclassified channels.

B. RESEARCH FRAMEWORK

The U.S. military uses eight key factors to assess how new capabilities will fit into existing operations. Known as the DOTMLPF-P framework, this approach helps planners examine every aspect of bringing new systems into service (Defense Acquisition University, 2023). These factors include:

- Doctrine: how forces will use the equipment
- Organization: how units should be structured
- Training: what training people need

- Material: what physical equipment is required
- Leadership and Education: how to prepare leaders
- Personnel: what personnel are needed
- Facilities: what buildings and bases are necessary
- Policy: what rules or regulations apply

1. DOTMLPF-P Framework

Within the doctrinal sphere, new capabilities must align with established military principles and operational concepts. Military planners must evaluate how proposed systems support current strategic objectives, particularly in evolving areas such as DMO. This evaluation determines whether existing doctrine adequately supports the new capability or requires modification to maximize operational effectiveness (Defense Acquisition University, 2023b).

Organizational considerations address the structural changes needed to support new capabilities. This includes examining command relationships, unit configurations, and support elements. Military units may require reorganization to effectively employ and maintain new systems, potentially necessitating the establishment of specialized units or modification of existing command structures (Defense Acquisition University, 2023b).

The training component focuses on developing comprehensive programs to prepare military personnel for new capabilities. This encompasses initial qualification training, advanced operational instruction, and continuing education programs. Effective training ensures operators and support personnel can employ new systems across the full spectrum of military operations (Defense Acquisition University, 2023b).

Material analysis examines the physical systems and supporting infrastructure required for successful integration. This includes procurement strategies, maintenance requirements, and logistical support networks. Planners must evaluate supply chain sustainability, parts availability, and system compatibility with existing platforms (Defense Acquisition University, 2023b).

Leadership and education requirements center on preparing military commanders and staff to effectively employ new capabilities. This preparation involves formal military education programs, professional development courses, and specialized training in tactical and strategic employment. Leaders must understand both the technical aspects and operational implications of new systems (Defense Acquisition University, 2023b).

Personnel requirements encompass the human resources needed to operate and maintain new capabilities (Rendon & Snider, 2019). The military must figure out what skills people need to work with the new equipment, how many qualified personnel they need, and how these jobs fit into military career paths. Leaders also need plans for finding and keeping the right people—from recruiting those with technical skills to creating incentives that help retain experienced staff members (Defense Acquisition University, 2023b).

Facility requirements address the physical infrastructure needed to house, maintain, and support new capabilities. This evaluation examines existing facilities' adequacy and identifies necessary modifications or new construction. Infrastructure planning must account for operational, maintenance, and training requirements (Defense Acquisition University, 2023b).

Policy considerations examine the regulatory and legal framework governing new capabilities. This includes procurement regulations, international agreements, and operational restrictions. Policy analysis ensures compliance with existing requirements while identifying areas where policy modifications could enhance operational effectiveness (Defense Acquisition University, 2023b).

Through systematic examination of these interconnected elements, the DOTMLPF-P framework enables comprehensive evaluation of new military capabilities. This structured approach ensures thorough consideration of all factors affecting successful integration, while maintaining focus on enhanced operational effectiveness (Defense Acquisition University, 2023a).

2. Political and Acquisition Process Analysis

The acquisition of new military systems requires navigation through complex political and procedural channels within the U.S. defense establishment. This examination explores the interrelated factors affecting military procurement, with particular emphasis on congressional oversight, funding allocation, technology transfer protocols, and international procurement considerations.

The U.S. Congress maintains significant authority over defense acquisitions through its budgetary and oversight powers. The Senate and House Armed Services Committees examine procurement proposals, evaluating their alignment with national security objectives and fiscal constraints. Foreign military acquisitions face particular scrutiny due to domestic industry implications and security considerations. While the Buy American Act establishes preferences for domestic procurement, Congress does support foreign acquisitions when they address critical capability gaps or provide unique operational advantages (Arabia, 2024).

Defense acquisitions operate within finite resource constraints, requiring careful prioritization among competing programs. New procurement initiatives must demonstrate clear operational benefits and cost-effectiveness, particularly when considering foreign-developed systems. These programs compete directly with established domestic modernization efforts, including major weapons platforms and naval construction programs. Foreign systems may present advantages through reduced development costs or specialized capabilities that would be prohibitively expensive to develop domestically.

Procuring foreign military systems requires careful consideration of technology transfer agreements and intellectual property rights. These arrangements must balance protecting sensitive technologies with ensuring adequate operational control and maintenance capabilities. Successful agreements often incorporate provisions for domestic production or assembly, addressing both security requirements and industrial base concerns. The negotiation process requires careful attention to supply chain security and long-term sustainment considerations.

U.S. defense acquisition policy emphasizes protecting domestic industrial capabilities. Procurement decisions must account for impacts on U.S. manufacturing capacity and technological expertise. While protectionist measures can constrain acquisition options, mechanisms exist for incorporating foreign systems while supporting domestic industry through co-production arrangements and technology-sharing agreements. These approaches can preserve industrial base capabilities while accessing advanced foreign technologies.

The Foreign Military Sales (FMS) system provides an established framework for government-to-government procurement of military systems. This process addresses regulatory compliance, security requirements, and technology transfer considerations through formalized channels. While regulatory differences and political sensitivities can affect procurement timelines, FMS agreements often enhance military cooperation and interoperability with allied nations. These arrangements frequently include provisions for training, maintenance support, and ongoing technical collaboration (Greenwood Aerospace, 2023).

The successful integration of new military capabilities requires careful consideration of these interconnected political and procedural factors. Procurement decisions must balance operational requirements against political constraints, budgetary limitations, and industrial base considerations. Understanding these dynamics enables more effective navigation of the acquisition process while maintaining alignment with broader defense objectives.

III. LITERATURE REVIEW

The U.S. Navy's current strategy calls for forces to spread out over large ocean areas rather than concentrate in single locations. According to the U.S. Navy's *CNO NavPlan* (Chief of Naval Operations, 2021), this dispersed approach serves two key purposes: it gives naval forces more options for movement and makes it harder for opponents to track and target U.S. Navy ships. However, this strategy creates new supply challenges. When ships operate far across vast maritime regions, delivering fuel, food, parts, and other essential materials becomes more complex and demanding.

These distributed operations require new approaches to logistics support. Naval forces must maintain effectiveness even when operating far from established supply lines and traditional ports, as detailed in the *Marine Corps' Expeditionary Advanced Base Operations Handbook* (Marine Corps Warfighting Lab, n.d.). This operational model demands versatile transportation platforms that can reach forces in remote or austere locations. Amphibious aircraft offer one solution, providing flexible resupply capabilities for units operating in coastal areas or isolated positions without conventional port access.

In high-risk and contested environments, traditional resupply routes are vulnerable to attack, making decentralized logistics solutions essential. As explored in *Logistics in Contested Environments* (Bengigi et al., 2020), hostile conditions and long supply lines make resupply particularly difficult in austere environments. The ability of amphibious aircraft like the US-2 to bypass traditional supply routes and deliver supplies directly to remote locations offers a significant advantage, especially when adversaries aim to disrupt logistics networks.

This capability mirrors successful historical precedents. During World War II's Pacific campaigns, the U.S. Navy relied heavily on the PBY Catalina flying boat to conduct vital missions, including coastal patrol, supply delivery, and rescuing downed aircrew. These aircraft proved especially valuable in regions lacking developed ports and airfields (Dorny, 2013). Today's Indo-Pacific operations face similar geographic and logistical hurdles that require flexible air support options. The US-2 could serve a similar role, offering amphibious capabilities for resupply and SAR, but with modern advancements in speed, avionics, and payload capacity (Mills & Phillips-Devine, 2020).

Historical evidence demonstrates the significant impact of amphibious aircraft on maritime control operations. During World War II, the PBY Catalina proved essential in maintaining surveillance and control across extensive ocean areas. Similar operational requirements exist today in the Indo-Pacific region, where maritime forces must operate across vast distances while facing both logistical challenges and potential contested environments (Dorny, 2013).

Modern naval operations could benefit from amphibious aircraft capabilities. Recent analysis suggests that reintegrating such platforms into naval fleets would enhance operational flexibility, particularly in regions lacking established infrastructure (Mills & Phillips-Devine, 2020). Amphibious aircraft offer multiple mission capabilities, including search and rescue, logistics support, and personnel movement in austere environments—functions vital to current maritime strategy where traditional air facilities may be unavailable or vulnerable.

As seen in the PBY Catalina's success during WWII, amphibious aircraft continue to demonstrate their strategic value. The Catalina's ability to operate from water and land allowed it to resupply isolated forces in the Pacific theater. The US-2 could fulfill similar roles in today's distributed naval operations, offering enhanced capabilities to address modern logistical demands in the Indo-Pacific (Dorny, 2013).

IV. RESEARCH ANALYSIS

The integration of the ShinMaywa US-2 amphibious aircraft into the U.S. Navy's Distributed Maritime Operations (DMO) and Expeditionary Advanced Base Operations (EABO) frameworks presents a critical opportunity to enhance maritime capabilities in the Indo-Pacific. This chapter utilizes the DOTMLPF-P framework to evaluate the adjustments necessary across doctrine, organization, training, materiel, leadership, personnel, facilities, and policy to effectively incorporate the US-2 into PACFLT operations. This analysis highlights the aircraft's potential to bridge logistical and operational gaps in dispersed, contested environments, with particular emphasis on its amphibious capabilities not currently available.

By aligning doctrinal changes with evolving operational demands, establishing flexible organizational structures, and implementing robust training programs, the US-2 can address emerging challenges in maritime operations. Material readiness, leadership adaptability, and personnel cross-training are examined to ensure the platform's sustainment and functionality, while a strategic basing plan balances primary and forward-operating facilities for maximum regional impact. Finally, the chapter outlines policy considerations and acquisition pathways to navigate legislative hurdles and facilitate seamless integration. Together, these elements demonstrate the comprehensive approach needed to fully leverage the US-2's unique capabilities, reinforcing U.S. naval superiority in the Indo-Pacific.

A. DOCTRINE

The U.S. Navy must adapt its operational principles to fully leverage the unique capabilities of the US-2 amphibious aircraft in supporting DMO and Expeditionary Advanced Base Operations (EABO) across the Indo-Pacific. Integrating the US-2 requires rethinking current tactics and addressing doctrinal gaps to ensure that this platform effectively supports logistics, search and rescue, and other essential missions in dispersed and contested environments. By drawing on the historical successes of amphibious aircraft and aligning with current naval requirements, this doctrinal analysis identifies necessary changes to maximize the platform's operational impact, including those in command, control, and communications.

Successfully integrating the US-2 into DMO requires establishing comprehensive operational concepts, tactics, and procedures specific to amphibious capabilities. This would include creating detailed standard operating procedures for such as water landings, takeoffs, and deployment within the U.S. Navy's modern infrastructure. Doctrine should define mission-specific tactics for SAR, personnel and cargo transport, maritime patrol, and surveillance. Additionally, collaboration and resource-sharing guidelines could be essential for seamless interoperability with allied forces and inter-service partners, such as the Coast Guard and Marine Corps, during joint operations and exercises. Establishing a clear and adaptable doctrine will ensure the US-2's full operational employment across mission sets and provide continuity in integrated operations.

According to the Shinmaywa Industries, Ltd. (2015) performance specifications, the US-2 serves as a last tactical mile platform offering slightly better payload but more than 200 miles of range, which can make a big difference in the Pacific. With a maximum payload capacity of approximately 11,800 pounds, depending on configuration, the US-2 is not designed for heavy-lift operations but excels in supporting operational fronts and locations inaccessible by land or beyond the range of existing platforms. Capable of covering a wide range of supply class transportation, the aircraft can be employed by Joint Logistics (J4) for theater-level resupply or by Task Force Commanders to move supplies and personnel between positions. Its versatility would make it a valuable tool for various missions, excluding heavy-lift requirements typically assigned to USTRANSCOM assets.

Amphibious aircraft have historically demonstrated resilience and operational utility, as evidenced during World War II when 90% survived the initial days of conflict and proved indispensable for logistics and aerial support (Sheehy, 2024). Proper integration of the US-2 into modern tactical frameworks, supported by war games and strategic planning, holds similar promise for enhancing operational flexibility today. By incorporating the US-2 into both simulated and real-world exercises, the U.S. Navy can refine operational tactics, validate interoperability, and maximize the aircraft's capabilities. This integration would directly support Distributed Maritime Operations (DMO) objectives and strengthen U.S. logistical and operational capabilities across the Indo-Pacific theater.

B. ORGANIZATION

The successful integration of the ShinMaywa US-2 into the U.S. Navy's DMO framework requires a carefully designed organizational structure tailored to its unique capabilities and mission requirements. Drawing lessons from existing fleet logistics squadrons, this section explores how the US-2 can be organized, commanded, and supported to enhance operational flexibility, sustainment, and interoperability in the Indo-Pacific theater.

1. Organizational Parallels

To successfully integrate the ShinMaywa US-2 into the U.S. Navy's DMO framework, a theoretical organizational structure inspired by Fleet Logistics Multi-Mission (VRM) and Fleet Logistics Support (VRC) squadrons offers a blueprint for effective operations (see Figure 1). This integration could enhance the U.S. Navy's logistical support, operational flexibility, and sustainment of forces across the Indo-Pacific, where dispersed and agile capabilities are critical. Leveraging insights from existing VRM and VRC squadron models, as well as allied interoperability practices, could enable a robust approach to DMO in a contested maritime environment.

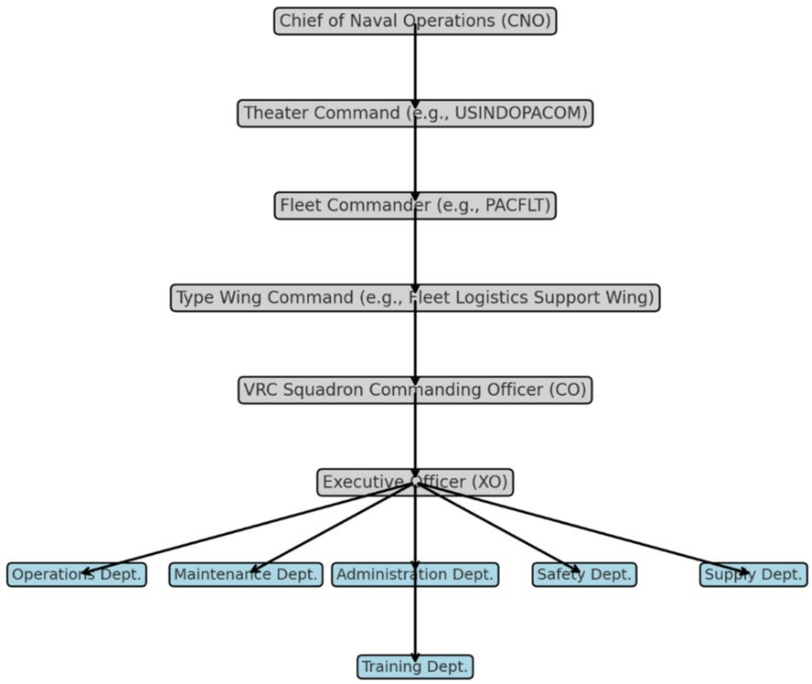

Figure 1. Possible Command Structure

VRM squadrons, such as VRM-30, support the U.S. Navy's operational requirements by providing rapid transport of logistics and personnel to carrier strike groups and remote units (U.S. Navy, 2021). This structure provides a relevant model for a US-2 squadron, which would similarly need to prioritize swift logistical support and personnel deployment in dispersed areas. This organizational focus aligns with the DMO framework's emphasis on agile, self-sustaining logistics in austere environments (O'Rourke, 2022). Meanwhile, Carrier Onboard Delivery (COD) squadrons like VRC-30 are organized to directly support carrier strike groups by streamlining logistics, expediting personnel transfers, and delivering essential supplies (U.S. Navy, 2021). This operational model can be adapted to US-2 missions requiring flexibility and broad reach.

This organizational setup is particularly valuable for the Indo-Pacific theater, where US-2 squadrons could be tasked with supporting dispersed expeditionary bases and isolated units. Stationed at key strategic locations, these squadrons could function autonomously while maintaining the operational readiness necessary for rapid response, mirroring the operational structures of VRM units (Leung, 2020). A regionalized model, utilizing both primary and FOB, would allow these squadrons to operate in sync with distributed forces, furthering the goals of EABO, which emphasizes flexible and resilient logistics (U.S. Department of Defense, 2021).

A standard VRC squadron configuration includes approximately eight aircraft, an efficient number to balance operational availability with maintenance cycles (Naval Personnel Command, 2020). For a US-2 squadron, similar structuring may apply, with 12–16 pilots and 16–24 flight crew members trained specifically for amphibious and logistics operations in challenging maritime conditions (Leung, 2020; Naval Personnel Command, 2020). Due to the added complexity of amphibious operations, additional specialized crew such as SAR specialists would be required (Leung, 2020).

Maintenance personnel would be essential, as the US-2's amphibious nature and saltwater exposure introduce higher demands for corrosion control and specialized repair. An estimated 100–120 maintainers, divided into teams for airframes, power plants, avionics, and quality assurance, would provide the technical support needed for rapid response in austere settings (U.S. Navy, 2021; Naval Air Systems Command, 2021). Additionally, the increased logistic demands of DMO and EABO would require enhanced support for deployed squadrons. There would be a need for approximately 15–20 logistics support personnel would be responsible for inventory management, fuel handling, and parts procurement, ensuring operational readiness (U.S. Navy, 2021).

2. Command and Control Adaptations for Seamless Integration

Integrating the US-2 would require a streamlined command and control (C2) structure that accommodates joint protocols and decentralized command to function effectively within the DMO framework. Drawing from the C2 structures of VRM and VRC squadrons, which often rely on modular command networks, US-2 units would benefit from a decentralized C2 approach that enables rapid responsiveness in dynamic environments (U.S. Navy, 2021). As demonstrated in these current VRM operations, individual units often operate with independent command, allowing them to address immediate logistical needs without requiring full-scale coordination.

Joint protocols would further align the US-2's operations with allied forces enabling seamless coordination and support during multinational missions. This interoperability is crucial in the Indo-Pacific, where coalition operations rely heavily on integrated command structures (Australian Strategic Policy Institute, 2020). Mobile logistics teams from US-2 units would provide rapid resupply and support across the region, responding to immediate needs from American and allied forces (O'Rourke, 2022).

3. Building a Working Group for Joint Operations

The success of the US-2's integration into the DMO framework depends on fostering a collaborative cross-functional environment, modeled after VRM squadrons' practice of knowledge-sharing among logistics, operations, and maintenance personnel (U.S. Navy, 2021). A dedicated Community of Practice (CoP) for US-2 personnel could streamline cross-functional collaboration, allowing logistics, intelligence, and tactical units to continuously share insights and improve practices tailored to amphibious logistics.

Expanding this CoP to include allied forces would support joint efforts in multinational logistics and operational planning, enhancing both operational and strategic interoperability. For instance, Japan, a key partner in the Indo-Pacific, could benefit from shared CoP practices that improve coordination in joint amphibious and expeditionary logistics (Kimura & Takahashi, 2022). Joint exercises and simulations, such as the annual Rim of the Pacific (RIMPAC) exercise, would allow these cross-functional teams to validate protocols, refine operational structures, and build trust, which is essential for seamless coordination during real missions (Yoshida, 2019).

4. Regionalized Support Infrastructure for Enhanced Operational Readiness

Establishing a regionalized infrastructure is essential for maintaining the US-2's operational readiness in the Indo-Pacific. Following the model used by VRM squadrons, which have a primary base with forward-deployed detachments, a primary hub in Guam or Okinawa with additional forward operating bases (FOBs) across the region would be highly effective (U.S. Navy, 2021). These bases would provide essential refueling, maintenance, and logistical support for the US-2, reducing the time and logistical costs of redeployment (Leung, 2020).

Facilities at these FOBs should include fuel storage, maintenance bays, and temporary accommodations for personnel, ensuring rapid mobilization and sustained operations. Strategic positioning of FOBs, such as those in Guam, Okinawa, and potentially the Philippines, would allow the US-2 to support a network of dispersed operational units, consistent with DMO objectives for scalable, resilient logistics (O'Rourke, 2022; Kimura & Takahashi, 2022). This regionalized infrastructure aligns with the U.S. Indo-Pacific Command's goal of maintaining a sustainable presence and extended reach in contested environments (Haddick, 2014).

By adopting organizational and logistical models based on the structures of VRM and VRC squadrons, the U.S. Navy can effectively integrate the ShinMaywa US-2 within its DMO framework. This integration would support the U.S. Navy's objectives in the Indo-Pacific by providing agile, reliable logistical support in dispersed environments. Dedicated US-2 squadrons, supported by regional FOBs and a streamlined C2 framework, would enhance mission success across a wide operational area, offering logistics and tactical flexibility aligned with the principles of DMO and EABO. A cross-functional collaboration framework and a CoP with allied forces would further strengthen this model, promoting interoperability and operational synergy for both U.S. and allied forces in the region.

C. TRAINING

Establishing a U.S. Navy training pipeline for the ShinMaywa US-2 amphibious aircraft would consist of mirroring current multi-engine and amphibious training elements and incorporating specialized practices from the Japan Maritime Self-Defense Force (JMSDF), who is currently using the aircraft. This pipeline would address both the unique capabilities of the US-2 and its strategic role within DMO and EABO frameworks. The initial phases could align with the U.S. Navy's multi-engine pilot programs, beginning with primary training at bases such as Naval Air Station (NAS) Pensacola or NAS Corpus Christi, where pilots develop foundational skills in flight, navigation, and maneuvering using single-engine aircraft like the T-6 Texan II (Naval Air Training Command, 2024). Upon completing primary training, pilots progress to advanced multi-engine handling at NAS Corpus Christi on platforms such as the T-44 Pegasus, where they develop multi-engine management and complex navigation capabilities over 6– 9 months (Naval Air Training Command, 2024).

To prepare pilots for the US-2's amphibious operations and contested logistics roles, specialized training would be necessary. US-2 training would likely emphasize amphibious operations, including water landings, takeoffs in varied weather conditions, and emergency procedures specific to maritime environments. Drawing inspiration from the logistics strategies employed by carrier support squadrons, US-2 teams would focus on training for joint operations (Naval Air Training Command, 2024). Their mission could include delivering supplies to widely dispersed units throughout the Indo-Pacific region while ensuring effective support for both open-ocean and near-shore missions. Real-world scenarios in joint U.S. Navy and Marine Corps training exercises would build proficiency in emergency resupply, casualty evacuation, and personnel delivery, critical for dispersed units under DMO principles (Leung, 2020).

The integration of the US-2 should also necessitate specialized technical training for pilots and maintenance crews, focusing on the same amphibious takeoff, landing, and hydrodynamic navigation. Drawing on the structure of VRM squadrons, which provide tiltrotor and amphibious operation training, US-2 crew members would undergo intensive training in rapid repair, remote maintenance, and contingency protocols for high-stakes situations (Naval Air Training Command, 2024). This training would ensure that maintenance teams can perform routine and emergency repairs in austere environments, similar to those maintained by VRM squadrons like VRM-50 for the CMV-22B Osprey. The US-2 training could also benefit from Japan-based programs with ShinMaywa personnel, who could offer hands-on instruction on aircraft-specific components and technical specifications, further enriching crew expertise in the US-2's advanced systems.

In addition to hands-on training, simulation-based and AI-enhanced modules would prepare pilots for complex mission scenarios. Simulation exercises, similar to those used by the Marine Corps Warfighting Lab (n.d.), could include contested airspace navigation, hostile environment evasion, and coordination with multinational units. These AI-driven modules could help personnel practice low-altitude maneuvers, route planning, and threat evasion while enhancing interoperability for coalition missions with Japanese, Australian, and South Korean forces.

A continuous assessment model would further ensure the operational readiness of US-2 personnel. The US-2 program could mandate refresher courses and joint exercises, allowing personnel to adapt to the evolving demands of DMO and coalition operations. This recurring certification and assessment structure would ensure that all US-2 personnel maintain high levels of proficiency in amphibious and high-seas operations and remain mission-ready to support Indo-Pacific logistics. By adopting these multi-layered training protocols from established logistics squadrons, the U.S. Navy can facilitate the US-2's seamless integration, leveraging its unique capabilities to enhance strategic flexibility in contested maritime environments.

Based on established programs from U.S. Navy fleet logistics squadrons and the JMSDF, the training encompasses primary flight instruction, multi-engine and amphibious qualifications, SAR operations, joint coordination, and technical specialization (Naval Air Training Command, 2024). Program Evaluation and Review Technique (PERT) and Critical Path Method (CPM) models provided the framework for analyzing training dependencies, critical path determination, and total completion time requirements (Defense Acquisition University, 2023).

The proposed training pipeline includes ten phases, each with specific activities and associated durations. Phases begin with primary flight and multi-engine training, followed by amphibious operations and US-2-specific systems training, culminating in SAR mission training, operational integration, and continuous assessment cycles (Naval Air Training Command, 2024). Duration times were derived from Naval Air Training Command (2024) and adapted to match a hypothetical framework for amphibious trainings. Dependencies were established to ensure sequential progress through each phase, where the completion of foundational training allows progression to advanced, mission-specific instruction. The training framework incorporates proven methods from U.S. Navy fleet logistics squadrons (VRC and VRM) and leverages the JMSDF's extensive US-2 operational experience.

Within the PERT methodology, individual activities received Optimistic (O), Most Likely (M), and Pessimistic (P) duration estimates. The following model is built using a hypothetical scenario and the values in this analysis are simulated examples created to demonstrate key concepts. This sample dataset illustrates potential applications and analytical capabilities, rather than representing actual weeks required. The examples show how similar methods could be applied to real-world scenarios. The Expected Time (TE) for each activity was calculated using the following formula:

$$TE=(O+4M+P)/6$$

This calculation places greater weight on the (M) time while still factoring in the (O) and (P) estimates (DAU, 2023). The calculated TE values and phase timelines are illustrated in Figure 2 for each activity.

Phase	Activity	Description	Duration (weeks)	Dependency	O	M	P	TE (weeks)
1	A	Basic flight instruction	6	Start	5	6	7	6
1	B	Core maneuvers and navigation training	8	A	7	8	9	8
2	C	Transition to multi-engine	4	B	3	4	5	4
2	D	Advanced navigation and handling	8	C	7	8	10	8.5
3	E	Seaplane basics	4	D	3	4	6	4.2
3	F	Advanced water operations and SAR simulation	6	E	5	6	8	6.2
4	G	System-specific training for US-2	8	F	7	8	10	8.5
4	H	Emergency water maneuvers	6	G	5	6	8	6.2
5	I	SAR fundamentals	4	H	3	4	6	4.2
5	J	Advanced SAR techniques	8	I	7	8	10	8.5
6	K	Mission qualification	6	J, Q	5	6	8	6.2
6	L	Joint exercises for operational readiness	4	K	3	4	6	4.2
7	M	Emergency resupply and joint logistics	5	L	4	5	7	5
7	N	Simulated joint operations	5	M	4	5	7	5
8	O	Amphibious takeoff and landing training	6	H	5	6	8	6.2
8	P	Rapid repair and remote maintenance	4	O	3	4	6	4.2
8	Q	Japan-based technical training	8	P	7	8	10	8.5
9	R	Contested airspace navigation	4	N, Q	3	4	6	4.2
9	S	Multinational coordination exercises	2	R	1	2	3	2
9	T	Emergency medical evacuation	2	S	1	2	3	2
10	U	Biannual refresher courses (recurring)	2	Independent	1	2	3	2
10	V	Joint exercise participation (recurring)	2	Independent	1	2	3	2

Figure 2. PERT/CPM Training Pipeline Schedule

The critical path is the longest sequence of dependent activities that defines the minimum time to complete the training pipeline. Summing the TE values for each phase along the critical path yields the expected project duration.

The critical path includes the following phases:

- Phase 1: A (6.0) + B (8.0) = 14.0 weeks
- Phase 2: C (4.0) + D (8.5) = 12.5 weeks
- Phase 3: E (4.2) + F (6.2) = 10.4 weeks
- Phase 4: G (8.5) + H (6.2) = 14.7 weeks
- Phase 5: I (4.2) + J (8.5) = 12.7 weeks

- Phase 6: K (6.2) + L (4.2) = 10.4 weeks
- Phase 7: M (5.0) + N (5.0) = 10.0 weeks
- Phase 8: O (6.2) + P (4.2) + Q (8.5) = 18.9 weeks
- Phase 9: R (4.2) + S (2.0) + T (2.0) = 8.2 weeks

The total TE for completing the training pipeline along this critical path is approximately 112 weeks.

The PERT/CPM model provides a structured estimate for the US-2 training pipeline, accommodating variations in activity durations while emphasizing dependencies. With an expected duration of approximately 112 weeks, this timeline provides a realistic projection for integrating the ShinMaywa US-2 into U.S. Navy operations, ensuring personnel readiness for amphibious, SAR, and logistics missions aligned with DMO and EABO frameworks.

D. MATERIAL

The cost structure for materials and support equipment associated with new aircraft is traditionally embedded as the program advances through its initial development phases. While this process is inherently time-intensive, it benefits from the collaborative efforts of the defense industry, with procurement contracts generally encompassing these aspects. However, the acquisition of the US-2 amphibious aircraft may present unique challenges, primarily due to the known relatively smaller size of Japan's defense industry and its distinct regulatory and operational frameworks (Magnuson, 2020). Beyond the initial procurement of spare parts, the success of this program could require long-term engagement with the Japanese defense sector, addressing ongoing spare part supply chains, depot-level repairable processes, and potential compatibility issues that may necessitate licensing agreements (Magnuson, 2020).

1. Supply Chain Readiness for US-2 Integration

The material considerations surrounding the ShinMaywa US-2 are heavily influenced by its current limited production and spare parts inventory (Magnuson, 2020).

Because the US-2 is a specialized amphibious aircraft with only a small number of units in service, the supply chain for spare parts and maintenance support is naturally constrained, potentially leading to higher costs and operational readiness challenges from the industry. In addition to the low quantity and low volumes needed by the Japanese military, the sole-source procurement contracts on military parts lead to higher prices due to lack of competition (Magnuson, 2020). However, the prospect of the United States brokering a license agreement to manufacture parts could significantly alter this landscape. Such an agreement would not only address the scarcity issues but could also leverage the United States' advanced manufacturing capabilities and extensive aerospace industry, potentially revolutionizing the availability and cost-effectiveness of the US-2 platform.

A conclusion drawn is that U.S.-led manufacturing initiative for the US-2 could dramatically increase the aircraft's viability for a broader range of customers, including the U.S. military itself. By establishing a robust production line for parts and potentially the entire aircraft within the United States, the economies of scale would likely reduce both acquisition and sustainment costs. This arrangement could also facilitate easier integration of U.S. technologies and avionics, enhancing the aircraft's capabilities and interoperability with existing U.S. and allied systems. Furthermore, such a partnership could open doors for collaborative development of specialized variants, tailoring the US-2 to specific mission requirements of the United States and its allies. This approach would not only resolve the current material limitations but could also help Japan position the US-2 as a more attractive option for maritime nations worldwide, backed by the reliability and support network associated with U.S. aerospace manufacturing.

2. Maintaining Readiness: US-2 Gear and Support Systems

Ground support equipment (GSE) and maintenance test equipment is well-known as being fundamental to ensuring the safe operation and long-term sustainment of aircraft. A full understanding of these capabilities prior to procurement is essential.

Currently, the U.S. Navy utilizes a variety of shipboard and ground-based GSE for fueling, power support, startup support, and other critical technologies for mission readiness, and this equipment is inextricably linked to operational support (Greenwood

Aerospace, 2023). Most GSE is specifically designed for individual aircraft, with a few exceptions that are utilized for several platforms, but all require specialized training. Importing foreign GSE for use by U.S. aircraft maintainers presents challenges, particularly in adapting to U.S. standards, such as power supply compatibility and language requirements, including the use of English (Greenwood Aerospace, 2023). Furthermore, given the platform's objective of mobility, it should be essential to assess the size and transportability of the equipment to ensure its feasibility for deployment across various operational environments.

Moreover, as seen throughout the Naval Supply Corps, the procurement and maintenance of depot-level repairable capabilities are essential for the long-term operational health of the aircraft. A significant aspect of life-cycle sustainment and cost reduction for aircraft components is the ability to repair critical parts at various levels: organizational (squadron), intermediate (Fleet Readiness Centers), and depot (manufacturer-specialized fleet centers) (Naval Safety Center, 2017). These maintenance processes allow for the repair of only the malfunctioning components, rather than replacing entire systems, thereby significantly reducing costs and saving millions of dollars annually. Securing the necessary licensing, training, and equipment to perform these repairs in-house would be a crucial cost factor that would also ensure operational readiness.

3. Material Transport Capacity and Limitations

Material lift capacities of the ShinMaywa US-2 vary significantly depending on its configuration, which can be adapted to meet diverse mission requirements, provided the operational environment supports the transition (Yoshida, 2019). In its rescue configuration, the forward compartment accommodates 11 stretchers and necessary crew while maintaining a 3,000-pound cargo capacity in the aft compartment, allowing for the transport of SAR boats or other essential materials (Martin et al., 2023). When configured for troop transport, the forward compartment seats 30 personnel, excluding the crew, while retaining the same 3,000-pound capacity in the aft compartment for gear or supplies(Martin et al., 2023). In a full cargo or munitions configuration, the US-2 supports a payload of 8,800 pounds in the forward compartment and 3,085 pounds in the aft compartment, offering significant flexibility for material transport in support of various operational objectives(Martin et al., 2023).

While the US-2 boasts impressive cargo capacity for its size, its bulk cargo capability is constrained by loading limitations. The aircraft features a single access hatch located on the port aft fuselage, measuring 4.7 feet wide and 5.1 feet high. This hatch restricts the size of items that can be loaded, as materials must be lifted by a forklift or manually handled due to the absence of a loading ramp (Martin et al., 2023). Additionally, access to the forward compartment from the rear is further limited by an internal passage measuring 2.6 feet wide and 5.9 feet high(Martin et al., 2023). The forward compartment provides dimensions of 22 feet in length, 7.5 feet in width, and 5.9 feet in height, while the aft compartment measures 20 feet in length, tapering from 7.5 feet to 4.6 feet in width, with a height of 5.9 feet (Martin et al., 2023).

The single access door presents challenges for unloading operations, especially in austere environments. On land, the door is approximately 8 feet above ground, necessitating the use of specialized equipment such as stairs, forklifts, or scissor lifts for effective loading and unloading of items to bulky or heavy for the standard ladder (Shinmaywa Industries Ld., 2015). In environments lacking such equipment, personnel may need to improvise with available resources, such as vehicle beds or crates, though these may be impractical for heavier or bulkier items. For water landings, the aircraft's versatility would allow it to offload via piers, small boats, or shallow water, where cargo can be unloaded manually. Moreover, the US-2 is capable of transitioning onto land if a suitable location with hard ground is available (Martin et al., 2023). This adaptability to operate in austere and logistically challenging environments makes the US-2 a unique asset. Its ability to enhance logistical operations in remote theaters offers capabilities that surpass traditional supply lines, reinforcing its value as a critical enabler in theater support.

E. LEADERSHIP

The integration of the ShinMaywa US-2 into the U.S. Navy's DMO framework inherently necessitates a leadership structure that can effectively command and operate this unique asset. As with most aircraft platforms, leaders within US-2 units must possess technical expertise alongside a comprehensive understanding of joint, multi-domain, and amphibious logistics. Drawing insights from U.S. Navy VRC and VRM squadrons, the leadership framework for US-2 integration would emphasize training leaders to navigate complex operations, enhance cross-branch coordination, and uphold mission readiness in contested environments. This approach aligns with the *Naval Operations Concept (NOC) 2010*, which emphasizes adaptable command and control (C2) for maritime missions in joint settings (U.S. Navy, 2010).

Establishing clear command roles and strategic responsibilities is essential to optimize decision-making agility and ensure resilience under DMO (U.S. Navy, 2010). In structuring US-2 leadership, the VRM-30 "Titans," which assign specialized roles to enhance mission adaptability, provides a model for delineating responsibilities (U.S. Navy, 2012). This could involve designating leaders to oversee joint resupply, casualty evacuation, and amphibious support, which would foster operational clarity and streamline coordination within the broader mission framework. Additionally, fostering adaptive leadership skills is crucial for US-2 operations, as the squadron will often conduct dispersed resupply under shifting environmental and threat conditions. The VRC-40 "Rawhides" exemplify adaptive leadership, equipping leaders to conduct logistical support in dynamic environments; similarly, US-2 commanders would benefit from training focused on rapid decision-making, contingency planning, and logistical assessments (U.S. Navy, 2012).

To effectively support both U.S. Navy and Marine Corps objectives, US-2 leaders must develop joint operational capabilities. Leadership training could thus incorporate joint operational strategy, multinational command protocols, and contested logistics coordination. The VRM-50 "SunHawks," who train leaders for interagency coordination and carrier strike group integration, offer a valuable model (U.S. Navy, 2012). Emulating VRM-50's approach, US-2 leadership training would equip leaders to manage complex joint logistics missions, integrating multinational resources and aligning with allied forces to enhance interoperability (Joint Chiefs of Staff, 2021). This aligns with joint capabilities integration frameworks, such as those outlined in *CJCSI 5123.01I*, which emphasize interagency coordination and leadership adaptability in joint-force contexts.

Given the US-2's amphibious capabilities, specialized training in maritime logistics and maintenance oversight would be critical. Leaders must become proficient in amphibious landing/takeoff procedures and understand maintenance challenges specific to saltwater operations. VRM-30's technical training provides a foundation here; US-2 leaders would similarly undergo training on amphibious logistics, waterborne maintenance strategies, and readiness assessments, ensuring they are equipped to handle technical and environmental demands inherent to maritime logistics (Department of the Army, 2015). Establishing a culture of continuous improvement and resilience is also paramount to ensure operational adaptability. VRM-50's iterative learning approach, which prioritizes post-mission reviews and feedback loops, offers a model for US-2 units (U.S. Navy, 2012). By institutionalizing this culture, US-2 leaders could leverage operational insights to refine strategies, optimize readiness, and sustain effectiveness in DMO and EABO contexts (Headquarters U.S. Marine Corps, 2011).

To foster leadership continuity within US-2 units, a development program emphasizing cross-training and mentorship is recommended. This approach is reflected in Naval Aviation squadrons, where junior officers rotate through varied logistics roles to build a well-rounded operational foundation. Implementing a similar structure, US-2 units could establish a pathway for leaders to gain experience across logistics, amphibious operations, and maintenance oversight. Mentorship initiatives could involve pairing junior leaders with experienced US-2 commanders and would facilitate knowledge transfer and expertise development, ensuring that the US-2 leadership pipeline remains robust and adaptive to future operational challenges. This comprehensive approach to leadership development aligns with the emphasis on adaptive, cross-domain leadership seen in *FM 6-22, Leader Development,* and is critical to maintaining the operational advantage of the US-2 within the U.S. Navy's strategic objectives (Department of the Army, 2015).

F. PERSONNEL

Using organizational insights from VRM and VRC squadrons and a transportation model to optimize personnel allocation, the research presents cost-effective strategies that maintain readiness in dynamic environments (U.S. Department of Defense, 2021).

1. Functional Team Structure and Cross-Training

Drawing on VRM and VRC squadrons' approaches, a specialized structure for the US-2 program is proposed. This structure includes core teams—Flight Operations, Maintenance and Technical Support, and Logistics and Coordination—that are each responsible for distinct aspects of amphibious and remote operations.

- **Flight Operations Team**: Responsible for amphibious landings and complex maritime navigation, this team would be trained in techniques similar to those used by VRM-30's CMV-22B aircrew. Cross-training allows team members to adapt to various logistics and operational tasks in remote locations (Naval Aviation Training Support Group, 2022; Voss, 2020).
- **Maintenance and Technical Support Team**: Modeled on VRM-50's maintenance specialization, this team would focus on corrosion control and rapid repairs, crucial for maintaining US-2's operational capacity in saltwater environments. Lessons from VRM squadrons indicate that specialized maintenance teams enhance operational longevity and support readiness in challenging conditions (Naval Sea Systems Command, 2021; Henry et al., 2019).
- **Logistics and Coordination Team**: This team would handle supply prioritization, mission planning, and payload management, supporting seamless integration into U.S. Navy and Marine Corps missions essential to DMO (Miller-Smith, 2020; Smith-Carroll, 2022). Effective logistical management is critical in DMO and EABO environments, where supply chains are complex, and flexibility is key to maintaining operational resilience (Headquarters U.S. Marine Corps, 2020).

Cross-training among these teams would enable personnel to perform multiple roles, enhancing flexibility, especially for isolated missions. Cross-functional training has been shown to improve mission adaptability and reduce dependency on single-role personnel, which is particularly valuable in remote and contested environments (Jones, 2021; Thomas & Lee, 2018).

2. Scalable Manpower Model for Variable Operational Demand

A scalable manpower model inspired by VRM and VRC squadrons is proposed for the US-2. This model includes a core team for regular operations and a reserve pool activated during peak demand periods. The flexibility provided by this model ensures efficient resource utilization without the cost burden of overstaffing (Miller-Smith, 2020; Defense Manpower Data Center, 2019). Studies in operational readiness have demonstrated that maintaining a reserve of trained personnel allows for efficient upscaling without incurring continuous high costs (Patterson & Wright, 2022).

3. Transportation Model and Data-Driven Approach

The transportation linear programming model's optimal solution provides a cost-effective framework for US-2 personnel deployment. By minimizing movement costs while meeting operational demands, the U.S. Navy can allocate resources efficiently, especially in scenarios where personnel need to support EABO's remote and dispersed operations (Johnson, 2019). This model, when paired with the scalable manpower approach, allows for flexible and responsive staffing that aligns with real-time mission needs. The hypothetical model uses

- Supply points (where sailors could start): Atsugi, Okinawa, and Guam
- Demand points (where sailors could potentially need to go): Philippines, Singapore, and Vietnam
- Variables (X_{ij}): How many sailors would be assumed to send from each base to each location
- Constraints: Rules ensuring the U.S. Navy does not send more sailors than it has (supply) and meets the minimum requirements at each location (demand)

- Objective function: Mathematical equation that calculates total distance traveled, which the U.S. Navy would want to minimize

For example, X_{11} represents how many sailors should travel from Atsugi (Base 1) to the Philippines (Location 1). The model considers all possible combinations and finds the arrangement that results in the shortest total travel distance while meeting all requirements.

The model considers three hypothetical supply points (U.S. bases) and three demand points (Southeast Asian locations), with distances serving as the cost metric. This example dataset contains simulated figures designed for demonstration purposes. No true personnel numbers were used in creating these values. While the analysis methods shown here could be applied to operational data, these specific numbers serve only to illustrate the analytical process and potential applications. Figure 3 presents the complete distribution matrix, including supply and demand constraints.

FROM / TO	Philippines	Singapore	Vietnam	Supply
Atsugi	1,275 mi	3,768 mi	2,252 mi	298 sailors
Okinawa	1,601 mi	3,773 mi	2,356 mi	654 sailors
Guam	2,559 mi	4,683 mi	3,963 mi	710 sailors
Demand	200 sailors	400 sailors	350 sailors	

Note: Map, distance calculations, and data visualization created by Cortni Thrasher (2024) using Apple Maps.

Figure 3. Distance and Hypothetical Personnel Numbers between Nodes

The objective function minimizes total travel distance:

Minimize $Z = \sum\sum(c_{ij}x_{ij})$ where:

- c_{ij} represents the distance from Base i to Location j
- x_{ij} represents the number of sailors to be moved

- expressed explicitly: $Z = 1275X_{11} + 3768X_{12} + 2252X_{13} + 1601X_{21} + 3773X_{22} + 2356X_{23} + 2559X_{31} + 4683X_{32} + 3963X_{33}$

Subject to the following constraints:

Supply Constraints:

- $X_{11} + X_{12} + X_{13} \leq 298$ (Atsugi)
- $X_{21} + X_{22} + X_{23} \leq 654$ (Okinawa)
- $X_{31} + X_{32} + X_{33} \leq 710$ (Guam)

Demand Constraints:

- $X_{11} + X_{21} + X_{31} \geq 200$ (Philippines)
- $X_{12} + X_{22} + X_{32} \geq 400$ (Singapore)
- $X_{13} + X_{23} + X_{33} \geq 350$ (Vietnam)
- Non-negativity: $X_{ij} \geq 0$ for all i,j

The optimal solution yields the following distribution:

- Philippines requirement (200 sailors) fulfilled entirely from Atsugi
- Singapore requirement (400 sailors) fulfilled entirely from Okinawa
- Vietnam requirement (350 sailors) split between two locations:
- 98 sailors from Atsugi
- 252 sailors from Okinawa

This distribution minimizes total travel distance while satisfying all manning requirements at each location. The solution demonstrates efficient utilization of closer bases (Atsugi and Okinawa) while leaving Guam's resources available for other contingencies.

Building on the insights from the transportation model, the US-2 program could implement a data-driven approach for ongoing manpower management. By regularly analyzing metrics such as flight hours, maintenance schedules, and operational tempo, leadership can proactively adjust staffing and deployment, optimizing readiness and cost-efficiency. Data-driven manpower planning has been shown to improve operational predictability and reduce unnecessary personnel costs in military and industrial logistics contexts (Brown & Wilson, 2022; Smith & Turner, 2021).

G. FACILITIES

To effectively house and support the ShinMaywa US-2 aircraft in the Pacific region, a strategic approach combining a primary home base with multiple flexible facilities would most likely offer the greatest operational advantage. The primary base of operations could be located at a major air station, such as Okinawa or Guam, to ensure rapid access to critical parts, supplies, and technical expertise. A main facility would require a large hangar capable of accommodating supply staging and aircraft during extended maintenance periods, ensuring full readiness for sustained operations. Secondary, more flexible facilities could be established based on mission requirements, allowing the US-2 to leverage its unique amphibious capabilities. Given the aircraft’s minimal requirements for suitable landing conditions—whether on land or water—the range of potential basing options across the Pacific is extensive, providing significant operational flexibility (Yoshida, 2019).

1. Squadron Support Facilities

The primary hangar should be fully equipped with specialized maintenance bays with applicable GSE, workshops for avionics and engine repair, and dedicated storage areas for spare parts and tools, meeting the same standards as experienced in any U.S. Navy squadron currently in operation. Adjacent to, or integrated within, the hangar complex, an operations center could be essential for mission planning, briefings, and real-time coordination. In addition to the operational and maintenance areas, the facility may include office spaces, nearby crew quarters, and dedicated training areas to ensure comprehensive support for squadron activities. Following the model used by current VRC logistic support squadrons, one squadron could occupy the facility and rotate detachments as operational needs dictate (Kimura & Takahashi, 2022). This “one squadron” approach could minimize the overall infrastructure required at the primary base while enabling flexible deployment and rotation of crews, enhancing readiness and maintaining operational tempo for extended periods.

2. Pacific Fleet Support Structure

To support the mobile and dynamic nature of the US-2 aircraft's missions, several strategically positioned FOBs should be identified and prepared across the Pacific region. These FOBs would not require the extensive facilities of the main base but should meet essential operational needs for temporary squadron deployments. Key requirements would include basic maintenance capabilities, fuel storage and distribution, temporary crew accommodations, and secure communications infrastructure to maintain operational continuity (Nicastro, 2023). The FOBs could be strategically located to cover critical areas of interest, with potential sites in the Philippines, Indonesia, and various Pacific Island nations. With more than 40 current U.S. defense installations located west of the International Date Line in the Pacific, as shown in Figure 4, a variety of strategic options exist for establishing FOBs (Nicastro, 2023). Each FOB could provide access to a suitable water landing area equipped with pier services, or alternatively, a basic runway or improvised airstrip for land operations. By establishing this network of FOBs alongside the primary base, US-2 squadrons could maintain their operational versatility and rapid response capabilities throughout the vast Pacific theater, ensuring they are well-positioned to execute their primary mission of contested logistics across a range of scenarios.

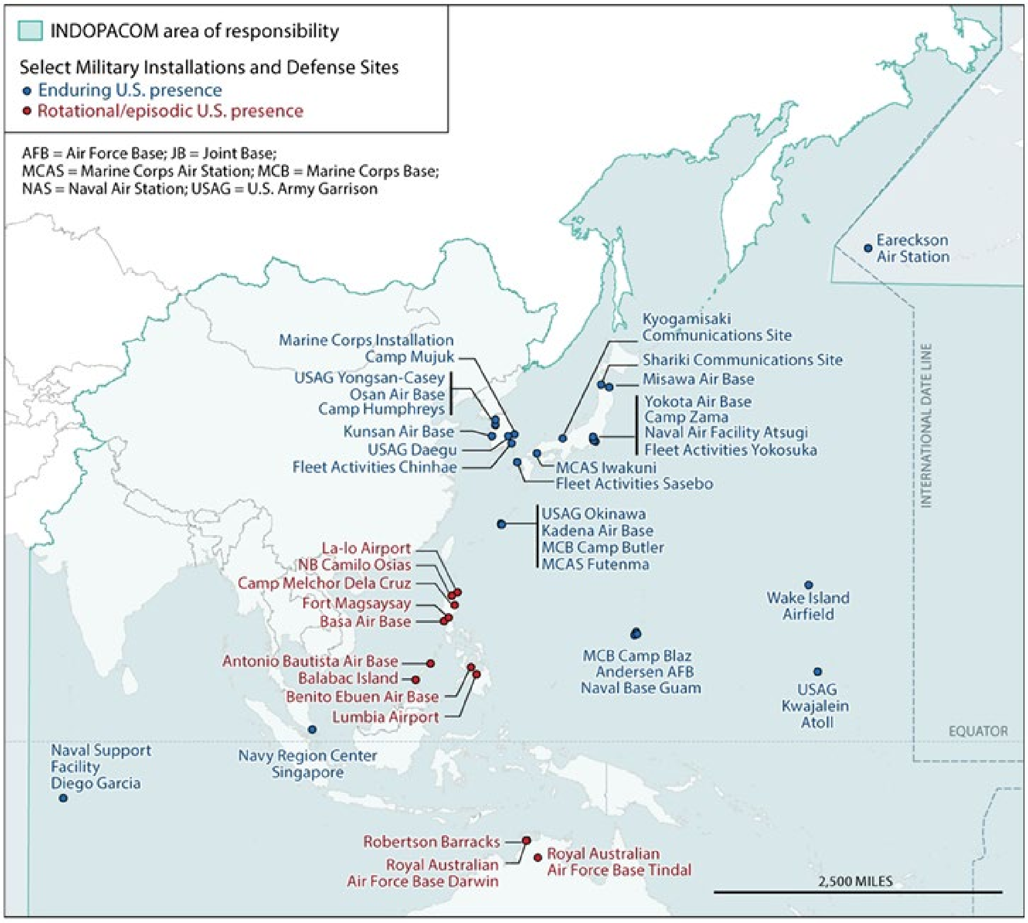

Figure 4. Fiscal Year 2022 Base Structure Support. Source: Nicastro (2023).

3. Operational Support Dynamics

When directly supporting operations, the US-2's single loading access door, which lacks an integrated ramp, presents unique logistical considerations (Yoshida, 2019). Positioned approximately 8 feet above the ground when on land and 2 feet above water level when afloat, the door necessitates appropriate equipment for efficient loading and unloading (Martin et al. 2023). On land, simple solutions such as portable stairs can facilitate cargo handling when forklifts or scissor lifts are unavailable. Currently, Japanese forces load regular items from the ground with no assistance; however, in austere environments, personnel may need to improvise using utility vehicle beds, crates, or other available materials to manage heavy or bulky items that cannot easily be passed up or down manually (Yoshida, 2019). Another solution could be to stage additional stairs at FOBs in the theater for loading ease.

Optimal operations could ideally leverage an airfield or makeshift airstrip for streamlined loading and unloading. In scenarios requiring water landings, the US-2 offers the flexibility to transition onto land via a solid beach or ramp. When such options are unavailable, the aircraft could support pier-side unloading, small boat transfers, or beach itself to enable shallow water hand-offloading. This adaptability positions the US-2 as a unique logistical asset capable of operating in the most austere and challenging environments, enhancing theater support in ways that conventional supply lines cannot achieve.

H. POLICY

Integrating a foreign-designed and manufactured aircraft like the US-2 presents challenges in acquisition, international cooperation, and long-term sustainment. U.S. defense policies related to procurement, supply chain management, and international agreements must be assessed to ensure seamless incorporation of this platform into the fleet. This policy analysis also includes legislative considerations, such as congressional oversight and funding priorities, which could affect the successful integration of the US-2 into the U.S. Navy.

1. Acquisition Policy and Legislative Barriers

Currently, there are no found established legal pathways for the U.S. to directly procure military aircraft from Japan or other allied nations. While some multinational programs allow for collaborative production or assembly within allied nations, these agreements are unique to specific initiatives and lack a generalized framework for broader acquisitions. To address this, a feasible approach would be to pursue a waiver similar to the existing FAR 52.225-7 (2024), Waiver of Buy American Statute for Civil Aircraft and Related Articles, which allows exceptions for civil aircraft in certain circumstances. Applying a similar waiver for military aircraft would enable the U.S. Department of Defense to procure platforms like the ShinMaywa US-2, which meet critical capability gaps not currently addressed by domestic manufacturers. Should the need for the US-2 be justified based on unique operational requirements—such as those posed by DMO in the Indo-Pacific—a waiver could facilitate timely acquisition, bridging immediate capability gaps until domestic alternatives are available.

2. Current Funding Policies

Funding considerations also pose challenges, particularly when comparing the immediate benefits of integrating an existing amphibious aircraft like the US-2 to ongoing, yet long-term, domestic development projects. For instance, currently the Defense Advanced Research Projects Agency is funding $8.3 million to a subsidiary of Boeing called Aurora to continue research on a heavy-lift amphibious aircraft called the Liberty Lifter, which remains in the early research and development phase and may not transition to procurement for several years (Losey, 2024). In contrast, the US-2 offers the armed forces a near-term enhancement in logistics support and combat search and rescue capabilities alongside an opportunity to gather operational insights and data that could inform future amphibious aircraft projects (Alman, 2021). By temporarily reallocating or supplementing existing funds, the U.S. military could deploy an amphibious aircraft immediately, allowing for both operational experimentation and immediate logistical support within the Indo-Pacific theater.

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V. CONCLUSIONS AND RECOMMENDATIONS

The conclusions drawn in this chapter emphasize the critical role of the ShinMaywa US-2 in addressing both immediate and long-term operational challenges for the U.S. Navy. By bridging capability gaps in amphibious logistics and enhancing regional interoperability, the US-2 offers a versatile and impactful solution for DMO The following sections highlight key insights and actionable recommendations to ensure the successful integration of the US-2 into the fleet, aligning with strategic priorities in the Indo-Pacific region.

A. CONCLUSIONS

The integration of the ShinMaywa US-2 amphibious aircraft into the U.S. Navy fleet presents a valuable and timely opportunity to address pressing operational needs in the Indo-Pacific region. This chapter outlines the primary conclusions derived from the study, emphasizing the immediate benefits of the US-2 for DMO and its long-term strategic implications.

1. Rapid Integration to Fill Immediate Capability Gaps

Integrating an amphibious aircraft such as the US-2 into the U.S. Navy would provide a timely and effective solution to address critical capability gaps in the Indo-Pacific theater. Unlike current naval assets, such as the SH-60 and the MV-22, which are limited by range, capacity, and the need for landing areas, the US-2's amphibious design offers unmatched flexibility and reach, essential for DMO. Its ability to conduct rapid resupply, search and rescue, and personnel transport across vast and dispersed areas, whether on land or sea, ensures operational continuity even in austere and contested environments. The US-2's operational versatility not only enhances the U.S. Navy's logistical and tactical capacity but also supports rapid crisis response, reinforcing U.S. presence and resilience across the Indo-Pacific. This integration represents a strategic advancement that strengthens the U.S. Navy's capability to sustain military and humanitarian missions in an increasingly complex maritime landscape.

2. Enhanced Interoperability with Allies

The addition of the US-2 would also strengthen interoperability with allies, particularly Japan, through shared operations, joint training, and logistics support. This enhanced cooperation would foster greater regional stability, improve combined readiness, and create a more unified response to regional crises, ultimately reinforcing the U.S.–Japan alliance in the face of shared security challenges. The program could also provide a stepping stone for future acquisition programs, allowing the United States to save time and money by utilizing allied capabilities in critical times of need.

B. RECOMMENDATIONS

To effectively integrate the US-2 and maximize its operational value, the following recommendations outline strategic steps the U.S. Navy should consider. These recommendations are meant to balance immediate operational needs with long-term industrial and strategic goals.

1. Immediate Action Required to Initiate the Procurement Process.

Given the urgent need for amphibious logistics capabilities in the Indo-Pacific, the U.S. Navy should initiate a program for the US-2 without delay. Broadening last-mile tactical options and increasing range and payload with a proven, reliable aircraft would be a significant win for the Navy. Approval for federal regulation waivers and agreement terms from both the United States and Japan could prove to be the toughest hurdle. Early engagement with Japanese authorities and industry partners will be essential to navigate regulatory requirements, establish agreements for technology rights, and address potential acquisition barriers.

2. Engage U.S. Defense Industry for Licensing and Manufacturing

To address sustainment and support challenges, the Department of Defense should engage with U.S. defense industry partners to explore licensing agreements with ShinMaywa as early as possible. This engagement could lead to domestic manufacturing of parts—or potentially the entire aircraft—within the U.S., bolstering the defense industrial base, improving parts availability, and ensuring long-term logistical sustainability.

3. Develop Specialized Training and Doctrine for Amphibious Operations

Given the unique capabilities of the US-2, the U.S. Navy should research and develop specific training and doctrine for amphibious operations, including water-based landings, austere logistics support, and rapid SAR. Specialized training programs could help persuade federal regulators and other key players about how the US-2 could bolster operational readiness and enhance interoperability for joint missions across the Indo-Pacific.

4. Alternative Consideration: Accelerate Domestic Amphibious Aircraft Development

As an alternate or parallel strategy, the U.S. Navy should leverage the adaptive acquisition framework to address urgent operational needs while positioning for long-term technological independence. Specifically, the Navy should consider increasing funding for DARPA's Liberty Lifter program to accelerate the development of a domestically produced amphibious aircraft. While the ShinMaywa US-2 provides an immediate solution for critical operational requirements, investing in a U.S.-developed platform through an adaptive, streamlined acquisition process ensures responsiveness to current needs while fostering innovation and maintaining alignment with national defense priorities.

This dual-track approach allows the Navy to rapidly deploy the US-2 under an urgent needs capability while concurrently advancing the Liberty Lifter program. By balancing short-term operational readiness with long-term strategic advantage, this strategy enhances theater support capabilities and secures future technological superiority in amphibious aviation.

5. Assess Potential for Expanding US-2 Capabilities

The U.S. Navy should also evaluate whether the US-2 could be modified for additional mission profiles, such as intelligence, surveillance, and reconnaissance or anti-submarine warfare, expanding the aircraft’s utility across multiple operational domains. If feasible, a modified US-2 variant could fulfill a broader range of mission requirements, providing even greater value to the fleet in contested environments.

C. RECOMMENDATIONS FOR FUTURE WORK

1. Economic Viability of Amphibious Aircraft: Research cost-benefit analyses for integrating. amphibious aircraft into modern fleets.
2. International Collaboration: Investigate the strategic implications of U.S.–Japan collaboration on defense manufacturing.
3. Political and Acquisition Challenges: Analyze the political hurdles and funding competition in acquiring foreign-developed military assets.
4. Historical versus Modern Amphibious Operations: Comparatively analyze WWII-era amphibious operations and today’s needs.
5. Autonomous possibilities: Could the US-2 or current organically researched amphibious platform be modified for autonomous flight, and what limitations would that have on its cargo and operational parameters?
6. Exploring Non-traditional Acquisition Strategies for Sustainment: Could public-private partnerships, rapid acquisition frameworks, or cooperative international agreements, have the potential to streamline processes, reduce costs, and improve sustainment capabilities?

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