MARINE CORPS
# Gazette
Professional Journal of U.S. Marines

MAY 2024 Vol. 108 No. 5 www.mca-marines.org/gazette




**THE MODERN DAY MARINE EXPO: APRIL 30–MAY 2, 2024**

A publication of the Marine Corps Association


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May 2024
Volume 108 Number 5

MARINE CORPS Gazette
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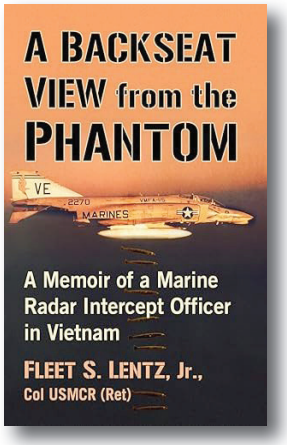
**Cover**
*Marines from MWSS-372 refuel an MV-22B from VMM-163 in Subic Bay, Philippines as part of Marine Aviation Support Activity 23.*
*(Photo by GySgt Stephen Leskoven, MWSS-372 Fuels Chief.)*

## DEPARTMENTS








## IDEAS AND ISSUES

### Aviation



### Acquisition



### How We Fight



### Wargaming/Advertiser Content

# THE MILITARY SPOUSE'S GUIDE
## TO REDUCING FINANCIAL STRESS

It's common for military members to refer to their spouse as the CFO of the household. While it's a wonderful compliment, it comes with the responsibility and stress of properly managing the family's finances to reach their financial goals.

Building financial success is a long-term plan and doesn't happen overnight. It comes from years of learning, growing, making mistakes, and sometimes pure trial and error. Let's look at steps you can take to help reduce financial stress.

### GET ON THE SAME PAGE

Both spouses don't have to be involved in every detail of financial planning, but you should align on what you're hoping to accomplish. Consider going on a financial date, where you talk openly about your financial planning and begin to formulate a plan designed to reach shared goals. The first time you have this conversation may be difficult, but the more it happens, the easier it becomes.

### HAVE A PLAN AND STAY WITHIN A FAMILY BUDGET

One great benefit of serving in the military is a reliable stream of monthly income. You can use it to precisely build a budget which helps you pay off debt and plan for the future. Use your budget to map out your basic living expenses. Be sure to include saving for both short- and long-term goals.

### AUTOMATE YOUR FINANCES

Automate as much of your finances as you can, including bill payments and savings. Many banks offer free online services that make paying your bills automatic.

For savings, consider using automatic funds transfers to support your long- and short-term savings goals. This increases your chance for financial success.

**These tips are just the beginning. Scan this QR code or select this link to review the rest of these tips and find other resources designed to provide support to military spouses and to help make life a little easier.**

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**MAY 2024**

## Editorial: Aviation, Acquisition and "How We Fight"

In my monthly editorial I generally highlight some of the stand-out articles in the magazine, offer some context on any focus areas, and recommend specific articles for close reading. This month's edition is unique and so my recommendation is simple: *read it all*. This month's collection of articles provides expert insights across the MAGTF. For the first time since 2018, we are able to present an Aviation focus area thanks to the exceptional support of the Deputy Commandant for Aviation, LtGen Bradford J. Gering, and the hard work of Col Jeremy Winters. Over half of the articles in this focus area were the efforts of the "Aviation Hallway" at HQMC while the rest were written by authors from the Aviation community throughout the Corps. Many center on aspects of Project EAGLE, Marine Aviation's threat-informed modernization strategy as a common "target location" across both our new and legacy aircraft, and across all six functions of Marine Aviation—to include discussion of the emergent capabilities of unmanned aerial systems, directed energy weapons and the most important element: the people who make up the ACE. The *Gazette* is glad to support this fact-based dialogue to help reinforce the next Aviation campaign plan and the future of this defining element of the MAGTF.

This month's edition also supports the Modern Day Marine Military Exposition, and we are grateful to have a focus area examining the processes and programs of the acquisition community as they deliver the capabilities our Marines require now and in the future. Special thanks to the leadership of Marine Corps Systems Command and the Program Executive Offices for Land Systems and Training Systems for providing this month's content and supporting Modern Day Marine. Topics in this area include how innovation can work within the bounds of acquisition regulations to add speed to the fielding of required capabilities, how AI can add realism to constructive training and recommendations to optimize the inclusion of manning and training requirements in the development and delivery of new equipment. Readers will also enjoy a detailed look at the future of simulated marksmanship training—not to replace live-fire range time but to make the use of these resources more effective and our Marines more lethal.

Rounding out the MAGTF we have a ground-truth look at how 2d MarDiv is innovating and operating as the ground combat element of II MEF today with the next three articles in the division's "How We Fight" series. This month's installments examine ground fires/artillery, littoral mobility, and cold weather operations.

MCA Premium Members will also note that this month's edition of *Leatherneck* includes an Aviation focus and they can access articles telling the stories of Marine air traffic controllers from various Marine Corps air stations and facilities and "combat controllers" operating out of Hamid Karzai International Airport in Afghanistan in 2022 and articles on the Vought F4-U Corsair and the evolution of airplane art.

Finally, it is with a truly heavy heart that I recognize the loss of a genuine legend of the Corps. The 29th Commandant, Gen Alfred M. Gray, Jr., passed away on the morning of 20 March at the age of 95. In a remarkable career as an enlisted Marine and an officer spanning from 1950 to 1991, and on into retirement Gen Gray was a thought leader, an iconic Marine warrior and a tireless advocate for the Corps and his warfighters. In addition to the brief tribute on page 4, you will find an obituary in this month's *Leatherneck*. In the coming months we will be publishing a range of articles covering Gen Gray's service and the legacy he has left the Marine Corps. Semper Fidelis.

**Christopher Woodbridge**

The *Marine Corps Gazette* (ISSN 0025–3170) is published monthly by the Marine Corps Association to provide a forum for the exchange of ideas that will advance knowledge, interest, and esprit in the Marine Corps. Periodicals postage paid at Quantico, VA, USPS #329-340, and at additional mailing offices. • OPINIONS expressed herein are those of the authors and do not necessarily reflect the attitude of the Department of Defense, Navy Department, or Headquarters Marine Corps. "Marine Corps" and the Eagle, Globe, and Anchor are trademarks of the U.S. Marine Corps, used with permission. • MEMBERSHIP RATE: Annual $42.00 • ADVERTISING QUERIES: Contact Valerie Preletz at advertising@mca-marines.org/703–640–0107 or LeeAnn Mitchell, VP Sales at 703–640–0169. • COPYRIGHT 2024 by the Marine Corps Association. All reprint rights reserved. • EDITORIAL/BUSINESS OFFICES: All mail and other queries to Box 1775, Quantico, VA 22134. Phone 703–640–6161. Fax 703–640-0140. Location: Bldg #715, Broadway St., Quantico, VA 22134. • E-MAIL ADDRESS: gazette@mca-marines.org. • WEB ADDRESS: www.mca-marines.org/gazette. • CHANGE OF ADDRESS: POSTMASTER: Send address changes to *Marine Corps Gazette*, Box 1775, Quantico, VA 22134 or e-mail: mca@mca-marines.org. • For credit card orders, call 866–622–1775. PUBLISHER'S STATEMENT: Publication of advertisements does not constitute endorsements by MCA except for such products or services clearly offered under the MCA's name. The publisher reserves the right to accept or reject any advertising order at his absolute discretion.

# IN MEMORIAM

**GENERAL ALFRED M. GRAY JR.**
**1928-2024**

March 20th marked the loss of a true legend of our Corps. Gen Alfred M. Gray Jr., the 29th Commandant, passed away at 95. Gen Gray enlisted in 1950 and served in the Amphibious Reconnaissance Platoon, Fleet Marine Force, Pacific, earning the rank of sergeant. He was commissioned on 9 April 1952. A "Marines' Marine," for the next 39 years few in the Corps would ever see as diverse and varied career. Gen Gray served as an artillery officer, an infantry officer, a communications officer, an aerial observer, and an intelligence officer. He served multiple overseas tours including Korea and Vietnam in both staff assignments and command at every level from Platoon through MAF and Fleet Marine Forces. Gen Gray assumed the office of Commandant on 1 July 1987 and retired on 30 June 1991. In retirement he remained an active and engaged advocate for the Marine Corps and the individual Marine.

His influence on the Corps is still evident today and his legacy includes our tactical doctrine and warfighting philosophy: Maneuver Warfare, Marine Corps University, the Gray Research Center and the Corps' commitment to professional military education for officers and enlisted Marines. Above all, the focus on combat readiness, and the ethos of "Every Marine a Rifleman" remain the most enduring impact of Gen Gray's leadership on our Corps. Semper Fidelis

# SEMPER FIDELIS

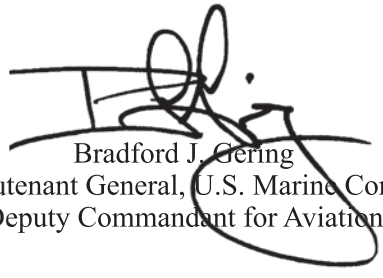
For 112 years, Marine Aviation has delivered unprecedented speed, agility, depth, and lethality throughout the battlespace and across the range of military operations. During operations on Guadalcanal in 1942, Aviation Marines from the Cactus Air Force established an expeditionary advance base at Henderson Field, defended it from Japanese ground and naval attack, generated sustained combat power that successfully repelled enemy air attacks, provided close air support to 1st Marine Division, and conducted long-range reconnaissance and strike missions in support of Fleet operations to attrite the Japanese Imperial Navy. Today, we reflect on the accomplishments of the Cactus Air Force to inform how Marine Aviation will evolve to deliver dominant capabilities to all echelons of the Marine Air-Ground Task Force, the Naval Force, and the Joint/Combined Force across the spectrum of conflict.

As the 44th Deputy Commandant for Aviation, my duty to the Commandant is to develop, integrate, and coordinate plans and policies to manage the total life cycle of Marine Aviation programs. The team here in the Aviation Hallway executes those duties through partnerships with our other Deputy Commandants, the Fleet Marine Force, the Naval Aviation Enterprise, and industry. As directed by CMC 39, Marine Aviation is balancing the sustainment and upgrades of current platforms to meet our enduring crisis response requirements, while executing deliberate force modernization across all functions of Marine Aviation. Our modernization focuses on an evolutionary approach to the way the Marine Corps fights, and our endstate is to maintain Marine Aviation's competitive advantage across the range of military operations and all warfighting functions.

Project EAGLE is Marine Aviation's threat-informed modernization strategy, spanning three Future-Year Defense Program cycles out to 2040. Project EAGLE is nested in higher headquarters guidance, supports Combatant Command current and projected requirements for crisis response and operational plans, and is resource-informed. Project EAGLE evolves the Aviation Combat Element with the changing character of warfare while introducing cutting-edge technologies that tip the tactical advantage in our MAGTF Commanders' favor.

Marines, much like the Cactus Air Force did in their day, the hard work you're doing around the globe, from crisis response to campaigning forward of the International Date Line, is writing another chapter in the history of Marine Aviation. Whether you're maintaining our aircraft, controlling or refueling from a distributed aviation site, transitioning to a new warfighting platform, or flying into a dark and dusty objective area, you remain our most lethal and essential asset. Your innovation in the face of uncertainty is unrivalled, and frankly keeps our adversaries awake at night. I encourage you to read the thoughtful articles in this *Marine Corps Gazette*, engage in constructive discourse with our team in the Aviation Hallway, and join us as we chart the path forward for the Aviation Combat Element.

Semper Fidelis,



Bradford J. Gering
Lieutenant General, U.S. Marine Corps
Deputy Commandant for Aviation

# Project EAGLE

## Reorienting Marine Aviation's Lift Vector toward 2040

by LtCol Gavin "Toto" Robillard

Societal divisions, state tensions, and contested international norms are setting conditions for a volatile and potentially dangerous future. Although these conditions are not new to history, the addition of rapidly evolving demographic, environmental, economic, and technological developments present both tremendous opportunity and significant challenges to the Marine Corps.[1] Given these conditions and developments, the Marine Corps seeks to continually refine its understanding of the future operating environment and refine relevant operating concepts to compete beyond 2030.

Most importantly, Marine Aviation must be able to deliver the lethality coefficient to the MAGTF, Joint Force maritime component command, and the broader Joint Force when called upon. To deliver the necessary lethality, Marine Aviation endeavors to leadturn the acquisition of capabilities and advanced technologies through a Three-Future Years Defense Program (FYDP) plan, starting in fiscal year 2026. We will use *Force Design 2030* and force modernization guidance as the strategic waypoint to address current challenges while setting conditions to compete in the next decade. In collaboration and coordination with the Commandant of the Marine Corps' Office of Net Assessment and the Marine Corps Warfighting Lab's Futures branch, Marine Aviation will continue to contribute to the strategic design effort by forecasting challenges out to 2040 and establishing a plan that allows Marine Aviation to outpace our adversaries.

Marine Aviation's Project EAGLE is that plan. Project EAGLE's embedded three-FYDP plan is the strategic lift vector of Marine Aviation to 2040. The objective is to achieve a framework that enables the Marine Corps to adjust the current Planning, Programming, Budgeting, and Execution Assessments process to meet the correct future operational requirements. The approach seeks capabilities and technological innovations that exceed a single FYDP to provide informed predictability and flexibility. The unconstrained planning of future FYDPs provides opportunities to invest in the current FYDP in the procurement of future technology to match the changing environment and ensure Marine Aviation remains an integral member of the Joint Force.

***>LtCol Robillard is currently assigned as the Lead Aviation Strategy and Plans Officer for Headquarters, Marine Corps Department of Aviation.***

Fundamentally, war is both timeless and ever-changing. As Marine Aviation adapts and evolves to the changing character of conflict, we shall remain true to our identity and honor all the hard aviation lessons learned over the years. Therefore, Project EAGLE is guided by the following priorities:

- Support the MAGTF in force modernization efforts via the functions of Marine Aviation.
- Ensure detailed collaboration and interoperability with the Joint Force maritime component command.
- Support broader joint and coalition force efforts of interoperability and interchangeability.

Project EAGLE has *three* phases. These phases are specifically designed to support CMC 38's initial force design guidance and CMC 39's force modernization vision. In addition, Project EAGLE phases are intended to provide more analytical rigor to the Marine Corps' budget planning and programming. These phases also provide an opportunity to communicate a clear and steadfast vision of Marine Aviation to the Department of Navy, Office of the Secretary of Defense, Congress, and industry.

### Phase I: Framework Development

This phase began in the summer of 2022 and will continue to be refined throughout all phases. The following were areas of focus during Phase I:

- Initial research and orientation of historical demographic, environmental, economic, and technological developments, and the impacts of these variables on the current environment.
- Understanding the future operating environment and emerging trends.
- Development and research of potential concepts and functions.
- Initial development of lines of effort (LOEs), roadmaps, and key milestones out to 2040.

### Phase II: New CMC 39 Guidance

This phase began in the fall of 2023 and will continue to be refined throughout Phase III. The objective of this phase is to refine the vision and LOEs developed during Phase I and implement appropriate CMC 39 guidance at the beginning of fiscal year 2024. This phase will also include the publishing of the *Aviation Plan (*AVPLAN*)* in December of 2024. The AVPLAN has been a vital tool to communicate the Deputy Commandant for Aviation's vision and direction to multiple audiences. This annual message will again transmit DC Aviation's rudder steers and altitude changes to maintain alignment and focus on Marine Aviation's core responsibility of supporting the MAGTF.


***Project EAGLE placemat.*** *(Image provided by author.)*

## Phase III: Execution

This phase will begin in the summer of 2025 and will continue through 2040. Phase III will incorporate actions from Phase I and II and will introduce FYDP 41–45's vision for planning.

## Project EAGLE Has Five Lines of Effort (LOE)

*LOE 1: Concepts*

Marine Aviation is looking at the viability of two new concepts: distributed aviation operations (DAO) and decision-centric aviation operations (DCAO) 2040. These concepts are nested with and support expeditionary advanced base operations (EABO), Stand-in Forces, and broader Joint Force operating concepts. These aviation concepts, which will be tested and developed via the Marine Corps' Concept Generation and Development Process, will drive aviation strategy, doctrine, and acquisition planning.

- DAO. As part of *Force Design 2030* and force modernization, Marine Aviation must further its capabilities for operating in austere and distributed littoral environments as an essential element of the Stand-in Force, and in support of EABO. Included in this functional concept is the need to review the traditional functions of Marine Aviation.

***Marine Aviation functions is to provide a framework for planners in planning aviation operations, but this requires having relevant aviation functions.***

- DCAO 2040. The central idea of DCAO is to accelerate the decision cycle of the ACE to machine-level speeds using cutting-edge and emerging technologies. The intent is to enable the rapid composition and decomposition of a more distributed force achieving the benefits of mass while minimizing the risks associated with concentration. Current studies are underway to assess the full requirements and efficacy of DCAO 2040. However, DAO is the first step towards DCAO 2040.

*LOE 2: Functions of Marine Aviation*

Marine Corps Warfighting Publication 3-20, *Aviation Operations*, directs planners to consider aviation functions when conducting aviation planning and not the means available (i.e., weapons systems or platforms). The role of the Marine Aviation functions is to provide a framework for planners in planning aviation operations, but this requires having relevant aviation functions.

The existing six functions of Marine Aviation (offensive air support, antiair warfare, assault support, aerial reconnaissance, electronic warfare, and control of aircraft and missiles) were critical to the Marine Corps' success in conducting expeditionary land and amphibious operations. However, based on the changing global environment and technological developments, a modernized Marine Aviation functional framework is necessary for planners

to approach today and tomorrow's maritime campaigns. Current studies are underway to assess the efficacy of expanding the functions of Marine Aviation to better support joint and coalition forces in a maritime campaign.

*LOE 3: Digital Data-Centric Culture*

To maintain a competitive advantage in future conflicts and meet the current mission requirements, Marine Aviation will *embrace* a digital data-centric culture, *equip* the ACE with cutting-edge artificial intelligence (AI) tools and knowledge, and *enhance* the Marine Corps' asymmetric warfighting capability leveraging AI and other emerging technologies. Marine Aviation is dedicated to creating a digital data-centric culture where AI agents serve as a force multiplier and a teammate in the ready room, on the flight line, in the field with our enablers, and in the cockpit. When fully integrated into aviation operations, AI agents will enable the seamless and rapid move from in, on, and out of the loop against our adversaries.

Becoming a data-centric and data-enabled organization will enhance Marine Aviation's culture, risk management, efficiency, effectiveness, and decision making. Such a change requires leadership at all levels, trust in data, and investment in infrastructure, personnel, and training. Developing a digital data-centric culture within Marine Aviation will be challenging at first, but it is a key component to supporting force modernization efforts, DAO, and DCAO 2040 concepts.

*LOE 4: Three-Future Years Defense Program*

LOE 4 will address the specific priorities and allocation of resources and funding across the next three FYDPs to support the future vision of Marine Aviation encapsulated in Project EAGLE.

*LOE 5: Roadmaps*

The following proposed roadmaps for Project EAGLE involve multiple key stakeholders within HQMC and will require detailed collaboration and coordination across the enterprise for implementation.


***Structural forces, emerging dynamics, and advanced threats require a new and evolving Marine Corps operating concepts out to 2040.*** *(Photo provided by author.)*

- Vertical Takeoff and Landing Development Portfolio.
- MAGTF Unmanned Expeditionary Development Portfolio.
- Aviation Command and Control and Ground Support.
- Aviation Sustainment 2040.
- Infrastructure Roadmap 2040.
- Ranges Roadmap 2040.
- Live/Virtual/Constructive Roadmap 2040.
- Aircrew Recruitment and Retention Roadmap.

**Developing a digital data-centric culture ... will be challenging at first, but it is a key component to supporting force modernization efforts ...**

## Bottom Line

Structural force changes, emerging technologies, and advanced threats require new and evolving Marine Aviation operating concepts to deliver the lethality coefficient when required. First, DAO, DCAO 2040, and decision-centric concepts provide pathways into fighting in future operating environments. Second, the review of the six functions of Marine Aviation is essential to supporting EABO, joint operating concepts, and *Force Design 2030*. Third, transformational capabilities such as AI, ML, and the cultivation of a digital data-centric culture will equip Marines with digital tools and knowledge to enhance their warfighting capabilities within the ready room, on the flight line, in the field with our enablers, and in the cockpit. Project EAGLE reorients Marine Aviation's lift vector and is the next waypoint in the Commandant's vision for force modernization to ensure the Nation's 911 force remains agile, dynamic, and ready.

**Notes**

1. Office of the Director of National Intelligence, *Global Trends 2040–A More Contested World,* (Washington, DC: 2021).

# Distributed Aviation Operations

## A functional concept for alignment and planning

by LtCol Gavin "Toto" Robillard

Aviation is essential for distributed forces to leverage the virtues of massed effects without the vulnerabilities of concentrated forces. Maneuver warfare is not new, and the importance of the ACE in enabling the Marine to sense, make sense, locate, close with, and destroy the enemy is indisputable. However, the future operating environment demands Marine Aviation advance its ability to operate in a distributed littoral environment as an essential element of the Stand-in Force (SIF), in support of expeditionary advanced base operations, and naval campaigning. Existing aviation concepts, battle-tested over the past century, are now insufficient to enable critical future warfighting imperatives—persistence at scale, maneuver at range, tempo in depth, resilience across data exchange pathways, multi-domain command and control (C2), and massed effects in all domains.

As an example, the Marine Corps' SIF is at the forward edge of a partnered maritime defense that denies the adversary freedom of action by enabling distributed effects across multiple domains. Enabling these distributed effects requires a force that is adept at reconnaissance and counter-reconnaissance, digitally interoperable within the MAGTF and across the Joint Force, has capabilities that are interchangeable with joint and coalition partners, and physically capable of maneuvering with speed and depth across expansive geographic areas. Marine Aviation fills these requirements with critical capabilities that integrate aerial and ground sensors with lethal fires and long-range maneuver and sustainment, enabling the SIF to thrive in a multi-domain, contested environment. To maintain this advantage, Marine Aviation must continue the iterative development of capabilities and concepts for conducting persistent distributed aviation operations (DAO).

***>See bio on page 6.***

DAO is not and cannot be a functional concept designed for a specific area of operations, operational plan, or MAW. DAO, as a functional concept, allows for Marine Aviation to communicate to the other elements of the MAGTF—as well as joint, coalition, and industry partners—how the ACE intends to fight and develop capabilities aligned with Project EAGLE. The DAO functional concept is not intended to direct the operational commanders on how they will fight their formations but is simply the functional umbrella with which the operational forces can develop focused tactics and training. In general, DAO must overcome challenges in four broad areas: operating in contested areas against a peer adversary, expanding operational reach in all operating areas, generating sorties in austere environments, and integrating with the Joint Force.

*Central Idea.* The central idea of the DAO concept is to create a lethal, resilient, persistent, and sustainable ACE while simultaneously inducing complexity and uncertainty for the enemy through the persistent distribution of aviation elements across extended distances; the operation of distributed aviation elements with minimal aviation logistic support from rear-areas; and networking distributed aviation elements with SIF, joint, and coalition C2 systems.

***Maneuver warfare is not new and the importance of the ACE in enabling the Marine to sense, make sense, locate, close with, and destroy the enemy is indisputable.***

*Supporting Ideas.* DAO has three supporting ideas: reassessment of the functions of Marine Aviation, hybrid decision support tools (HDST), and logistics in support of DAO.

First, a reassessment of the functions of Marine Aviation is necessary for planners to approach the complexities of a modern joint and combined maritime campaign against a peer adversary. An examination of the Navy's doctrine reveals that the Navy does not use aviation functions for planning. Given that

Marine Aviation will contend with supporting ground forces while supporting a joint and combined maritime campaign, it would be unwise to abandon the use of aviation functions for planning. Instead, the Marine Corps should consider a reformed functional framework for Marine Aviation, which integrates existing Marine Aviation functions and new functionality for the maritime domain.

Integrated aviation operations bring together effects from multiple domains to deliver combined arms protection and offensive power in support of joint operations in littoral operating areas.

***Integrated aviation operations bring together effects from multiple domains to deliver combined arms protection and offensive power in support of joint operations in littoral operating areas.***

The proposed modifications remain largely tied to the six functions of Marine Aviation, as those concepts remain valid and timeless. The new-tentative construct adds elements of 21st-century lethality to the functions of Marine Aviation, most prominently by replacing the control of aircraft and missiles with multi-domain C2. As Marine Aviation develops capabilities to produce effects across all the warfighting domains its organic C2 capabilities must also evolve as part of the greater MAGTF and joint C2 systems to enable aviation-centric kill webs.

One additional function is proposed to account for the resourcing and importance of these priorities in the Force Design envisioned expeditionary advanced base operations ecosystem. The separation of aviation ground support as a function of Marine Aviation is critical to clearly outline the roles and responsibilities of logistical and engineer support to an ACE executing DAO and serves as a critical enabler to joint aviation assets. Though non-ACE logistics and engineers will also be enablers to the ACE capacity, the resident Marine wing support squadrons and other logistical elements, such as the Marine Aviation logistics squadron, assigned to the ACE will conduct unique tasks to ensure ACE warfighting capacity.

Ultimately, DAO will stress all the functions of Marine Aviation. A new look at the functions and the authorities necessary for those functions to integrate across the Naval Services, Joint Force, and our coalition and allied partners are required to reduce redundancy with our Navy-Marine Corps aviation team. To that end, planners must recognize the high demand for aviation assets, the low density of Marine assets across a massive theater, and the necessity for flexibility of Marines across the spectrum of Marine Aviation to successfully employ all functions of Marine Aviation in any environment.

Second, HDST will accelerate the decision cycle of the ACE to machine-level speeds using cutting-edge and emerging technologies thus enabling the rapid composition and de-composition of a more distributed force. HDST derives its doctrinal foundation from the philosophy contained in *MCDP 1, Warfighting*. *MCDP 1* states, "War is both timeless and ever-changing. While the basic nature of war is constant, the means and methods we use evolve continuously. If we cease to refine, expand, and improve our profession, we risk becoming outdated, stagnant, and defeated."

HDST provides a potential solution to the rapid and exponential evolution of warfare in the 21st century. HDST combines emerging technologies with concepts found in the indirect approach writings of Sun Tzu, B.H. Liddell Hart, and John Boyd. HDST harnesses maneuver warfare that originates from a desire to circumvent a problem and attack from a position of advantage rather than meet it straight on. The following areas require further investigation and research to fully identify all the characteristics of HDST within the DAO concept:

- Decision-centric approach to military operations.
- Human Command with machine-assisted control (C2).
- Harnessing emerging technologies and concepts.
- Fractionated and heterogeneous force—dynamically composed.
- A means to accelerate capability development and fielding.
- Composable architecture and capabilities.

Third, logistics in support of DAO envisions a dispersed logistics system that sustains distributed Marine Aviation assets within a peer adversary weapons engagement zone (WEZ). Current and future Marine Corps assault support aircraft and unmanned logistics systems—air platforms are postured to mass dispersed logistics across a network of key locations to sustain Marine Aviation operations during an escalation from steady state to combat operations. Goal: Marine Aviation can quickly move and operate from numerous sites and will not concentrate on a central location.

Marine Corps aircraft will operate persistently away from traditional aviation logistics infrastructure by employing from outside the WEZ and dispersing across a network of landing zones and air sites inside the WEZ. Distributed Marine wing support squadrons engineering capability will create and maintain the network of air sites for operations by assault support aircraft. This will enable the ACE to conduct a myriad of operations during competition and will be postured to transport logistics support across the air sites during and throughout the range of military operations.

Maintenance policy and procedure changes will enable aircrew to keep the aircraft at a high state of material readiness during extended periods operating inside the WEZ. Predictive maintenance processes will improve the readiness of aircraft/systems operating inside the WEZ and enable a proactive

posture of aviation logistics. Technical solutions will enable nontraditional personnel to perform maintenance functions that currently reside with specially qualified maintainers. Rear area (outside the WEZ) maintenance organizations will monitor aircraft health and coordinate right-time-right-fit logistics as required. A network of air sites will build the structure to support fueling, arming, and expeditionary maintenance for aircraft executing combat operations. External lines of communication from outside the WEZ will feed the internal lines of communication between the network of air sites inside the WEZ. Austere sites are identified inside the WEZ to support various combinations of fueling, ordnance, and maintenance, operations. Air sites provide a location for limited-duration aviation sustainment. A network of air sites enables the availability of logistics resources for immediate use without concentrating resources for long-term storage.

Logistics in support of DAO must enable extended operations with minimal to episodic logistics support from rear area maintenance infrastructure. This will require new material solutions, policy changes in aircraft scheduled maintenance procedures, cutting-edge augmented reality devices with the ability to communicate with rear area maintenance personnel, enhanced aircrew maintenance training syllabi, and a review of current tactics, techniques, and procedures.

In conclusion, Marine Aviation is essential for distributed forces to leverage the virtues of massed effects and fill these requirements with critical capabilities that integrate aerial and ground sensors with lethal fires and long-range maneuver and sustainment, enabling the SIF to thrive in a multi-domain, contested environment. To maintain this advantage, Marine Aviation must develop capabilities and concepts to conduct persistent distributed aviation operations. The DAO functional concept provides the overarching conceptional alignment to overcome the challenges of operating in contested areas against a peer adversary, expanding operational reach in all operating areas, generating sorties in austere environments, and integrating with the Joint Force. DAO also provides the operational concept that informs capability development aligned with Project EAGLE to 2040.

USMC

# Project EAGLE LOE 3

## Data-centric decision-making vision and strategy

by LtCol Gavin "Toto" Robillard

### Vision

To maintain a competitive advantage in future conflicts and meet the current mission requirements, Marine Aviation will *embrace* a digital data-centric culture, *equip* the ACE with cutting-edge artificial intelligence (AI) tools and knowledge, and *enhance* the Marine Corps' asymmetric warfighting capability by leveraging AI and other emerging technologies. Marine Aviation is dedicated to creating a digital data-centric culture where AI technology serves as a force multiplier and a teammate in the ready room, on the flight line, in the field with our enablers, and in the cockpit. Teaming with AI technology will enable Marine Aviation to seamlessly move from *in, on*, and *out* of the loop against our adversaries.

### Background

The DOD's Chief Digital and Artificial Intelligence Office (CDAO) is the senior official responsible for the acceleration of the DOD's adoption of data, analytics, and AI to generate decision advantage across the enterprise, from the boardroom to the battlefield. Stood up in February 2022 by integrating the Joint Artificial Intelligence Center, Defense Digital Services, the chief data officer, and the enterprise platform Advana into one organization, the CDAO is building a strong foundation for data, analytics, and AI-enabled capabilities to be developed and fielded at scale. Part of this foundation is ensuring the DOD has the necessary people, platforms, and processes needed to continuously provide business leaders and warfighters with agile solutions.

***>See bio on page 6.***

The Marine Corps established the Service Data Office within the Deputy Commandant for Information (DCI) to modernize the Marine Corps' approach to enterprise data management and tools and increase the adoption of AI capabilities with an emphasis on implementing flexible and agile mission capabilities across all echelons. DC Aviation is committed to supporting and implementing the initiatives and efforts from the CDAO and DCI and views them as critical to Marine Aviation's transformation demanded by Force Design and force modernization efforts.

***Marine Aviation is dedicated to creating a digital data-centric culture where AI technology serves as a force multiplier and a teammate ...***

As we continue into the third decade of the 21st century, it is imperative that Marine Aviation nest its local efforts under DCI and the broader CDAO effort by embracing a digital data-centric culture and equipping Marine Aviation with cutting-edge AI tools and knowledge to enhance our warfighting capabilities. Any such transformation is a complex process, but it is imperative if Marine Aviation is to harness current generative AI, machine learning (ML), and other emerging autonomous technological capabilities.

### *Strategy*

A digital data culture requires designing, procuring, testing, upgrading, operating, and sustaining Marine Aviation's software and hardware systems with data interoperability and application programming interfaces as key requirements. In line with CDAO and DCI efforts, *Talent Management 2030*, and overall force modernization guidance, DC Aviation must broaden efforts to *embrace, equip*, and *enhance* the current talent of data, ML, and analytics experts within the fleet and recruit new data experts within Marine Aviation. In addition, Marine Aviation must contract external expertise to support efforts in experimentations of AI, ML, and large language model implementation.

The following are key areas of focus within DC Aviation:

#### *Build a Digital Data-Savvy Leadership Team*

As Marine Aviation transforms, it will be essential to have leaders in place who understand the importance of data and can drive change. This includes understanding the basic tenets of generative AI (like ChatGPT) and ML.[1] In support of DCI's efforts, Marine Aviation will create a data-focused team, the Aviation Data Steward (ADS) Cell. The ADS Cell will be made up of uniformed and civilian AI subject-matter experts, academic and think-tank advisors, and augmented by Marine Innovation Unit data and AI subject-matter experts. The role of the ADS Cell is to guide Marine Aviation's digital data efforts and support CDAO and DCI's Service Data Office initiatives and the implementation

of those initiatives within DC Aviation and the ACE.

*Invest in Data Infrastructure and Analytics Tools*

Investments need to continue in data infrastructure and analytics tools tailored specifically to Marine Aviation but also integrated into the broader intelligence community, Office Secretary of Defense, combatant commanders, NAVAIR, and Headquarters Marine Corps digital infrastructure. This will ensure that Marine Aviation's data is easily accessible and that it can be analyzed in a meaningful way. It is important to ensure that the data infrastructure is scalable and can adapt as the organization's data needs evolve. Specific areas of focus include:

- Maximizing the digitization of all processes.
- Improving data quality/completeness.
- Putting data in the cloud.
- Setting up digital AI-assisted workflows within operations and maintenance departments (e.g., AI-assisted flight schedule creation and routing; AI-assisted scheduled and unscheduled maintenance planning tools).
- Developing specific AI-assisted analytic tools tailored for commanders, operation officers, aviation maintenance officers, safety departments, and training officers.
- The development of automated battle management aides to assist aviation commanders and aviation command and control Marines with both time-sensitive (i.e. current operations) and deliberate (i.e. targeting cycle) decision making.

***Marine Aviation is pursuing ... opportunities to equip and enhance Marines' understanding of how to use-data, AI-assisted large language model tools ...***

*Harness Current DOD Data Literacy Programs*

Data literacy is the ability to understand and work with data, and it will become increasingly important for more Marines within Marine Aviation to have these skills. Leveraging opportunities provided by CDAO, DCI, and Training and Education Command initiatives, Marine Aviation is pursuing training and development opportunities to equip and enhance

Marines' understanding of how to use data, AI-assisted large language model tools, and how to use them to inform decision making. Specific areas of focus include:

- Leverage current DOD data literacy programs and provide incentives to encourage their use (e.g., Digital University and MIT Horizon).
- Leverage the Marine Corps Software Factory (MCSWF) to bring Marines into the Aviation Hallway who are both trained and empowered to develop organic tools to meet the emerging needs of DCA's staff and the fleet. This includes the exploration of funding an aviation data squad within the MCSWF consisting of a product manager, developers, and IA/security exclusively focused on Marine Aviation priorities. This aviation data squad would be nested within the data platoons to enable multiyear development within the MCSWF. Upon experimentation and validation, this data squad could then eventually be deployed to support aviation software needs across the operational force.
- Draft a memorandum of understanding with DCI's MCSWF to establish an aviation data squad. The aviation data squad should be responsible for the organizational implementation of new technologies and processes built on data. The aviation data squad should be led by a uniformed member of the ADS Cell within the Cunningham Group but staffed by contract support at the outset with the potential to absorb the more technical roles into the uniformed structure as we educate a data-proficient workforce. The aviation data squad should be guided by ADS Cell to stay focused on the problem sets of their resource sponsor but be in direct support of MCSWF to remain aligned with institutional investments and to avoid diffuse or duplicative projects across different deputy commandants.

*Encourage Digital Data-Driven Decision-Making*

This will help ensure that data is being used to drive standardization across Marine Aviation. Data-driven decision making involves using data to test assumptions, evaluate performance, and make informed decisions in multiple areas such as operations and maintenance. To make the culture change, leaders will need to trust the data and the analytic tools that support decision making. Specific areas of focus include:

- Enhancing the pilot training officer's training plan through cutting-edge AI tools to increase the overall T-rating of squadrons.
- Enhancing the maintenance department's workflows, decision making, and priorities through cutting-edge AI tools to increase overall aircraft readiness.
- Compare machine learning models of Planning, Programming, Budget, and Execution Process (PPBE) investments with legacy decision-making processes (Council of Colonels).

***The goal of ... data-centric decision making is to increase a leader's ability to observe, orient, decide, and act ...***

- Utilizing data analysis and visualization tools generated through modeling and simulation assets to drive concept development and PPBE investments within Marine Aviation.

*Monitor and Measure Progress*

Establish metrics to track progress and measure the success of the transformation both internal to Marine Aviation and external DOD-wide efforts. It is important to keep track of what is working, what is not, and what needs to be changed. Continuously review the organization process and make necessary changes. Specific areas of focus include:

- Explore opportunities with the Inspector General of the Marine Corps to create dedicated functional area checklists on data and AI-assisted tool compliance.

***Future success in competition and battle requires seamless integration of cutting-edge AI technologies in decision making.***

- Begin a dialog with NAVAIR discussing the implications of AI-assisted maintenance processes and the necessary updates to current inspection policy and procedures.

## Conclusion

Future success in competition and battle requires seamless integration of cutting-edge AI technologies in decision making. To lead this approach, Marine Aviation will *embrace* a digital data-centric culture, *equip* Marines with digital tools and knowledge, and *enhance* their warfighting capabilities within the ready room, on the flight line, in the field with our enablers, and in the cockpit. The goal of Project EAGLE's LOE 3: data-centric decision making is to increase a leader's ability to observe, orient, decide, and act to manage tempo and outcycle our adversaries.

**Note**

1. ChatGPT (Generative Pre-Trained Transformer) is a chatbot launched by OpenAI in November 2022. It is built on top of OpenAI's GPT family of large language models and is fine-tuned (an approach to transfer learning) with both supervised and reinforcement learning techniques.

# Aviation's Evolution to Multi-domain Command and Control

**Harnessing the advantages of combined arms in multiple domains**

by LtCol Herbert J. Bowsher

Over the past century, Marines have relied on aviation to provide the majority of fire support and assault support for the MAGTF. At the center of this support is the Marine Aviation Command and Control System, the most capable military command and control (C2) formation in the Joint Force. Since 1943 when the Service formed the first air command and control units for service in World War II, the Marine Air Command and Control System has integrated air with other landbased supporting arms. Aviation command and control enables integrated MAGTF operations and the information flow that is vital to efficient aviation operations and effective decision making. In the past, Marine Aviation C2 doctrine and capabilities were based on interaction between the air and land domains. Today, advances in aviation platform capabilities necessitate a reevaluation of the scope of aviation C2. Current and planned air assets such as the F-35, MQ-9A Extended Range MAGTF Unmanned Expeditionary Medium-Altitude, High-Endurance aircraft, and combat collaborative aircraft bring new ways of supporting Marines on the ground and require our C2 formations to adjust accordingly. The purpose of this article is to explain how Marine Aviation C2 is evolving from the "control of aircraft and missiles" to multi-domain C2.

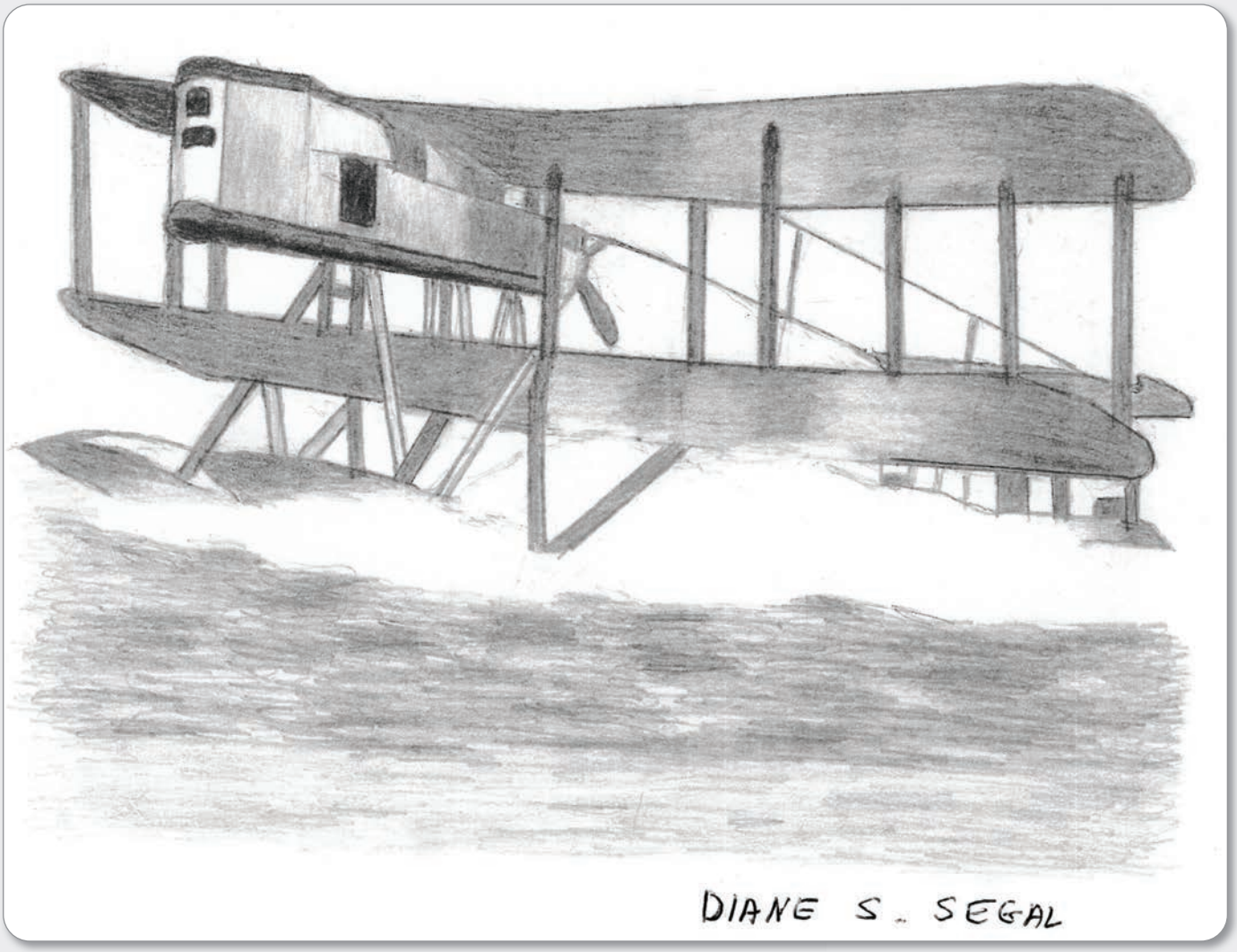
***>LtCol Bowsher is an Air Command and Control Officer currently serving as a Reserve Staff Officer, Aviation Expeditionary Enablers Branch, for the Deputy Commandant for Aviation.***

## What Is Changing?

The doctrinal six functions of Marine Aviation include control of aircraft and missiles, the function provided by the Marine air C2 system. The Marine Corps will retain the control of aircraft and missiles as a core function of the Marine Aviation Command and Control System, but it will broaden this doctrinal function to encompass the multiple domains in which aviation provides fire support in the objective area. The result is an aviation-centric, multi-domain C2 that enables effects in the air, land, sea, undersea, cyber, and electromagnetic spectrum.[1] The vision is an aviation C2 system that provides digital connectivity to link sensor to shooter in the most efficient way possible. Control of aircraft and missiles becomes a sub-function of multi-domain command and control. The goal of the change is to improve warfighting effectiveness against a peer adversary in a contested battlespace.

## Why the Change?

Multi-domain command and control harnesses the advantages of combined arms in multiple domains. The change is a recognition that our aviation capabilities have advanced to the point where control of aircraft and missiles no longer accurately describes the lethality available to the MAGTF. Our own capabilities such as F-35 and new drones provide the ability to achieve effects in the cyber domain, against enemy ships, enemy undersea platforms, and in the air and on land. Other Services offer even broader capabilities. In a realistic example, an F-35 aircraft acting as a sensor can send targeting data to an M142 High Mobility Artillery Rocket System that targets enemy surface ships.[2] Marine Aviation C2 provides the essential coordination and integration to enable these types of kill chains. Aviation C2 manages digital links between sensors such as traditional aircraft, radio antennas, or drones and the shooters such as missiles or warships that engage targets. Multi-domain C2 includes traditional air and land capabilities and also encompasses cyberspace operations control, C2 of drones (including UAS and loitering munitions), and signature management control. The change of terminology also recognizes the reality of the transforming character of war. The expected operating environment is a congested battlespace filled with sensors, drones, combat collaborative platforms, and unmanned underwater vehicles powered by advanced computer chips. Our adversaries are developing capabilities in all these domains. The Defense Science Board concluded in 2020 that "cross domain coercion and



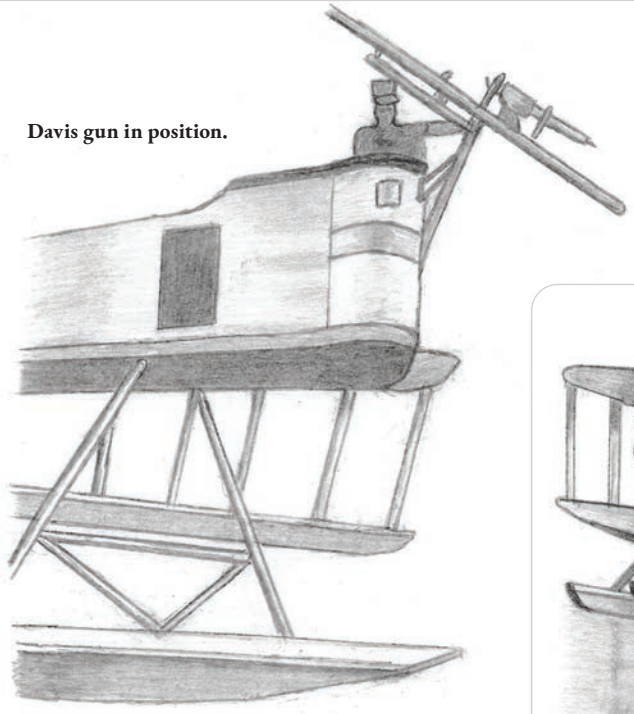

# N-1 FROM THE PHILADELPHIA NAVY YARD

**Written and Illustrated by DIANE S. SEGAL**

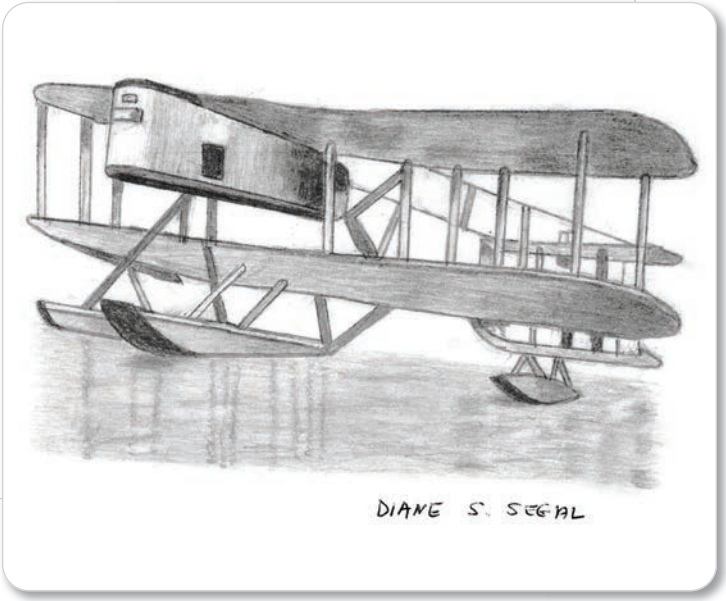
**Dedicated in loving memory to my mother,**

**DOROTHY M. SEGAL,**

**for her service to the Navy Department, Bureau of Aeronautics, Naval Air Experimental Engineering Command, in Philadelphia, Pennsylvania, as a civilian during World War II. Her work involved assisting in the preparation of confidential reports on radar, loran and sonar.**




**Davis gun in position.**




At the Philadelphia Navy Yard the Naval Aircraft
Factory in 1917 had its instruction
It was to start in-house aircraft production

The first aircraft to be designed and built there was a
maritime patrol aircraft, the N-1
It was designed to carry the Davis gun

The aircraft designer was Jerome Clarke Hunsaker,
an aeronautical engineer
In charge of aircraft design for the U.S. Navy,
his talents were clear

This Naval Academy/MIT graduate became a good lead
To give the U.S. Navy what it would need

In 1918 the N-1 had a Liberty L-12 water-cooled 45° V-12
piston engine and a 5,900 lb maximum takeoff weight
With a crew of 2 and a maximum speed of 94 mph
it was supposed to be great

The armament consisted of one Davis gun
It was developed by Naval Academy graduate and
U.S. Navy Commander Cleland Davis
just prior to World War I

The Davis gun was the first recoilless gun taken into
service and from small craft could be fired
By using Isaac Newton's Law was development inspired

Newton's Law of Motion: "For every action there is an
equal and opposite reaction" and on this the gun
development depends
So the gun shot at once from both ends

From the middle of the gun barrel
a loaded propellant charge fired an explosive projectile
out one end as it was meant
A charge of lead shot the same weight as the projectile
counterbalanced the recoil out the other end when sent

The sizes of the gun were not all the same
In 2-pounder, 6-pounder and 12-pounder sizes they came

It was the 6-pounder and ammunition
that the U.S. Navy chose
This was to arm and prepare the patrol seaplanes
when an opportunity arose

The guns, mounts and ammunition were easy to produce
This was an important consideration for their use

The N-1 had the misfortune of 2 crashes with the
prototypes made which were four
And so the project with high expectations was cancelled
and there were no more.

multi-domain effects will be critical for defending U.S. interests against strategic competitors."[3] This change to aviation-centric, multi-domain C2 also recognizes that Marine Aviation command control must connect with naval and other Service networks. The Marine Corps and other Services can no longer use the same disjointed approaches and expect to be successful against a peer adversary.[4] A team approach will be essential to effectively counter adversary regional military advantages. Aviation C2 formations enable the MAGTF to connect with multi-domain fire support from other Services and our allies and partners.

The risk of not adapting to the changing character of war is defeat in combat. According to the Defense Science Board, nations that cannot conduct multi-domain operations risk being surprised on the battlefield with potentially devastating consequences.

## What's Next?

The change from traditional air command and control to multi-domain C2 will require Marines to think more broadly about the support that aviation platforms provide, to train with our teammates in the other Services with expertise in these domains, and to assess and validate the change during exercises. More specifically, the challenge for Marine Aviation is threefold: first to integrate with other Service C2 systems. This requires significantly improved joint training. We must move beyond naval integration and connect with Army and Air Force capabilities. Second, exchange sensor information. Multi-domain C2 must make sense of, and oversee, increasingly congested battlespace and share information to achieve joint objectives. As generative artificial intelligence increases computing power it also makes war more complex. A strategy of deterrence will require varsity-level execution—which means better coordination across the MAGTF and with the other services. Finally, facilitate the command and control of distributed forces. The Ukraine War illustrates that dispersion, mobility, and deception are essential to survive combat.[5]

***Marine Corps air support network operator establishes communications for a tactical air control element during BALIKATAN 23.*** *(Photo by Cpl Marcus E. Melara.)*

## Train as You Intend to Fight

War in Ukraine also shows that every action in war brings an opposing and often unpredictable reaction from our adversary. The next step is continued assessment and validation of multi-domain C2 using rigorous live-fire exercises against a thinking adversary or red cell. We must test our assumptions and change the vision where needed. We have to train our forces operating across multiple domains to think about how the enemy might respond to our capabilities and decisions and in turn how we might creatively respond to the enemy's actions. In Ukraine, Russian military electromagnetic activity, including the use of GPS jammers, was effective against Ukraine's precision-guided munitions. But Russia's use of the jammers also enabled the Ukrainians to find and destroy them.[6] Other than observing actual combat, free-play exercises are how we learn to use multi-domain C2 to impose our will on the adversary. Exercises or wargames are also essential to provide commanders with experience with using new multi-domain capabilities. Commanders who understand these capabilities will be more likely to make better-informed decisions in combat.

***We must retain the ability to continue fighting even without access to critical information and communications systems.***

Exercises also expose the dangers of over-reliance on advanced communication systems.[7] Although digital networks using powerful computer chips offer advantages, dependence on these systems also may introduce vulnerabilities. We must retain the ability to continue fighting even without access to critical information and communications systems. Naval doctrine states that "we must be able to operate without exquisite capabilities when denied by the adversary, the environment, or by our own accord for operational and tactical advantage. That is the balance between the art and science of exercising C2 in today's information-intensive era."[8] While we need faster, better networked, more secure command, control, and communications, we also need Marines trained on basic HF radios who know how to continue operating based on intent in a denied or degraded environment. To cultivate the ability to op-

erate effectively based on intent in this environment, we must emphasize the development of Marines' discernment, creativity, and moral reasoning during realistic, free-play training exercises.

## Summary

This change to multi-domain C2 is about creating combined arms dilemmas for our adversaries. Marines across the MAGTF need to know that multi-domain C2 is not a slogan; rather, it is about improving warfighting effectiveness by taking advantage of a wider selection of fire support capabilities and rapidly providing that fire support to the objective area. Marine Aviation is leading the transformation of the MAGTF to a more lethal force that can impose our will on any adversary at any time and any place. The change to multi-domain C2 is a description and a mandate—a description of the broader set of capabilities aviation brings to the MAGTF and a mandate to train as we intend to fight.

### Notes

1. Department of the Navy, Headquarters Marine Corps, *C2*, (Washington, DC: 2023).

2. Miranda Priebe et al., *Multiple Dilemmas: Challenges and Options for All-Domain Command and Control* (Santa Monica, CA: Rand Corp, 2020). See also Karen Lema, "U.S., Philippine Forces Sink Mock Enemy Warship in Their Biggest War Games Yet," *Reuters*, April 26, 2023, https://www.reuters.com /world/us-philippine-forces-sink-mock-enemy-warship-their-biggest-war-games-yet-2023-04-26.

3. Department of Defense, Defense Science Board, *21st Century Multi-Domain Effects: Executive Summary*, (Washington, DC: 2020).

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5. Staff, "Ypres with AI," *The Economist* 448, No. 9354 (2023).

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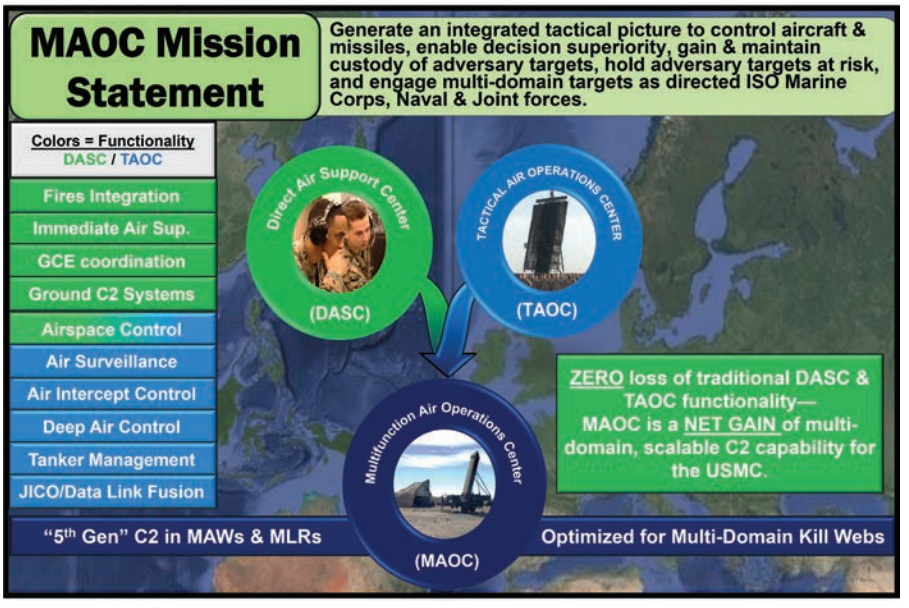
# "5th Generation" Marine Air Command and Control System

**The time for MAOC is now!**

by Maj Tony Megliorino III

A "kill chain" is a systematic process to target and engage an adversary to create desired effects.[1] The kill chain can be broken down into specific steps—find, fix, track, target, engage, and assess—that enable planners to build and task forces for combat operations.[2] Question to the force: what single organic Marine Corps tactical agency has the capability and capacity to receive, process, and integrate the information required to execute multidomain kill chains, at scale, with the Navy or Joint Force, and be relevant against a peer adversary? The answer is the Multifunction Air Operations Center (MAOC). Its mission is to generate an integrated tactical picture to control aircraft and missiles, enable decision superiority, gain and maintain custody of adversary targets, hold adversary targets at risk, and engage multidomain targets as directed in support of Marine Corps, naval, and Joint Forces. The Service has already acknowledged the MAOC's value proposition to the institution and its vital capabilities that will support the Marine Corps, naval, and Joint Forces. The publication of the Commandant of Marine Corps June 2023 *Force Design Annual Update* prescribed the directed action to "institutionalize MAOC" and sets the stage for the Marine Air Command and Control System (MACCS) transformation to meet the requirements of the future operating environment.[3]

The current MACCS organization is rooted in the Cold War era, optimized for the linear, air-land battle concept. A "5th generation" MACCS based on multifunctionally is required to leverage fielded and forthcoming aviation command and control programs of record to adequately contribute to the 21st-century Marine Corps and Joint Force. The *38th Commandant's Planning Guidance* articulated this problem four years ago, stating, "the current force is not organized, trained, or equipped to support the naval force—operating in contested maritime spaces, facilitating sea control, or executing distributed maritime operations."[4] To provide the MAGTF, naval, and Joint Forces with effective and efficient air command and control (AC2) in this environment, the MACCS must restructure its employment construct to support new and future operating concepts. Today's MACCS is sub-optimized for current




***MAOC Primer: MAOC mission statement.*** ***(Image provided by Marine Air Control Group 38.)***

***>Maj Megliorino is an Air Command and Control Officer assigned to Headquarters Marine Corps Aviation Expeditionary Enablers Branch as the Aviation C2 Subject-Matter Expert and Multifunction Air Operations Center Transition Task Force Lead Action Officer.***

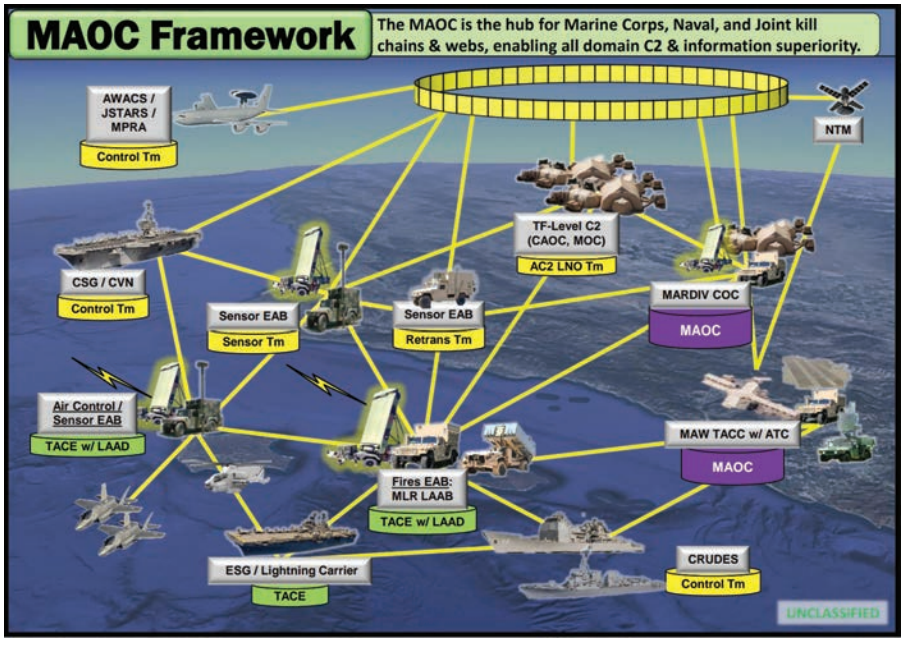
and future warfighting tasks and operates well below the capabilities of currently fielded AC2 equipment, driving the need for change. A prime example of this type of change is the tactical air community, which transformed and evolved with the F-35, recognizing the ever-changing character of war. The aviation C2 community missed opportunities over multiple decades to make changes required to onboard the increased capabilities in our 5th-generation weapons systems, namely, the Common Aviation Command and Control System (CAC2S), Composite Tracking Network, and the Ground/Air Task Oriented Radar.

Since the 1960s, the MACCS has changed very little in the way of organizational structure that produces functional agencies.[5] To this day, there exists a stovepipe-like approach to organizations within the Marine Air Command and Control Group. Squadrons are largely organized against task lines to perform specific functions of Marine Aviation by unit, which at one time had very disparate equipment sets.[6] Today, Marine Air Control Squadrons are largely dedicated to anti-air warfare mission sets; conversely, Marine Air Support Squadrons are largely dedicated to direct air support mission sets. At a time when AC2 systems were vastly different, this functional division met the requirements for the operating environment at that time. Since then, CAC2S has been fielded across all MACCS AC2 agencies, providing a "common" AC2 system for the MACCS writ large. This begs the question: why are we still functionally divided with equipment that is purpose-built to optimize all functions of AC2—specifically, control of aircraft and missiles?

The recognition of transformational change within the MACCS is not a new concept. The *Marine Corps Gazette* article, "Marine Air Control Group–Be Gone!" identified many of the same reasons for change almost 24 years ago. It identified growth in technology and network-centric C2 systems as the catalyst to steer away from "a specialized Marine Air Command Control system."[7] The author also makes the claim that the development of these more capable systems should result in flattening the overall C2 structure across the MAGTF.[8] Although the author's points start diverging from the position of this article, I believe the crux of their argument still rings true: "the fundamental shift in paradigms from specialized and centralized C2 to flatter, general, and decentralized C2 system allows us to observe, orient, decide, and act operationally at a faster tempo than ever before."[9] This sounds eerily like today's problem set of kill chains at the scale and tempo at which we will be required to operate.

These sentiments are further echoed in another *Marine Corps Gazette* article, "Airspace Integration, Multifunctionality provides for seamless control by the MAGTF commander."[10] The author makes some key historical tie-ins addressing the "Aviation Command and Control Transformation Task Force (AC2TTF) that was established by the Deputy Commandant for Aviation in 2005.[11] The AC2TTF examined AC2 against new warfighting concepts at the time, to include new systems like CAC2S, and potential changes to the structure of the Marine air command and control group and the redesign of MACCS agencies.[12] Given the timeframe that the AC2TTF was addressing these problem sets, Operation IRAQI FREEDOM was in full effect and largely affected the institution's appetite for transformational change. Coming full circle in 2024, in the wave of change with *Force Design 2030*, the Deputy Commandant for Aviation has established the MAOC Transition Task Force to carry out the Commandant's directed action to "institutionalize MAOC."[13] This TTF is a testament to the Service's appetite for change and acknowledgement of a gap in AC2 sufficient to meet future joint warfighting tasking. The solution to fill this gap is MAOC.

The Defense Advanced Research Projects Agency has established a concept called "Mosaic Warfare."[14] It uses the analogy of individual ceramic tiles compiled to compose a single picture. Likewise, individual warfighting platforms can be thought of as individual ceramic tiles that are composed to produce a "force package."[15] The collective idea of the concept is to send such a high volume of weapons and sensors at the adversary that they become overwhelmed and an ineffective force. The Defense Advanced Research Projects Agency's hard problem is that today's weapon systems have been exquisitely designed to fit a specific part of a greater




***MAOC Primer: MAOC framework.*** *(Image provided by Marine Air Control Group 38.)*

puzzle: if a piece is removed, another piece will not fit.[16] Similarly, if we think of our current MACCS agencies, if one were to be removed from the battlefield, another agency cannot simply replace their complete functionality. Because our current MACCS agencies are designed to perform specific functions of Marine Aviation, there is little ability to be resilient in continuing to provide critical AC2 capabilities to the MAGTF or Joint Force if an agency is rendered ineffective. MAOC provides this resiliency as future AC2 units will have the ability to produce common multifunctionality with the employment of multiple centers, elements, and teams that contribute to the greater force package.

This notion is further reiterated in a policy paper written by the Mitchell Institute for Aerospace Studies, which addresses kill-chain competition as it applies to the Air Force and its plan to maintain kill-chain superiority. The paper specifically identifies China's development of countermeasures to "obstruct or collapse U.S. kill chains, which could lead to combat failures that have devastating, long-term consequences for the security of the United States and its allies and partners."[17] Their solution to overcome this challenge is noted in the Service's ability to increase the scale, scope, speed, and survivability to execute its kill chains.[18] Execution of this concept requires a level of command and control in which the Air Force has identified the "Advanced Battle Management System" to dramatically increase the Service's ability to conduct multidomain kill chains and kill webs.[19] The general idea is that it creates a greater network of sensors and shooters, much like a mesh network, that enables their ability to complete find, fix, track, target, engage, and assess at the scale, scope, speed, and survivability needed to persist in a highly contested environment.[20] Reflecting on the article written in 2000, "Marine Air Control Group–Be Gone!" the author's key points of "network-centric C2" and "flattening the overall C2 structure" fit perfectly in a kill-chain dominance concept proposed here in 2023. Perhaps the author was ahead of their time; however, we have arrived, and the time for change and transformation of the MACCS community is now.

Similarities in how the Air Force may potentially address their hard problem can also be seen within the Navy today. The Naval Integrated Fire Control-Counter Air and the associated family of systems that comprise the greater sensor-shooter network is the Navy's solution to execute kill chains and greater kill webs. The Navy's system of systems is predicated on successfully employing three major pieces of equipment organic to the Marine Corps, specifically, CAC2S, Ground/Air Task Oriented Radar, and Composite Tracking Network to execute kill chains "from the land."[21] As previously stated, these essential pieces of equipment are the MACCS community's 5th-generation weapon systems that make the MACCS a critical component in closing joint kill chains. This has created a demand signal to form a tactical AC2 agency that is optimized to support this family of systems and integrate with the Navy's Cooperative Engagement Capability and greater Joint networks. The MAOC provides this capability to the MAGTF commander, enabling integration within the Navy's Composite Warfare Command construct and Navy Tactical Air Control System to rapidly exchange fire control quality data across a federated network.

Collectively, the core theme of this article is codified in the *Functional Concept for Marine Air Command and Control, Expeditionary Air Command and Control for the 21st Century Fleet Marine Forces*. The concept clearly articulates that the "Marine Air Command and Control System (MACCS) is not organized, trained, equipped, ready or postured to succeed in the future operating environment."[22] It states that rapid change is required to conduct multidomain operations, contribute the sea control and sea denial, and persist as part of a greater stand-in force.[23] Likewise, it notes that for the Marine Corps to meet the demands outlined in the *National Defense Strategy*, it must possess a MACCS that contributes to the FMF's and fleet's situational awareness, unity of effort, mission command, and enable lethal effects in a highly contested environment.[24] Marine Aviation has acknowledged this requirement and has responded with the initiative to institutionalize MAOC in support of the service and its greater Force Design efforts.

***The general idea is that it creates a greater network of sensors and shooters ... that enables their ability ... to persist in a highly contested environment.***

The institutionalization of MAOC is an ongoing effort underway across the Service with stakeholders throughout the FMF, Headquarters Marine Corps, and supporting establishments as critical equities to weave MAOC within the fibers of the Service. Lessons learned from current MAOC employment experimentation efforts, lead and executed by Marine Air Support Squadron 3, are being incorporated into requirements, training and readiness standards, and draft tactics publications which will shape the future of the MACCS. At the end of the day, this MACCS transformation provides the MAGTF with gains in efficiency via better trained and more capable AC2 Marines, highly flexible AC2 to support all functions of aviation, and a C2 construct (MAOC) able to rapidly scale to any size MAGTF and support the Joint Force.

**Notes**

1. Nicholas A. O'Donoughue, Samantha McBirney, and Brian Persons, "Distributed Kill Chains: Drawing Insights for Mosaic Warfare from the Immune System and from the Navy," *Menlo Security*, 2021, https://safe.menlosecurity.com/doc/docview/viewer/docN0F3F1300B1BF77a05259f29b0ed0dfdc67bfd977dbbb24e7b622fb52a3de29278ff0e2bc7b2b.

2. Heather R. Penney, "Scale, Scope, Speed & Survivability: Winning the Kill Chain Competition," *Mitchell Institute for Aerospace Studies*, May 3, 2023, https://mitchellaerospacepower.org/scale-scope-speed-survivability-winning-the-kill-chain-competition.

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8. Ibid.

9. Ibid.

10. Jeremy Winters, "Airspace Integration, Multifunctionality Provides for Seamless Control by the MAGTF Commander," *Marine Corps Gazette* 97, No. 5 (2013).

11. Ibid.

12. Ibid.

13. Ibid; and *Force Design 2030 Annual Update*.

14. "Airspace Integration, Multifunctionality Provides for Seamless Control by the MAGTF Commander." Distributed kill chains: Drawing insights for mosaic warfare from the immune system and from the Navy.

15. Ibid.

16. Ibid.

17. Ibid; and "Scale, Scope, Speed & Survivability."

18. "Airspace Integration, Multifunctionality Provides for Seamless Control by the MAGTF Commander."

19. Ibid.

20. Ibid.

21. Ibid; and "Distributed Kill Chains."

22. Headquarters Marine Corps, *A Functional Concept for Marine Air Command and Control, Expeditionary Air Command and Control for the 21st Century Fleet Marine Forces, Version 1.0,* (Washington, DC: 2022).

23. Ibid.

24. Ibid.

# Aviation Ground Support

## The critical capability in a modern concept of employment

by LtCol Jacob H. Wilde

Aviation ground support (AGS) is the ACE's primary aviation expeditionary maneuver enabler and the critical component that gives Marine Aviation its expeditionary capability. It directly supports the execution of the six functions of Marine Aviation and consists of tailored engineering and logistics capabilities (except aviation supply, maintenance, and ordnance) required for sustained air operations at airfields in austere environments.[1] Currently and for the foreseeable future, Marine Corps Aviation will remain the Service's most capable element for sensing and striking the adversary and enabling battlespace maneuver, making it the Marine Corps' best bid for success—its main effort and center of gravity. As such, AGS becomes the critical capability that enables sortie generation for all types of aviation operations.

The statements above may seem a bit jarring. Since its inception, and as later codified in law, the Marine Corps has been an infantry-centric force, with all other elements—including aviation—oriented to support the infantry in the "seizure or defense of advanced naval bases and for the conduct of such land operations as may be essential to the prosecution of a naval campaign."[2] With its recent hard turn toward expeditionary advanced base operations (EABO) in the Pacific Theater via Force Design, and its corresponding focus on small, agile, and lethal stand-in forces in the form of Marine littoral regiments, the Service has done something virtually unthinkable in the post-*FMFM 1* Marine Corps and effectively relegated its ground forces to a supporting effort. Instead of the massed-infantry assaults of the World Wars or the expeditionary forces in readiness of the 1990s, the Service intends to employ its forces in the seizure and defense of isolated sites from which to employ long-range precision sensors and weapons systems capable of locating and striking enemy ships, aircraft, and missiles in support of the fleet. While fielding continues for the various landbased and maritime systems required to achieve its vision, Marine Corps Aviation retains its role as the chief provider of fires and battlefield mobility.

For a variety of reasons, the Marine Corps' F-35B/C, MV-22, and CH-53E/K platforms are well suited for the type of operations envisioned for the geographical vastness of the Pacific in the face of our primary adversary's technological parity. Unfortunately, even with the robust aerial refueling capability provided by the Marine Corps and joint aviation, even the most capable aircraft require secure and functional ground sites at which they can rearm, refuel, and undergo maintenance. The Marine wing support squadron (MWSS) establishes aviation expeditionary advanced bases (EAB) and advanced naval bases (ANB) and performs the airfield and landing zone support activities necessary to sustain aviation operations via the six activities of AGS: forward aviation combat engineering, airfield operations, base recovery after attack, airfield damage repair, forward arming and refueling point operations, and aircraft salvage and recovery. Once established, these temporary EABs and

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***A Marine Corps MV-22B Osprey with Marine Medium Tiltrotor Squadron 265 (Rein), 31st MEU, lands at a forward arming and refueling point on Ie Shima, 31 January 2022.*** ***(Photo by Cpl Malik Lewis.)***

ANBs extend the operational reach, shorten the turnaround time, and enable rapid reconstitution of aviation forces.

First established in the late 1980s as part of the Marine Corps' transition to a maneuver warfare philosophy and formalization of its MAGTF organizational construct, the MWSS is responsible for providing expeditionary AGS to a composite MAG or other designated aviation forces. While each of the other Services possesses its own aviation element, the MWSS and the multi-functional task-organized capabilities it provides are unique to the Marine Corps and what makes its aviation elements truly expeditionary. In the absence of similar Service-specific capabilities, the Marine Corps is the only branch poised to offer truly expeditionary AGS to the U.S. Joint Force and its partners and allies, effectively establishing this capability as a new and additional function of Marine Corps aviation.

Unfortunately, the Marine Corps currently lacks sufficient AGS structure to fully support its own concept of employment—to say nothing of supporting joint or combined aviation forces. The Commandant's highly controversial initial phase of Force Design was intended to be a bold adjustment for the Marine Corps that included sweeping cuts and restructuring within its existing budget. Along with its divestment of tanks, tactical bridging, and several rotary wing attack squadrons, the Service also slashed approximately 35 percent of its AGS structure. From the outset, senior leaders recognized the significant risks posed by these changes and are now working to right-size the capabilities required to execute EABO. AGS has been identified as one of the critical capabilities too deeply cut and efforts are underway to restore sufficient structure to meet the requirements of distributed aviation operations as a component of EABO. These readjustments, if approved and funded, will enable a MAGTF or Joint Force commander to achieve maximum sortie generation for Marine Corps, naval, joint, and coalition aviation forces in crisis or conflict.

It has been said that while history does not repeat itself, it does rhyme, and the Marine Corps of today seems to be taking a verse out of its own storied history in the Pacific Theater. Many remember the heroic tales of the battles of Guadalcanal, the Marianas Campaign, Tarawa, Iwo Jima, and Okinawa, but few recall the purpose for which our famed divisions stormed those far-flung bits of rock: to secure airfields and anchorage for our air and naval forces. The significance and importance of AGS in the future fight cannot be overstated; it will be the single most critical supporting capability, first in scouting and surveying useable airfields and landing zones, in establishing and maintaining aviation EABs and ANBs, and in stretching the operational reach of the Joint Force's most critical aviation platforms. When partnered with a Marine Aviation logistics squadron, it will provide fuel, ordnance, and aviation maintenance from unsinkable sites well within the weapons engagement zone and sites from which to sustain and support small and mobile units in austere locations distributed across vast operational areas. Without AGS, our units will be rendered useless—unable to traverse the battlefield, seize and hold key terrain, or locate the enemy and destroy him at a time and place of our choosing.

To some, the suggestion that the MAGTF's main effort and center of gravity has shifted to Marine Aviation may be heretical, even blasphemous; however, for more than a century, Marine air has provided the bulk of the MAGTF's firepower and mobility and remains its most capable element in the anticipated future fight. The projection of AGS to expeditionary forward sites provides commanders with significantly broadened options and supports a dynamic and responsive concept of operations that exemplifies and enables true maneuver warfare. Supported by an equally dynamic logistics web, AGS is the critical capability that enables the MAGTF or joint task force to fight and win on its own terms.

***... it will be the single most critical supporting capability ... in stretching the operational reach of the Joint Force's most critical aviation platforms.***

**Notes**

1. Headquarters Marine Corps, *MCTP 3-20B, Aviation Ground Support*, (Washington, DC: 2021).

2. United States Marine Corps: composition; functions, U.S. Code 10 (1956), §5063.

# Directed Energy Weapons for Air Defense of the MAGTF

## Emerging capabilities to meet emerging threats

by Mr. Jim Lane

***Marines with the 2nd Low Altitude Air Defense (LAAD) Battalion set up the CLaWS at Camp Lejeune, NC, 20 February 2020. 2nd LAAD used the CLaWS to practice shooting down type-1 commercial drones and expand unit capabilities.*** *(Photo by Cpl Ethan Pumphret.)*

In a current Marine Corps recruiting commercial, expeditionary forces knock down enemy drones with pulses of energy. While the futuristic vision may look like a sci-fi movie trailer, ongoing technology initiatives are bringing directed energy (DE) weapons closer to the hands of fleet Marines. DE refers to the use of focused electromagnetic waves, such as lasers and microwaves, to produce a desired effect on a target. The force of the near future will have DE weapons as a layer of defense against drones and other airborne threats.

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Skeptics note that DE weapons have always been touted as a few years away, with technical challenges that always kept them from real military practicality. However recent advances have changed the utility equation dramatically, such as solid-state and fiber-laser technology that have reduced size and increased reliability. The Marine Corps was early to leverage these advances, and was at the forefront of high energy laser (HEL) weapons with the deployment of the Compact Laser Weapons Systems (CLaWS) to the Central Command theater in 2018.[1] CLaWS was a 2-5kW palletized system used in defense of forward operating bases, and actively countered several real-world drone attacks. With the success of this mission, LAAD Marines have now shot down more targets with DE than with their venerable stinger missiles.

As Marines transitioned out of those regional missions, those prototype systems were divested and later replaced by the Army's current palletized high-energy laser system. In the meantime, the Army and Navy have both introduced and are operating significant DE capabilities with designs oriented toward their respective Service missions. For Marine air defenders' projected mission, a particular mix of system characteristics is desired for emerging new generations of DE weapons. For the counter-UAS and air defense missions, both high-energy lasers and high-power microwave capabilities are under consideration.

To meet the need for modern, rugged, and sophisticated air defenses demanded by expected operating environments, the Marine Corps is developing and fielding new air defense weapons, sensors, and control systems as components of the Marine Air Defense Integrated System (MADIS) platforms

due to begin fielding later this year. The acceleration and proliferation of UAS, cruise missiles, and loitering munitions, along with the strategic re-focus to address near-peer adversaries, demands ever-advanced weapons for the next phases of MADIS evolution—especially DE.

## Evolving Mission

Marine ground based air defense (GBAD) forces are tasked to defend MAGTF vital assets and areas of operation against all types of air threats. Potential peer and near-peer adversaries operate ever-more capable aircraft and cruise missiles, and even non-state actors have access to UAS, rockets, artillery, and mortars. With the aging, handheld Stinger missile as the sole GBAD kinetic capability, the MAGTF has been mismatched or even overmatched against present and emerging air threats. MADIS was developed with these gaps in mind and Increment 1 begins arriving in the fleet this year. A near-term Block 2 capability enhancement will field trailers with an arms-room concept of mixed effectors, potentially including high-power microwave systems for close-in defense against UAS swarm threats.

***... the MAGTF has been mismatched or even overmatched against present and emerging air threats.***

As MADIS begins fielding, concepts for the next versions of the system are in development, including a DE-centric MADIS capability analogous to the Army's DE- maneuver-short range air defense. DE systems are rapidly becoming more tactically relevant to the counter-UAS; counterintelligence, surveillance, and reconnaissance assets; and air/missile defense missions for which these systems are designed. To pave the way, the Marine Corps is pursuing pathfinder initiatives and capability demonstrations to integrate high-energy lasers into the MADIS platform. Light-MADIS, the ultra-light tactical vehicle version of the system, would follow in the wake with similar capability scaled to its platform and mission.

## Why DE?

As an expeditionary air defense and counter-drone option, DE offers multiple potential advantages over conventional kinetic effectors.

- Given their flexibility, DE weapons might be used by GBAD in short-range air defense, counter-unmanned aircraft systems, or counter-rocket, artillery, and mortar missions. These weapons might be used to temporarily

disable or damage hostile surveillance platforms that may be conducting intelligence-gathering or weapons targeting.

- DE weapons are particularly well suited for countering small UAS threats. Lasers allow for quick responsive and precise engagements of airborne threats—a crucial advantage when dealing with small, agile UASs or other difficult targets. High-power microwave systems can serve as a close-in defense against a drone-swarm attack.
- By design, HEL systems are accompanied by extremely capable advanced optics that can contribute greatly to tactical situational awareness, including passive identification and intent determination. During lower-intensity phases of conflict, these capabilities would provide greater utility for the warfighter than the ability to actively affect targets.
- Conventional air defense systems often require large and complex logistical operations for ammunition resupply. DE weapons, relying on electrical power rather than physical ammunition, could significantly reduce the logistical burden, especially crucial for expeditionary missions.
- HEL weapons could potentially be designed to allow operators to apply graduated effects appropriate to the tactical situation.
- Although development and initial engineering costs can be high, DE systems have lower per-shot costs. Considering the low cost and proliferation of many UAS threats, employing DE weapons allows for reserving the limited numbers of high-cost, missiles for defense against cruise missiles or other higher-end threats.

## Making the DE Vision a Reality

In 2023, the Marine Corps Combat Development Command published a DE functional concept that describes the Corps' intent to develop and employ DE for several mission areas. Air defense concept documents currently in development will include the application of DE. Capabilities developers are planning the next increment of MADIS to be DE-focused, with the capability description document that will define the required capabilities for that system in the works.

***3d LAAD Battalion gunners set up CLaWS in Yuma, AZ, 30 July 2020.*** *(Photo by LCpl Larisa Chavez.)*

In support of the Marine Corps vision, the Office of Naval Research and Naval Surface Warfare Center Dahlgren has successfully demonstrated an expeditionary 5kW system mounted on a Humvee that has continued to evolve and produce knowledge and capability improvements. Current efforts continue with the aim of producing a 10Kw-range system integrated into a joint light tactical vehicle that will continue over the next year or so and pave the way for an envisioned DE-capable MADIS.

## Tailored for the Expeditionary Mission

For GBAD, DE weapons would prioritize some design characteristics over others. The desire to optimize basic performance parameters such as effective ranges, reaction time, engagement durations, and magazine depth is common across all Services' applications. However, the expeditionary mission demands a great emphasis on minimizing size, weight, power, and cooling requirements. This extends to host platforms and system transportability, and existing systems such as MADIS and L-MADIS are already very constrained for physical integration. Support services in the operating environments such as cooling and power will be rare or entirely unavailable. As the transit, operating environment, and physical demands placed on expeditionary systems are extreme, design emphasis on reliability and maintainability will need to be high.

## The Time for DE Is Here

Providing a DE capability to the warfighter is a Marine Corps priority. The Marine Corps development and acquisition communities are moving out with both demonstration activities and the development of operational and employment concepts as well as system requirements. Current and planned efforts are all-in with the inclusion and integration of DE systems to close operational gaps and provide technical, logistics, and tactical advantages. Soon that sci-fi vision will be realized as another tool in the Marine air defender's kit.

**Note**

1. Ashley Calingo, "Marine Corps at the Forefront for Ground-Based Lasers," *Marines.mil,* June 19, 2019, https://www.marines.mil/News/News-Display/Article/1880583/marine-corps-at-the-forefront-for-ground-based-lasers.

# Collaborative Combat Aircraft

**A technological and tactical key to future capabilities**

by Headquarters Marine Corps TACAIR & the Cunningham Group

***>Headquarters Marine Corps Tactical Aircraft (TACAIR) manages requirements within the Marine Corps F-35 Portfolio. The TACAIR Subject-Matter Experts have worked closely with the Cunningham Group, the F-35 Joint Program Office, the Air Force, and industry partners to continue Marine Corps Unmanned Expeditionary TACAIR development and integration with the F-35 system.***

The Marine Corps has a long tradition of innovation and experimentation with the application of emerging technologies needed to refine its warfighting employment concepts. In the interwar years, the Corps' focus on amphibious warfare provided the tactics and equipment essential to the island-hopping campaign of World War II. That same intellectual courage and unorthodox forward-thinking led to the creation of the MAGTF, which has been a key joint enabler for decades.

Today, in keeping with this tradition, the Marine Corps has taken significant strides to mold the stand-in force (SIF) as another key Joint Force enabler. The SIF has proven to be an important intellectual underpinning of U.S. strategy—especially in the INDOPACOM area of responsibility. The strategic reality of operating across vast geographic distances, in a nonpermissive environment, is a challenge American forces have not encountered since the Second World War. It demands improving existing capabilities and rapidly embracing emerging technologies. Specifically, advances in beyond-line-of-sight communication technologies, developments associated with 5th-generation F-35 mission systems as well as increased reliance on unmanned surface and aviation assets will be vitally important to Marine Corps' contributions to the combatant commanders' war plans in the future. One example of an emerging capability, in development by the Marine Corps, is that of collaborative combat aircraft (CCA) technology and its integration with the Service's existing systems. CCA are poised to be a cornerstone of future Marine Corps aviation capability and lethality.

***CCA platforms represent a groundbreaking approach, leveraging the power of connectivity and coordination among multiple unmanned aerial systems to enhance combat capabilities.***

## What Are Collaborative Combat Aircraft?

The paradigm of combat aircraft is undergoing a transformative shift with the advent of collaborative technologies. CCA platforms represent a groundbreaking approach, leveraging the power of connectivity and coordination among multiple unmanned aerial systems to enhance combat capabilities. One of the defining features of CCA is their ability to operate as a cohesive and synchronized unit, sharing information and adapting to dynamic battlefield conditions in realtime. This interconnectedness enables these aircraft to execute a wide array of tasks, from surveillance and reconnaissance to strategic strikes, with unparalleled efficiency and precision.

Furthermore, CCA technology redefines the concept of swarm intelligence in warfare. By operating as a collective entity, these aircraft can distribute tasks among themselves, optimize resource utilization, and respond swiftly to evolving threats. CCA also excels in its ability to operate across different domains, combining air, ground, and naval capabilities. This versatility allows military forces to conduct integrated operations with heightened effectiveness, offering a significant advantage in complex and multifaceted conflicts.

A 2022 Department of the Air Force Scientific Advisory Board study defined CCA as "uncrewed aircraft operating alongside the DAF's fifth or sixth generation crewed fighter ... employing a distributed, mission-tailorable mix of sensors, weapons and other mission equipment."[1] The Marine Corps views the definition and application of CCA assets in a similar manner, including in-


***A Marine Corps XQ-58A Valkyrie flies off the Florida coast during its second test flight from Eglin Air Force Base.*** *(Photo by MSgt John McRell).*

tegration with the SIF and the Service's F-35 aircraft.

Over the past two years, the Marine Corps Unmanned Expeditionary Tactical Aircraft (MUX TACAIR) efforts have focused on CCA development and integration with the F-35 system. Though the Service's objectives regarding future CCA requirements are currently being refined, foundational capabilities include:

- Rapidly Reconfigurable
  - Low observable platform able to adapt to changes in operating environments and evolving commander's objectives.
  - Variable payload options to support intelligence preparation of the battlefield/electronic support, target identification and registering (i.e., intelligence, surveillance, and reconnaissance), communications relay, full-motion video, target mensuration, and fused and distributed multi-spectral measurement.
- Semi-Autonomous
  - A "loyal wingman" to manned platforms in support of larger schemes of maneuver *or* the main effort to saturate, decoy, and mask the main element while providing electronic attack, cueing, and assessment of enemy reaction/readiness.
  - The ability to consider and capitalize on advancements in artificial intelligence/machine learning technologies to further mature autonomy.
- Persistent
  - The ability to loiter at long range in operationally challenging maritime environments will allow the concentration of forces when triggers/criteria are met for the employment of kinetic fires.

***The CCA platforms also transform the risk calculus ...***

  - The identification, classification, location, fixing, tracking, and targeting of naval surface vessels in over-the-horizon maritime operations will be key when engagement distances do not allow manned aircraft to search for targets and effectively employ specific high probability of kill weapons without cueing.
- Joint
  - Collaborative combat aircraft capabilities are embedded in the MAGTF and potential employment concepts are well understood by other members of the Joint Force.
  - Interoperability is paramount to enhancing the Marine Corps as a Joint Force enabler.

## Collaborative Combat Aircraft Benefits

The fundamental challenge of future conflict is that U.S. forces may not have the luxury of operating in a permissive environment. MUX TACAIR's goals include improved lethality, survivability, interoperability, and sustainability of 5th-generation tactical fighter/attack platforms via manned-unmanned teaming with CCA. Off-boarding weapons and sensors onto an unmanned leading edge will complicate the adversary's targeting solution, provide persistent coverage of the area of operations, safeguard aircrew, and provide risk-appropriate options for combatant commanders. Affordable mass in the form of CCA will allow the ACE of the future to support the SIF against a peer adversary in a contested environment and reverse the cost imposition curve in our Nation's favor.

Collaborative combat aircraft assets vastly expand battlespace awareness and sensing. They are part of a network of 4th/5th-generation aircraft and a host of other surface, sub-surface, airborne, and space sensors that provide near real-time data sharing. The CCA bring several advantages to a MAGTF or Joint Force commander, such as improved target identification, precision engagement, and more efficient mission planning. The CCA platforms also transform the risk calculus, functioning to keep Marines out of harm's way and allowing unmanned aircraft to operate in higher-risk areas of operation, in heavily contested environments.

The tailorable nature of CCA platforms offer access to a wide variety of capabilities necessary to support numerous mission sets. A plug-and-play functionality will support effects ranging from EA and kinetic fires to passive data collection. These benefits, coupled with advancements in autonomous technology, make CCA integration with the Marine Corps' F-35 fleet vital to future endeavors.

## F-35 Integration

The vast distances of the Pacific are a fundamental challenge. Acknowledging that challenge is one of the reasons the SIF concept has been developed. The Marine Corps deploys in a distributed manner; a core principle is the need to be relevant in the objective area;

therefore, the correct forces, in both capability and size, must be in the objective area. That logic underpinned the development and fielding of the F-35, and in the future, the integration of CCA technology that will maximize the F-35's capability to communicate and cooperate with the SIF as part of a broader advanced kill web. Moreover, joint interoperability and scale of such assets are the key to manageable cost, schedule, and performance of both the F-35 and CCA systems.

It was with that idea in mind that in 2023 the Marine Corps, supported by the DOD Rapid Defense Experimentation Reserve (RDER), began F-35 collaboration with the XQ-58 Valkyrie experimental unmanned combat aerial vehicle within the Penetrating Affordable Autonomous Collaborative Killer–Portfolio. The XQ-58 is a first step in unmanned integration with F-35s that can be tested and developed immediately. This program

***A Marine Corps XQ-58A Valkyrie during its second test flight escorted by two Air Force F-35A aircraft assigned to the 96th Test Wing at Eglin Air Force Base.*** *(Photo by MSgt John McRell.)*

is intended to demonstrate stand-in jamming onboard the XQ-58 in support of F-35 strikes against an adversary target that lies within threat weapons engagement zones. Current efforts have been funded by congressionally added resources and RDER. Experimentation efforts are intended to clarify and refine requirements documents and quickly field lethal capabilities to the Marine Corps. The use of modest RDER funding helped to facilitate the development of expeditionary aviation concepts, including a communications solution that will allow transmit and receive functionality between F-35 and CCA platforms. In the near future, the Marine Corps intends to demonstrate this functionality with the end-state goal of full integration within F-35 sensor fusion.

As this technology matures, the communications solution will be integrated within existing and future ground control station assets to enable both stand-off ground control from thousands of miles away and stand-in control by the SIF operating in contested environments.

In addition to ongoing experimentation with CCA/F-35 integration, additional studies will cover key CCA attributes, CCAs in a contested logistics environment, CCA impacts on F-35 survivability, and the ideal human-machine interface between 5th/6th-generation aircraft and CCA. This information will be used to inform future investment strategies that will directly impact the Service's ability to accelerate the integration of autonomous capabilities within the manned/unmanned kill chain.

## Collaborative Combat Aircraft Operational Example

An operational use case study might be the following: Imagine a Marine controlling a section of CCA platforms from a ground control station soon after their launch from a remote site. These platforms are part of a detachment forward deployed at an austere secure facility. From that position, the task is to fly the CCA several hundred miles over open water to be first on the scene and gather information in support of a key partner nation. As the CCA section is en route, an allied ship is boarded and attacked, which represents unprecedented aggression against a treaty ally ship by a neighboring threat nation. This event resulted in the immediate request for support to INDOPACOM.

The Marine controlling the CCA section receives tasking from the Joint Force maritime component commander and reroutes the aircraft, locating the captured ship. On station, the CCA section provides a comprehensive multi-domain picture using on-board sensors, edge processing, and networking leading to the discovery of three fishing vessels, one of which is adorned with anti-ship and anti-air systems. A joint naval mission is launched to recover the ship. The CCA acts as what might be termed a "next-generation on-scene commander," passing targeting data to a Marine littoral regiment which launches a naval strike missile at the weaponized fishing vessel from a previously undisclosed location ashore. The CCA loiter and link up with F-35Bs launched from a MEU, who then help with a long-range seizure and return of the ally's ship.

## The Future

Project EAGLE is the Headquarters Marine Corps Aviation strategy aimed at preparing Marine Aviation for the operating environment of 2040. It is executing along five lines of effort including concepts, functions of Marine Aviation, digital data-centric culture, three future years defense programs, and roadmaps. Collaborative combat aircraft development with F-35 integration will have equity along several specific Project EAGLE lines of effort. The intent is to inform future decisions regarding the development and application of CCA capabilities.

The fundamental requirement of all military planning is to design the force structure, operational concepts, and tactical capabilities that will be relevant and successful should they be called to action. The SIF concept was the first and most important step in confronting the threat we face today. The next step is creating the ability to leverage our technical and tactical superiority in a contested aviation environment. Massing survivable air power, leveraging information dominance, and operating in a faster decision cycle than our adversaries are paramount to successful future force design and concepts. The MUX TACAIR/Penetrating Affordable Autonomous Collaborative Killer–Portfolio efforts with CCA development and F-35 integration are vital to realizing future advantages against peer adversaries. CCA are poised to become a cornerstone in the future of military aviation, ushering in a new era of efficiency, precision, and strategic advantage on the battlefield.

***Massing survivable air power, leveraging information dominance, and operating in a faster decision cycle than our adversaries are paramount to successful future force design and concepts.***

**Notes**

1. Department of the Air Force, Scientific Advisory Board, *Collaborative Combat Aircraft for Next Generation Air Dominance*, (Washington, DC: 2022).

# A Modernized HMLA

## A MAGTF multi-tool for the peer fight

by Maj Erik W. Hickson

A multi-tool, such as a Leatherman, can be found on most packing lists of avid outdoorsmen, in an emergency safety kit kept in a car, and likely on the belts of Marines going on a deployment. Why? It is a versatile tool with many applications that are within arm's reach when other purpose-built tools are not available. Within the MAGTF, there are few communities, if any, that embody the essence of a multi-tool more than the Marine light attack helicopter squadron (HMLA). It is the Leatherman that every combatant commander desires to have at the ready. Its instruments which provide unmatched utility across the range of military operations are the AH-1Z "Viper" and UH-1Y "Venom," hereby referenced as H-1s. Since being introduced in the Vietnam War era, H-1 helicopters have seen multiple upgrades over their illustrious service life and, much like the Marine Corps itself, continue to modernize to maintain effectiveness in future operating environments. The current, maturing state of force modernization within the Marine Corps necessitates the employment of such multi-tools until more purpose-built platforms are fielded. The HMLA community is now at a critical inflection point in its modernization journey and the Marine Corps must provide essential resources for H-1s to remain the MAGTF's multi-tool in a peer-adversary conflict until a replacement assumes the HMLA mission. Given the Service's current fiscal constraints, it is important to understand how the inflection point developed, why HMLA modernization is a time-critical investment, and what the return on investment will yield.

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### How the HMLA Inflection Point Developed

When *Force Design 2030* was published in 2019, it initiated a long-overdue renaissance in the Marine Corps, one which required honest internal reflection and an aggressive look toward the future. This period could be perceived as one of the lowest points in the HMLA community. However, there is an alternative perspective that sheds a positive light on this period. Shaping actions during Force Design forced the HMLA community to identify its value proposition in a peer-adversary conflict in the future. However, leadership's desire for prospective evolutionary solutions did not afford HMLAs the necessary time to apply the appropriate rigor to the analysis of the H-1s in the future fight. However, that simple request for information set the HMLA community on a campaign of learning to understand the future conflict's environment, operating concepts, and tools necessary to sustain such a conflict. This campaign of learning continues for the Marine Corps at large as well as for the HMLA community. A significant development occurred after initial Force Design decisions were made that re-focused the lens on how HMLAs are viewed in the MAGTF, clearing the institutional vision and seeing a strong value proposition of the HMLA in the fight for the future.

***An AH-1Z and UH-1Y conducting anti-submarine warfare.*** *(Photo by LCpl Isaac Velasco.)*

In the spring of 2023, the Deputy Commandant for Aviation unveiled the vision for Marine Corps Aviation to transform into a modern fighting force that fights in a modernized operating concept known as distributed aviation operations. This articulate strategic vision, known as Project EAGLE, builds upon the concepts outlined in the *Tentative Manual for Expeditionary Advance Basing Operations*, a foundation of the Force Design initiative. Project EAGLE outlines a three future years defense program, fifteen-year strategy to modernize aviation, including roadmaps to plan the transition. The vertical take-off and landing family of systems roadmap charts the vision for the fu-

ture of Marine Corps rotorcraft. The capabilities-based portfolio within the vertical take-off and landing family of systems includes logistics, attack/strike, and assault support. With this comprehensive vision, the HMLA community has understood the commander's intent and now has a clear path and strategy to align with it. Fortunately, leaders of the HMLA community already possessed a vision for the future understanding of the INDOPACOM environment and already started down the right path. Gleaning aimpoints and time horizons from Project EAGLE now posture the community to convert its stored potential energy into kinetic energy, on the right vector and trajectory, aligned with the transformation of Marine Corps Aviation.

## Why Is HMLA Modernization a Time-Critical Investment?

Whether operating in support of a Marine littoral task force or from distributed sea bases, H-1s are the MAGTF's multi-tool through 2040. Without the time-critical investments in H-1s, current Service gaps in low-altitude attack, strike, and utility will continue to widen, and unseen gaps will manifest. The transition from legacy H-1 platforms to the future attack/strike (FAST) platform is a critical period and requires the necessary attention. Anticipating this impending transition, the HMLA community refined its modernization strategy with the goal of bridging capability gaps until FAST is fielded, reducing the community's learning curve during the transition and creating Service decision space for the procurement of the FAST platform.

Communication is the pacing line of effort for the future environment. Adversary capabilities necessitate multiple and redundant means to share information across the joint and coalition forces to complete kill chains. This network of information paths is known as a kill web and primarily leverages tactical data links (TDL) instead of voice communications. In 2024, H-1s will commence its communication modernization by fielding LINK-16. By 2028, assuming resources are applied, two-thirds of the active-duty squadrons will be equipped.

***An AH-1Z with two MH-60S Knighthawks and an MH-60R Seahawk during Exercise Trident Storm off San Clemente Island, CA.*** *(Photo by LT Rob Swain, USN.)*

The gateway to joint fires, LINK-16 enhances the effectiveness of HMLA as the only remaining dedicated aviation fires platform in the MAGTF besides the F-35. Additionally, by 2029, the HMLA will be the only remaining forward air controller (airborne) and tactical air coordination (airborne) community in the MAGTF. TDLs are essential for HMLA to complete its assigned tasks. Further development of future waveforms is in process, and H-1s are proactively integrating them into the modernization roadmap to remain a principal contributor to kill-web execution. Just as assured access to TDLs is foundational to the H-1's lethality and survivability modernization, so too is the H-1 Structural Improvement and Electrical Power Upgrade (SIEPU) program.

***... by 2029, the HMLA will be the only remaining forward air controller (airborne) and tactical air coordination (airborne) community in the MAGTF.***

Technology advancements, improved data processing, smarter weapons, and modernized communication equipment all have a common need: more power. The SIEPU program provides sufficient electrical power to integrate all modernization initiatives necessary for H-1s through 2040. SIEPU and LINK-16 comprise the baseline from which all essential modernization efforts are achieved. The HMLA community has carefully coordinated a fielding schedule that ensures the H-1s of the 2030s have the warfighting tools required to bridge the gap to the FAST platform in 2040. These include long-range net-enabled maritime strike weapons, advanced survivability capabilities, advanced air-to-air munitions to combat enemy fighter aircraft down to sUAS, and redundant means of communication to collaborate with joint and coalition forces within the combined joint all-domain command and control framework. With these capabilities and unlimited potential for continued modernization, the H-1s remain an indispensable multi-tool for the MAGTF in a peer-adversary conflict in the 2030s.

## What Is the Return on HMLA Investment?

In the 2030s HMLA's will be a key component of the stand-in force. They will deploy throughout the expeditionary air base network in the first island chain. Their ubiquity in the first island chain will be commonplace, moving from austere site to austere site in small-footprint and low-signature detachments, via traditional and non-traditional shipping. H-1s will protect and influence key maritime terrain with net-enabled organic kinetic and non-kinetic fires. They will narrow gaps and fill seams for the composite war-

fare commander; they will operate in and between the littoral and deep-water domains. Furthermore, H-1s are inherently survivable, capitalizing on a dispersed concept of employment and the use of information available within the combined joint all-domain command and control network to passively and actively defend against the adversary's capabilities—contrary to many uninformed and myopic perspectives on the lack of rotorcraft survivability.

H-1s will mask within the noise of the battlespace to conceal their austere operating sites and nodes. They will be the lifeline to the Marine littoral regiment, providing close and deep fire support, force protection, airborne extensions of command and control, and protecting key logistics lines of communication. They will employ payloads that extend the area of influence and degrade the enemy's ability to attack with UAVs, long-range missiles, as well as naval sea power, including both capital ships and maritime militia. As the decade of the 2030s draws to a close, when the optimized FAST platform is ready to conduct a lead change with the Viper and Venom, the Service will be ready—with the community prepared—to conduct a seamless transition.

What is the answer to the Force Design request for information regarding the HMLA value proposition in a peer adversary conflict? The HMLA is the most cost-efficient aviation investment opportunity for the Service in a high-end fight. A highly reliable and risk-worthy tool providing unmatched utility for the MAGTF, HMLA detachments will be employed as full contributors and participants in joint and combined kill webs. Through modernization, the HMLA will continue to narrow gaps for the Service in low altitude attack, strike, and utility to affect a seamless transition to the purpose-built FAST platform. In turn, the adversary will be confounded as they confront this modernized, lethal, and ubiquitous multi-tool throughout the battlespace. The Marine Corps must commit the modest but meaningful resources required for H-1 modernization to avoid unnecessary operational and tactical risks to the MAGTF.

***Reconnaissance Marines of the 15th MEU board a UH-1Y on the USS* Somerset *(LPD-25).*** *(Photo by Sgt Patrick Katz.)*

# Beyond the Horizon

## The F/A-18 Hornet's combat-proven foundation … poised for the future

by LtCol Adam Young

Just *over* 40 years ago, on Friday, 7 January 1983, Marine Fighter Attack Squadron 314 (VMFA-314) accepted the Service's first F/A-18A Hornet aboard Marine Corps Air Station El Toro, CA.[1] The unit was born just *under* 40 years prior to that day, and the new McDonnell Douglas F/A-18 Hornet became the Black Knights' fifth aircraft model. Today, VMFA-314 (*OAKINE!*) owns the distinction of being the Marine Corps' first squadron to fly the F-35C Lightning II—their sixth model. An astonishingly capable platform (keyboard warriors who say otherwise do not have access to complete information), Hornet aircrews eagerly integrate as bomb and missile trucks with their younger fifth-generation cousins, potentiating the confluence of modern sensor fusion, network-centric warfare, and weapon capacity.

As of February 2024, only 7 of the 174 still-flying Hornets have yet to reach their original design limit of 6,000 hours; however, Marine F/A-18s collectively have more than 50,000 flight hours remaining on the fleet through 2030. Their vast weapons menu, loadout capacity, and upgrades that enhance their lethality offer flexible effects throughout the continuum of military operations. Marine F/A-18s will provide warfare commanders with offensive and defensive options—up to and including large-scale conflict against a peer adversary—through the conclusion of this decade.

Marines love a baptism by fire and embrace violent initiations. Commanders did not wait long to call up the F/A-18, and it immediately established itself as a versatile instrument of death against determined and malevolent enemies. Hornets first tasted blood when, in the early hours of 15 April 1986, pilots from VMFA-314 and VMFA-323 "Death Rattlers" (*Come to Fight, Come to Win!*), then attached to U.S. Sixth Fleet operating from CVN-43 *Coral Sea*, combined with a joint strike package of Navy and Air Force aircraft to attack Benina Airfield and the Benghazi military barracks in support of Operation El Dorado Canyon.[2] Five years later, Hornets reaffirmed their potency as a multi-role fighter-attack platform, shooting down enemy MiGs and delivering ordnance against Iraqi targets during the same mission in Operation Desert Storm. Finally, over the most recent twenty years, the Hornet has served as a capable, deadly, ever-present mainstay during Operations Iraqi Freedom, Enduring Freedom, and Inherent Resolve.

The first F/A-18s that arrived at El Toro resemble today's Hornets in their outward sleek lines and eye-watering maneuverability, but similarities quickly cease. Those early models did not have Radar Warning Receiver equipment (colloquially called "RHAW gear," a carry-over from the F-4 pilots referring to the Phantom's AN/APR-25 Radar Homing and Warning system). AIM-120 Advanced Medium Range Air-to-Air Missile was still developmental. Navigation and Targeting pods were rudimentary. Finally, the Hornet's flight control software, PROM 7.3, allowed pilots too much deflection of control surfaces in slow regimes, sometimes causing them to enter out-of-control flight. Unfortunately, PROM 7.3 also unreliably recovered from out-of-control flight. Today's pilots enjoy PROM

***>LtCol Young is a Hornet Pilot assigned to Headquarters Marine Corps, Aviation. He is slated to command VMFA-312 (Fight's On!) and will sundown East Coast Hornet operations.***


***An F/A-18 assigned to the VMFA-115 Silver Eagles (Smoke 'em if You Got 'em!) transits home to Fightertown (Marine Corps Air Station Beaufort, SC) after completing a training mission in the Lowcountry.*** *(Photo by author.)*

10.7, which usually solves the issue by taking the weak link—the pilot—out of the loop. *Controls: RELEASE, FEET OFF RUDDERS, SPEEDBRAKE IN.*

As part of a meticulously planned final configuration, the Marine F/A-18 Fleet is completing transformative hardware upgrades centered around the groundbreaking APG-79v4 Gallium Nitride radar. This technology "provides the largest single leap in performance since the active, electronically scanned array revolution in the late 1990s." Compared to the older technology gallium arsenide radars, gallium nitride radars have approximately double the detection range against a given threat using the same size and power.[3] Another improvement delivers robust electronic attack by integrating the ALQ-214 radar jammer. Lastly, the Embedded National Tactical Receiver feeds aircrew near realtime theater-wide situational awareness via satellite communications.[4] Today's Hornet would be unrecognizable to her aircrew of just ten years ago.

Employing a diverse variety of antimaritime weapons, including AGM-84D Harpoon, AGM-84K SLAM-ER, AGM-88C HARM, AGM-88E AARGM, AGM-154C JSOW, F/A-18s supply the preponderance of the Service's ship-killing capability and capacity through their sundown. Heterogenous salvos of these munitions, using various modalities and spectra, unleash warhead effects that can achieve a convincing probability of mobility, firepower, and catastrophic effects against would-be HHQ-9 missile shooters *today*. Furthermore, consider recent Houthi complex attacks against Red Sea shipping: a division of Hornets assigned a cruise missile defense mission would be capable of carrying 48 missiles—with any mix of AIM-120 and AIM-9X Sidewinder.[5] Such a flexible, high-capacity, cheaper option may be preferable to a division carrying a rigid loadout of just sixteen advanced medium range air-to-air missiles and only eight AIM-9X—the premier weapon to counter small, stealthy cruise missiles and unmanned aerial systems.

Furthermore, Hornets can provide affordable mass when, for instance, a potential enemy uses novel, inexpensive tools to asymmetrically attack more expensive U.S. equipment and operations. The Advanced Precision Kill Weapon System converts unguided 2.75" Hydra rockets into extraordinarily precise, high-volume munitions that can effectively and efficiently attack an array of targets—even enemy airborne drones.[6] F/A-18s carry fourteen AGR-20A rockets on any one of four stations. A missionized anti-fast attack craft loadout would likely include 28 rounds *per aircraft*. Normally operating in a section of two aircraft, the flight would be able to pickle more than 50 lethal rounds to protect the defended asset.

***An F/A-18 assigned to the VMFA-115 Silver Eagles (Smoke 'em if You Got 'em!) prepares to receive fuel before returning to its assigned dual-role mission of close air support and defensive counter air during Operation INHERENT RESOLVE.*** *(Photo by author.)*

In summary, F/A-18s have served the Marine Corps well over the past forty-plus years. But the aircraft's contribution to national defense is far from over. The pivot to the Pacific, exemplified by initiatives like *Force Design 2030*, demands that warfighters examine how radical shifts to every facet of war affect its changing nature. However, new equipment does not always offer the best solution. One may sensibly conclude that a blend of legacy weapons and platforms with modern capabilities, integrated via datalink, creates the most

***The pivot to the Pacific ... demands that warfighters examine how radical shifts to every facet of war affect its changing nature. However, new equipment does not always offer the best solution.***

lethal and survivable package. To be clear, even an upgraded Hornet is no match in beyond-visual-range air-to-air warfare compared to a Lightning II. Nor can the Hornet detect, identify, and fix target radars for suppression of enemy air defense as ably as F-35s. One cannot earnestly compare the aircraft's signatures. However, our current and future warfare commanders—and our enemies—would be foolish to discount the Hornet's capabilities to provide useful enablers and lethal effectors across the battlespace for years to come.

**Notes**

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# "Fleet Representative"

## Broadening our definition through force integration

by Maj Andrew R. "Hammer" Wing

The Marine Corps unflinchingly values its identity as a modular force—one that employs assets in a flexible, plug-and-play capacity. As such, we marshal units into MAGTFs that are appropriately scaled and staffed for various missions, equipping commanders with the autonomy to reorganize in-stride as mission requirements evolve. Although this fluid mindset is far from new, it is beneficial to consider new applications of a modular approach within the burgeoning discussion of total force integration. As we align the priorities of *Talent Management 2030*, *Force Design 2030*, and the ever-developing implications of current events, our need to have the right people in the right jobs at the right time becomes increasingly apparent. Modular augmentation is thereby narrowed down to the individual Marine—a fact that stresses the need for an adaptable line between the active and reserve components. Specifically, within the aviation community, the last few years have seen numerous examples of reserve personnel demonstrating their ability to train and fight with the best of their active counterparts. To harness this promising reality at an institutional level, we must examine our notions of what a *fleet representative* Marine is—acknowledging that the definition is broadening—with benefits to be captured across all components.

### A Brief Detour into the Acquisitions World

The aviation test community is structured into two subsets: developmental test and operational test. Our Navy and Marine Corps developmental test pilots undergo rigorous academic training at HX-21's Test Pilot School in Patuxent River, MD—after which they apply their qualifications as fully-fledged test pilots across an array of programs. Through this process, they appropriately shed the mindset that they represent tactical fleet mission sets. Specifically, their proficiency in the full-mission spectrums of the aircraft they flew inherently expires for the sake of a refined focus. An aphorism within the developmental test community is that pilots use their engineering backgrounds, unique training, and vetted intelligence to answer the question: Did we build the thing *right*?

***>Maj Wing's bio was unavailable.***

***... we must examine our notions of what a* fleet representative *Marine is ...***

The operational test community, however, seeks to answer another, equally critical question: Did we build the right *thing*? The men and women of the Marine Corps Operational Test Squadron, VMX-1, must retain proficiency in the mission sets associated with their original series of aircraft. Doing so enables them to evaluate weapons, digital interoperability software, and countermeasure equipment with a mindset of tactical relevance and awareness of the fleet squadrons from which they hailed. In other words, they consider themselves *fleet representative* pilots. During busy testing periods that require increased manpower, VMX-1 will pull trusted, highly qualified young aviators from fleet squadrons. These augment pilots temporarily share in assessing the fitness of new equipment and procedures through the lens of an average pilot within our deploying forces. Unlike their HX-21 brethren who often focus on engineering questions such as, *if we strap this new widget onto an aircraft, how will it affect its various flight regimes*? Operational test aircrew and their fleet augments may ask questions like, *when we employ this new weapon system, will the average pilot find the associated button pushes ergonomic and logical in a dynamic setting?*

Such questions governed my efforts as an H-1 Operational Test Director with VMX-1. As test periods came and went, my counterparts and I faced the enduring challenge of gathering pilots from active units through the temporary duty orders process. This was not easy, for those units must perpetually focus on three critical demands: sourcing aircraft and qualified aircrew teams for enduring deployments such as WestPac MEUs, supporting ground-unit training such as troop movements and tactical air control party qualifications, and training new aircrews in their tactical qualifications after receiving them from Fleet Replacement Squadrons. Our underlying motivation was to preserve the sacrosanct definition of fleet representative—both in ourselves and in the augments we selected. It was only after I departed VMX-1 to spend years as active personnel within 4th MAW aviation units that I realized how much wider my definition—and the net I cast—could have been.

**Point 1: Fleet representative Marines can be found throughout reserve units, as indicated by the many ex-**

**amples of these individuals and their units being utilized in forward-looking, tactically relevant ways.**

As the reserve MAW the 4th MAW wields one of the most disaggregated force structures within the Marine Corps, spread across CONUS. Within its subordinate groups (MAG-41, MAG-49, MACG-48, and MATSG-42), thirteen separate squadrons and detachments fly a range of fixed-wing and rotary-wing aircraft. Their pilot staffing boasts a heavy majority of Selected Marine Corps Reserve officers.

So, what is worth highlighting about these units and aircrew? How do they so clearly typify fleet knowledge and vision? First and foremost, they consistently deploy and execute training detachments that are united with the current trajectory of our force. Examples from my own experience while serving as a department head in MAG-41 and MAG-49 units include:

- Deployment of multiple 4th MAW units in support of Exercise UNITAS—a multinational exercise with partner nations in South America.
- Annual deployments of fixed-wing operational support airlift for 5th MEB Marine Transport Detachment rotations in the Marine Corps Forces Central Command area of operations.
- MAG-wide tactical demonstration of expeditionary air-delivered ground refueling, multi-asset aerial recon, and dedicated rotary wing offensive aerial support.
- Training events with Navy H-60 units and direct-action teams to refine joint tactics, techniques, and procedures (TTP) for littoral raids.
- Training detachments in support of premier, joint Air Force exercises such as Red Flag Rescue (Davis-Monthan AFB, Tuscon, AZ) and the 66th Weapons Instructor Course (Nellis AFB, NV).
- Sustained support for Weapons and Tactics Instructor class offensive aerial support training and TTP development.

Second, numerous reserve pilots stay involved with the latest tactical discussions, publications, and decisions that our force produces—and not just as spectators, but as contributors. These are not "old dog" pilots filling stuffy ready rooms to avoid new TTPs. Rather, they are notably invested in understanding and affecting the trajectory of their community. This goes beyond dialogue; reserve pilots from both MAG-41 and MAG-49 consistently augment some of the most critical flight training events in our enterprise. Citing my own experiences again, examples of this involvement include:

***... the 4th MAW wields one of the most disaggregated force structures within the Marine Corps ...***

***... these initiatives ... will only be as effective as the buy-in shown by individual units and operators to advance a digital job marketplace and orders process.***

- Multiple reserve personnel attending operational advisory groups and Naval air training and operating procedures revision working groups.
- Weapons and Tactics Instructor Class augmentation with reserve augment instruction and aircraft.
- Night Systems Instructor augmentation of fleet units to train junior pilots in High Light Level and Low Light Level qualification events.
- Flight Leadership Standardization Instructor evaluations for fleet pilots pursuing flight leadership designations, as well as model manager standardization flights in the UC-35.

The ascendant vitality of reserve-ready rooms underlies these examples. In both 4th MAW units that I served, a significant portion of their cadres comprised pilots whom I considered to be peers or even junior to me. The prevailing mindset in both settings centered on tactical skill and sound crew resource management. Acumen and maturity were the highest markers of pedigree. These aviators are not in the reserves to slow down; rather, they consistently pursue excellence in new contexts.

**Point 2: If we accept this wider definition of relevance across both the active and reserve components, we must also accept our obligation to harness it now. What can we do to harness it more quickly?**

So far, this has been a broad discussion of propitious examples. However, the true challenge lies in bolstering the mechanisms that will enable fleet representatives to maneuver amongst our forces. Recent force-shaping documents have done the brunt of the work here. *Talent Management 2030*, its subsequent campaign plan for 2023–2025, and the staff of Manpower and Reserve Affairs have laid the foundation for this administrative call to arms. My aim, however, is to highlight the fact that these initiatives (summarized below as references) will only be as effective as the buy-in shown by individual units and operators to advance a digital job marketplace and orders process. This is especially true for the microcosm of aviation, which thrives on personal connections and organic networking to keep the gears of squadron readiness turning. A shift to new tools for soliciting augmentation will not occur without grassroots support.

Although there is much to consider regarding the fiscal workings of this topic, it expands beyond the scope of this article. However, the critical point I will stress is that investment in the reserves absolutely yields active-duty output. Our associated responsibility is to equip our Marine Forces Reserve administrators as they labor to streamline the active-duty operational support process across the force

In short, the rate of development from these initial steps will be directly proportional to the degree of communication between MAGs/MAWs and the manpower representatives who define the demands that a digital job market prioritizes. Ideally, operational planning teams (OPTs) will give way to monthly syncs between these entities. Syncs will engender momentum. Momentum will engender consistency. Consistency will engender cultural change such that modular pilot augmentation becomes standardized across active and reserve units.

If such a mechanism had been in place during my time as an operational test director, I do not doubt that we could have used it to integrate reserve aviators into our missions with outstanding results—so too could squadron operations departments as they seek personnel augmentation amidst high operational tempo. As we collectively strive to achieve a more integrated force, now is the time to mold the mechanisms that will enable fleet representative warfighters to rapidly answer our calls for their skills. A universally accessed digital job market that enables reserve pilots to efficiently pinpoint active-duty orders will prove fruitful if unit buy-in occurs. Now is the time for us to proactively influence that process by asking: *How do we build the right thing?*

Examples of the developing initiatives and mechanisms described herein include:

### *Talent Management 2030*

(Retrievable from www.marines.mil/Talent-Management)

Regarding the "Targeted Maturation of the Force," the *Talent Management 2030 Update* states, "The retention of trained, experienced, and proven Marines capitalizes on training investments and stands to increase our combat power and readiness. As we invest more intense training and education in Marines to prepare for more complex battlefields, we will retain more of our highest performing Marines."

### *Marine Forces Reserve (MARFORRES) Individual Mobilization Augmentee (IMA) Listings*

(Retrievable from www.marforres.marines.mil/General-Special-Staff/G1)

The MARFORRES website posts individual mobilization augmentee hotfill billets. This list is consistently updated. With it, reserve Marines may view open billet opportunities to temporarily pursue active-duty orders. Although this list is not currently used as a primary method for soliciting pilot augmentation, it serves as a template with which to integrate that goal. It can therefore be considered an initial step towards a more fully realized digital marketplace.

**... now is the time to mold the mechanisms that will enable fleet representative warfighters to rapidly answer our calls for their skills.**

### *Force Design 2030-Annual Update* (3 June 2023):

(Retrieve from www.marines.mil/Talent-Management)

This annual update states,

> In March, we published an update to TM2030, which directed accelerated personnel reforms and oriented the Service toward retaining more experienced Marines. More experienced Marines do not necessarily mean older Marines, but rather Marines with more repetitions. In February 2022, the Assistant Commandant of the Marine Corps (ACMC) established a Talent Management Strategy Group to align and harmonize Service-wide talent management efforts. This group focuses on future demographic, economic, and human capital trends while working with academic and research organizations to identify initiatives that will better align individual abilities, skills, and desires with the warfighting needs of the Service.

### *Talent Management Campaign Plan 2023–2025*

(Retrievable from www.manpower.usmc.mil)

This campaign plan cites a series of OPTs that were sparked by the demand for optimized investment and retention of personnel. Spread across 2023, these events included:

- Return on Investment OPT.
- Active Component-Reserve Component Permeability OPT.
- Officer Aviation Return on Investment and Retention OPT.

Additionally, this campaign plan emphasizes the use of a "Talent Management Engagement Portal ... to support a modern, transparent, data-based assignments environment that allows Marines, commands, and the Service headquarters to collaborate in the assignments process."

The document also alludes to the program *Gig Eagle* as a potentially viable interface. It states, "The Defense Innovation Unit's project is a talent marketplace that connects reserve personnel with specialized skillsets from across the DoD with commands to fill immediate mission requirements. The Marine Innovation Unit is currently participating in exploratory efforts in the development of the system [*Gig Eagle*]. This project represents an opportunity to explore new ways of employing talent and permeability between the active and reserve components."

# The Modified Mojave

## Loyal wingman drones for better tiltrotor assault support

by Capt Matthew Brook

*Under a moonless night sky, four V-22 Ospreys take off from an undisclosed expeditionary airbase. In the back of the tiltrotors, 80 Marines are ready to seize a compound located on a critical piece of high terrain. As they climb over the airfield, the Ospreys rotate their nacelles forward and accelerate to 240 knots. Immediately behind them, two more aircraft take off; the first one passes below the tiltrotor flight, hugging the terrain ahead with robotic precision, while the second climbs above and trails behind the rest of the formation. Both are "Mojave" Unmanned Aircraft Systems (UAS), armed with Hellfires and controlled from the lead Osprey via an encrypted datalink. During the 250-mile transit to the landing zone (LZ), the six-plane formation flies as a single element, hiding in the folds of the rugged terrain below and remaining undetectable to known enemy search radars. At the 100-mile mark, the lead UAS identifies mechanized infantry in battle positions and feeds their location data back to the Ospreys, five miles behind. The single Mojave passes quietly overhead and is undetected in the dark, while the Ospreys detour around a parallel ridgeline and pass safely by. Fifteen minutes later, a patrolling enemy short-range air defense (SHORAD) vehicle spots the formation and fires an IR-seeker missile. The decoy flares on the third Osprey defeat the first salvo; simultaneously, the trailing UAS observes the engagement, vectors in on the launch location, and neutralizes the SHORAD with a single Hellfire before it can launch again. Twenty miles from the objective area, the two Mojaves speed ahead and establish an orbit over the LZ, just west of the compound. After confirming the absence of enemy threats via a video feed from the UAS, the Ospreys approach and land. Within fifteen minutes, the assault force is in control of the compound and the Ospreys are in the air again, returning to base with a single Mojave leading the way; the other UAS remains behind at the landing zone to provide overhead observation and fires for the Marines below.*

***>Capt Brook is a MV-22B Division Lead and Night Systems Instructor who deployed with VMM-365, "The Blue Knights," to Norway in support of Exercise Trident Juncture, to CENTCOM in support of the 26th MEU, and to EUCOM/AFRICOM in support of the North and West Africa Response Force. He currently flies the UC-35D with H&HS Miramar.***

***A MV-22B from VMM-365 conducts bilateral training with Italian infantry in the Alps.*** *(Photo by author.)*

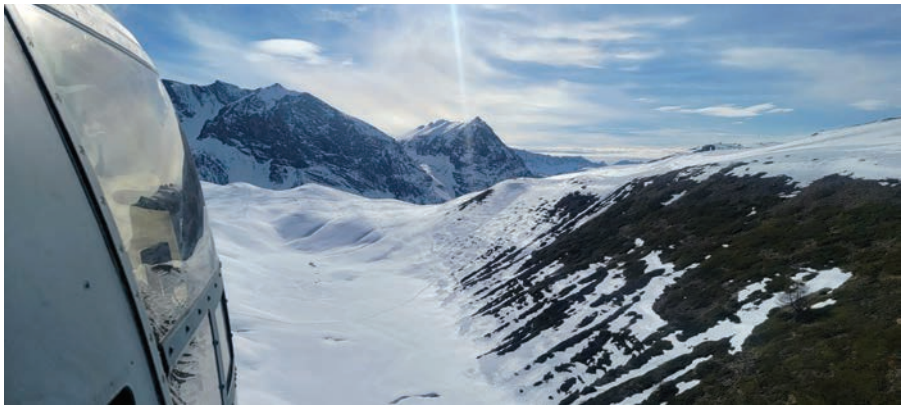
Tiltrotor aircraft have the potential to revolutionize the way the Marine Corps conducts assault support during expeditionary advanced base operations. With roughly double the speed and range of conventional vertical takeoff and landing-capable aircraft, the V-22 Osprey provides the MAGTF commander with unique capabilities that allow for long-range inserts to unexpected locations.[1] Unfortunately, they are not currently employed effectively due to the limited capabilities of legacy escort aircraft. In past conflicts, this was not a problem because coalition forces had already established air supremacy long before the V-22 deployed to the theater. However, the Marine Corps is now planning for future conflicts in non-permissive environments with advanced anti-air threats; in these potential scenarios, escorts are mandatory to protect the force, but no such capability currently exists.[2] To fight effectively in future conflicts, the Marine Corps should integrate V-22 Ospreys

and UAS into a combined team capable of conducting assault support in contested environments.

The V-22 made its first deployment to Iraq in 2007. It has since replaced the H-46 as the primary assault support aircraft of the MAGTF, and the Marine Corps' V-22 squadrons form the core organization of the MEU ACE.[3] Doctrinally, the Marine Corps largely uses the V-22 as a "faster phrog," and H-46 squadrons have long since transitioned to the new aircraft.[4] However, escort aircraft—required in a higher-threat environment to suppress threats and prosecute targets—have not kept pace. Instead of using escorts comparable to the tiltrotor in performance, the Marine Corps relies on modernized H-1 helicopters which have only half the speed and half the endurance of the V-22, despite advances in engine and conventional rotary-wing technology.[5] The helicopter escorts' limited range and speed negates the benefits of having a tiltrotor assault support aircraft in the first place, and the requirement for two separate formations, deconflicted by altitude, routing, and time, increases the signature of air operations, thus reducing survivability. Technology and tactics will need to adapt, or else assault support as an entire concept will become impossible in the face of widely proliferated anti-air threats which are constantly evolving; without reliable assault support, the MAGTF will lose the ability to generate tempo and rapidly mass forces in unexpected locations. The AH-1Z and UH-1Y are extremely capable and lethal aircraft and well-suited for close air support and special operations, but something new is needed for air assaults in contested environments.

The first part of the solution is a suitable UAS that can match the V-22 in speed and endurance while still providing enough combat power to escort it and defeat threats. Conventional UAS are designed for long loiter times at high altitudes and operations from well-established bases, while assault support aircraft fly low and fast when in high-threat environments.[6] Instead of purchasing additional MQ-9 Reapers, the Marine Corps should acquire a new UAS derived from the General Atomics Mojave. The Mojave is a new UAS design that can operate from expeditionary airfields, fly at lower altitudes, and carry increased ordnance (including gun pods) when compared to the MQ-9.[7] There are several modifications to the Mojave's current design that would allow the aircraft to match the speed and performance of the V-22, so the two aircraft could be paired together for operations. First, a reduction in the aspect ratio of the Mojave's wing would reduce parasitic drag.[8] Second, a more powerful engine would increase thrust. These design changes would trade endurance and efficiency for speed, but this is acceptable.[9] Even with reduced time-on-station available, the UAS would still have significantly more endurance than the V-22 and enough for most operations. Third, a terrain-following radar should be added to the Mojave; in a future high-threat environment saturated with modern surface-to-air missile systems, survivability in non-stealth aircraft is achieved by flying low to the ground and using the terrain to mask the aircraft from enemy radar. For manned aircraft, this is a training standard that is frequently exercised.[10] For unmanned systems without an onboard human decision maker, this will require a radar that can read the terrain ahead and keep the aircraft sufficiently low without crashing into said terrain.[11] As an addendum to these modifications, a future study is needed to assess the feasibility of employing a modified Mojave from amphibious assault ships and expeditionary airfields after the wing modifications are made.

The second part of the solution is a datalink between manned and unmanned aircraft; in this case, a link is needed between the V-22 Osprey and the modified Mojave UAS. Fortunately for the Marine Corps, the Army has already employed this technology onboard its new AH-64E attack helicopters, which have Manned/Unmanned Teaming–eXpanded (MUMT-X) capabilities installed to control flight paths and receive data feeds from RQ-7 and MQ-1C drones.[12] Meanwhile, the Marine Corps already has experience fielding "roll-on" communication kits in the cabin of the V-22, in the form of Networking on the Move—Airborne (NOTM-A).[13] In order to employ MUMT-X on the V-22, a similar roll-on kit could be engineered and installed in the cabin of select V-22 airframes that would allow aircrew to operate a pair of Mojave drones. In this scenario, after the V-22 takes off, a separate ground crew would launch the Mojave and then transfer control to the V-22; upon returning for landing, the V-22 crew would transfer control back to the ground crew and the Mojave would enter a holding pattern while the V-22 lands. While en route, the V-22s could direct their UAS to scout ahead for threats on low-level routes; in the objective area, UAS could gain situational awareness of landing zones prior to the arrival of assault support aircraft. In contrast to the conventional employment of UAS or mixed-formation flights, no satellite uplink is needed, communications between aircraft are kept within the formation, and everything moves through the battlespace



***VMM-365 conducts bilateral training with Italian infantry in the Alps.*** *(Photo by author.)*

as one massed package at low altitude. In practical terms, this equals a smaller signature and better survivability.

The third and final part of the solution is to make the V-22 a force multiplier in the manned-unmanned team by replacing the current navigation forward-looking infrared (FLIR) sensor with a dedicated targeting FLIR on select airframes. This would allow the V-22 to designate targets and employ the escort Mojave drones against threats, both offensively and defensively. With a targeting FLIR onboard the tiltrotor aircraft, conventional helicopters would no longer be required during assault support flights and the V-22s would be able to fly with the Mojave UAS at faster speeds, thus increasing range and survivability.

The tactics proposed in this article may be new, but the solution is feasible. It does not require new technologies to be developed, only for the combination of technologies already in use but not in conjunction: tiltrotor aircraft, targeting FLIRs, and short-field UAS. That said, two major factors are preventing this solution from being implemented: cost and skill.

The first problem, cost, is solved by purchasing modified Mojave UAS instead of MQ-9 Reapers. If the Marine Corps is serious about expeditionary advanced base operations, fixed-wing drones that require large airfields and satellite uplinks should not be prioritized for acquisition.[14] Instead, the modified Mojave fits within the mission of the Marine Corps and can operate from expeditionary airfields.[15] As proposed in this article, no satellite uplinks are required, which reduces its signature. No hard-surface runways are required, making the Mojave a better choice even when not paired with V-22s. The potential employment of UAS from ships fits better with the broader amphibious mission of the Marine Corps. Finally, the V-22 fleet and its community of aircrews represent a significant investment for the Marine Corps, both in financial and human terms; protecting that hard-earned capability with a relatively inexpensive and easily replaceable UAS is a worthwhile endeavor and will save lives.

***Capt Brook, then a newly-minted tiltrotor aircraft commander, pilots his MV-22B above the Persian Gulf while deployed with the 26th MEU.*** *(Photo by author.)*

The second problem is skill and training. Gaining proficiency in air-to-ground fires and certifying forward air controllers (airborne) requires a significant amount of dedicated training and resources, in the form of flight hours, personnel, and ordnance; long-term institutional knowledge and experience are critical. Unfortunately, the V-22 community is focused on assault support (as it should be) and does not currently employ offensive ordnance, but this problem is not insurmountable. To have aircrews controlling and employing ordnance from other aircraft requires a big leap in pilot skill and capability. To meet this need, the Marine Corps can look to the H-1 squadrons that it is already divesting according to *Force Design 2030;* reading between the lines, as squadrons sundown there will be a future surplus of highly qualified H-1 pilots, already trained in employing ordnance and with past deployment experience.[16] Some could be redesignated as V-22 pilots, perhaps with an additional MOS that specializes in being a forward air controller (airborne) and employing UAS via MUMT-X from the air. After these pilots provide the necessary knowledge and experience to the V-22 community, native V-22 pilots would have the option to choose between an assault support/flight leader career track or a fires/forward air controller (airborne) career track after being designated as tiltrotor aircraft commanders.

For the future fight, the Marine Corps must evolve its tactics to be faster and more lethal while simultaneously presenting a smaller signature to potential near-peer adversaries. Long-range assault support operations will remain highly relevant to the concept of expeditionary advanced base operations but are currently limited by the speed and range of legacy escort platforms. By using technologies already developed and fielded in other aircraft, the Marine Corps can create a combined manned-unmanned team that gives the MAGTF commander an integrated package capable of operating in a high-threat environment. To prepare for future conflicts, the Marine Corps should combine upgraded V-22s and modified Mojave UAS with a MUMT-X datalink to employ tiltrotor-borne combat assault transport flights with integrated fires and sensors, which will enable assault support operations in contested airspace.

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# The Future of Close Air Support in the Marine Corps Is Unmanned

**A solution to the ubiquitous tyranny of distance**

by Capt Donny Burton

As the battlespace becomes more distributed and enemy weapons become more formidable, Marine Corps innovation must increase commensurately. Aircraft in future operating environments must have more range, speed, and payload than ever before while reducing risk to aircrew. Aircraft such as the Bell UH-1Y and AH-1Z have reached their zenith due to their limited range, speed, and survivability. Fortunately, the Marine Corps' operating capabilities can be improved with burgeoning technologies such as tiltrotor and unmanned aerial systems (UAS). The looming threat in the Pacific should hasten the transition away from old technology and welcome new solutions to future problems. This is essential if the Marine Corps seeks to continue supporting ground forces with close air support (CAS) in the future. New Group 5 UAS (aircraft greater than 1,320 pounds that can fly over 18,000 feet) offers a potential solution.[1] The Marine Corps must replace its H-1 aircraft with a single shipboard-capable Group 5 UAS, the Bell V-247, to better support ground forces with CAS in the future operating environment.

The H-1 series manned attack helicopters (Bell AH-1Z and UH-1Y aircraft) lack relevance and lethality in the future fight due to limited range and speed. In 1947, a report from the Committee of the Academic Board included requirements for a ship-to-shore vertical takeoff and landing (VTOL) aircraft.[2] The requirements included an ideal payload of 5,000 pounds, a range of 200–300 nautical miles (nm), and a speed of 100 knots.[3] After 75 years of technological advancements, modern attack helicopters in the Marine Corps fleet cannot boast of numbers much better than those imagined in 1947. The UH-1Y has a cruise speed of 139 knots, a combat range of around 110 nm (including two-way transit, 10 minutes on station, and 20 minutes of fuel reserve), and a payload of 5,930 pounds.[4] The AH-1Z possesses only slight improvements in range and speed but with less payload. Neither aircraft possess the ability to conduct aerial refueling. The AH-1Z and UH-1Ys' inherent flight limitations prevent them from adequately performing in operating environments that require increased dispersion and standoff. No upgrade can overcome such limitations. As the Marine Corps shifts toward future operations in the Indo-Pacific Command (INDOPACOM), it becomes clear that H-1s will be a limiting factor.

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***Aircraft in future ... must have more range, speed, and payload ...***

The Marine Corps seizure of Camp Rhino in Afghanistan in 2001 made H-1's limitations apparent.[5] The mission required H-1s to provide CAS and reconnaissance for the insertion of Marines at the camp.[6] Because of their limited range and lack of aerial refueling capabilities, the H-1s needed a forward arming and refueling point (FARP) in Pakistan. Before mission commencement, an adjacent British unit depleted the forward arming and refueling point fuel supply. This setback delayed the mission for 36 hours, and the Marine Corps immediately lost surprise and initiative.[7] This setback along with the overall time required to allow H-1s to travel to the objective area (hours longer than CH-53s) made planning and execution tenuous.[8] Such setbacks will only become more pervasive as distances increase and the enemy becomes more formidable.

If the Marine Corps faced a similar problem as the seizure of Camp Rhino, but in the distributed maritime environment of the INDOPACOM area of operations, it would find far greater challenges. Opportunities for forward arming and refueling point may be more limited or may require a great deal of internal and external resources for the Marine Corps to safely execute. These resource requirements could include

additional ships or support outside of the MAGTF and would incur more opportunities for friction or mission failure. An organic shipboard CAS replacement for H-1s will reduce external friction and opportunities for mission failure. A replacement to the H-1 is needed to ensure success in the complex operating environment of the future.

In an attacking or defensive role, H-1s must operate near enemy weapons systems threat rings to employ their weapons. The most capable weapon employed by the AH-1Z is the new Joint-Air-to-Ground Missile with a range of about 16 kilometers.[9] This weapon cannot be used by the UH-1Y, and its range is only a fraction of many surface-to-air missile systems. For example, the SA-10 Grumble is currently employed by Ukraine against Russian aircraft.[10] It has a maximum range of about 97 kilometers.[11] Additional systems in Ukraine include the Igla MANPADS, which is much more prolific and difficult to detect though it has far less range.[12] Relatively simple and inexpensive systems, such as the SA-10 and Igla MANPADS, make the use of manned attack aircraft unsustainable. As of November 2022, the Ukrainians claimed to have destroyed 278 Russian aircraft primarily using these systems.[13] Even more problematic than the loss of aircraft is the loss of trained aircrews that take years to replace. Ukraine's Commander-in-Chief of the Armed Forces stated in November 2022, "The time required for the training of competent pilots further reduces Russia's ability to regenerate combat air capability."[14] Placing manned aircraft into an integrated air defense is costly in terms of the replacement of aircraft and far more costly in the lives of trained aircrews.

In 2016, Bell Helicopter conceptualized a group of 5 UAS to fulfill the MAGTF UAS Expeditionary (MUX) program.[15] The Bell design was intended to match the capabilities specified by the *2016 Marine Corps Aviation Plan* which outlined the ability to "provide sea-based, high altitude, persistent capability with ranges complimentary to MV-22 and F-35 missions."[16] This design, dubbed the Bell V-247, leverages similar tiltrotor technology found in the V-22 but in a smaller, unmanned platform. The V-247 is shipboard capable and can fold into a similar footprint as the UH-1Y.[17] Its superior capabilities include a lift capacity of approximately 13,000 pounds, a combat radius of 450 nm, a cruise speed of 250 knots, and a ceiling of 25,000 feet, outperforming H-1s in every measurable parameter.[18] These capabilities would be in keeping with the *2016 Aviation Plan* as the MV-22 has a combat radius of 420 nm and a cruise speed of 240 knots.[19]

***Rendering of the future concept Bell V-247 conducting shipboard operations.*** ***(Bell Courtesy photo.)***

The distance required to navigate the various island chains in the INDOPACOM area of operations presents an obstacle to any aircraft that is limited by range and lacks an aerial refueling capability. The Marine Corps general solution to INDOPACOM is outlined in the *Tentative Manual for Expeditionary Advanced Base Operations (EABO)*. It states the need for "aircraft often operating at long ranges and high endurance."[20] The performance of legacy attack helicopters, such as the UH-1Y and AH-1Z, fall well short of this requirement making such aircraft a constraint for most missions. The Bell V-247, with its approximately 11 hours of endurance and comparable range and speed to the MV-22, makes it a veritable solution to the problem set of supporting distributed forces with limited refuel options.[21] The V-247's endurance capabilities will provide hours of on-station time for CAS in support of ground forces compared to only minutes with the H-1s. The seizure of Camp Rhino in 2001, although successful, experienced numerous hurdles before and during execution. The Bell V-247, in a similar mission, would reduce or eliminate the hurdles brought on by external resources and increase the support provided to ground forces. It will increase both the probability and degree of success.

Performance improvement alone is not what accentuates the V-247's superiority over the H-1s. Its unmanned potential offers new levels of risk reduction to aircrews, commanders, and ground forces. No longer is there a requirement for a manned CAS aircraft to take on the burden of operating near a threat weapon. The disparity between onboard weapons, such as the Joint-Air-to-Ground Missile, against enemy surface-to-air missiles and MANPADS becomes less glaring if human life is not at stake. Even if the performance characteristics of the H-1s were increased, there is still no way around the danger to pilots near relatively superior threat systems. The capabilities of the Bell V-247 provide a significant risk reduction with a performance leap

that will only become more important as the operating environment becomes more lethal and dispersed. CAS is as inherently dangerous for aircrews as it is important for ground units. The ability to reduce risk to aircrews and increase the support to ground forces is enough to make the V-247 a logical solution to an enduring problem. Simply put, the Bell V-247 can do it safer, faster, and longer than the rest.

Developing and funding a shipboard-capable Group 5 UAS such as the Bell V-247 is an expensive endeavor. In 2020, the Marine Corps parceled the MUX program into multiple systems after growing expense concerns surrounding the creation of a single Group 5 shipboard UAS.[22] However, examples of allocating resources toward a specific capability and incessantly pursuing its development are found throughout Marine Corps history. Investment in the Bell V-247 is tantamount to investment in VTOL designs such as the V-22, F-35, or autogyros in the 1930s and helicopters in the 1940s.[23] Each aircraft design faced technological setbacks, doctrinal changes, and funding limitations. The Bell V-247 will likely encounter similar challenges, but those challenges are only prohibitive based on the value the Marine Corps places on such a capability. Given the Marine Corps shift to expeditionary advanced base operations, distributed maritime operations, littoral operations in a contested environment (all outlined in the *38th Commandant's Planning Guidance*), and its focus on INDOPACOM, pursuing the capabilities of the V-247 will greatly improve the Marine Corps ability to effectively operate in the future.

The Marine Corps first began to experiment with VTOL aircraft in 1936 when LtCol Roy Geiger presented his findings on the Kellet OP-2 autogyro. Geiger—later a four-star general and prominent contributor to Marine Aviation—saw the potential for vertical lift in the Marine Corps despite the OP-2's limited performance.[24] In subsequent years, innovators such as Igor Sikorsky and Larry Bell refined and improved the VTOL concept to give it enough lift capacity and range to be tactically relevant.[25] Now, the Marine Corps must continue to advance its capabilities to better match the challenges on the horizon. In his 2019 guidance, the Commandant of the Marine Corps expressed his opinion regarding new UAS concepts: "I encourage experimentation with lethal long-range unmanned systems capable of traveling 200 nautical miles."[26] Based on the historical precedent of VTOL innovation, the pacing threat in INDOPACOM, and the Commandant's guidance, the Marine Corps must replace H-1s with the Bell V-247.

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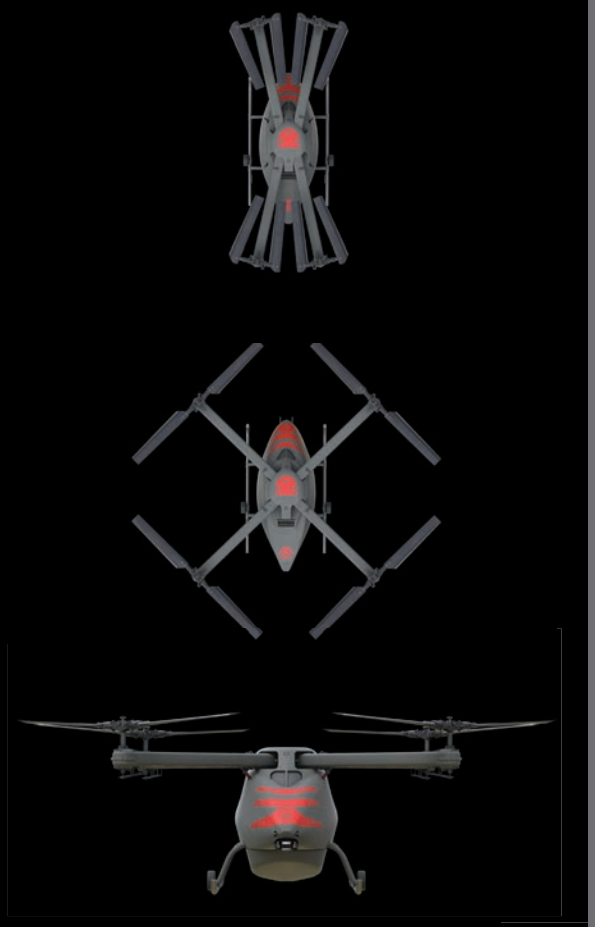

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# Building Redundancy

## Beyond line-of-sight communications for the MV-22B Osprey

by Maj Walker T. Gaultney

*It is dark, late, and at 1,500 feet above the black waters of the Pacific Ocean, a section of two MV-22B Ospreys is heading ashore from the relative safety of the amphibious ready group.*

*"Magpie, this is Tiger 31. How do you read?"*

*"Magpie, Tiger 31."*

*"Ice Pack, Tiger 11, no joy with the beach."*

*"Roger, Tig- ... you're ... of -ange, switch -ton –ck."*

*The section is alone without clear communications from either ship or shore. As they attempt to get their satellite communications (SATCOM) to work, they remember the report from their intelligence officer stating that the contested waters through which they were transiting were susceptible to degraded satellite communication. The pilots are out of communications range of any friendly forces, and any attempts to communicate emergencies or delays will go unheard.*

This vignette illustrates how the current MV-22B communications suite cannot match the platform's extended flight range and capabilities as a long-range assault support aircraft. As the Marine Corps and DOD shift their attention to the Indo-Pacific region, the lack of redundancy in long-range communication hinders the ability of the MV-22B to support expeditionary advanced based operations. The Marine Corps should retrofit its MV-22B fleet with high-frequency (HF) radio equipment to allow its communications capabilities to match its self-deployment range and support the distributed maritime force.

With its increased operational range as a tiltrotor platform, the Osprey outpaces its currently equipped radios. The MV-22B is capable of long-range flight exceeding 430 nautical miles without aerial refueling and more than 2,000 nautical miles with aerial refueling.[1] The radios currently installed onboard the MV-22B operate in the UHF/VHF (ultra/very high frequency) waveforms. Such radios are limited to line-of-sight (LOS) and relatively short distances based on the altitude at which the aircraft flies.[2]

***>Maj Gaultney is an MV-22B pilot with experience in the Indo-Pacific region. His deployment and detachment experience includes multiple patrols with the 31st MEU and numerous exercises supported in Japan, the Republic of the Philippines, the Republic of Korea, and the Marianas Islands. He is currently stationed at MCAS Miramar in San Diego, CA.***

***... the current MV-22B communications suite cannot match the platform's extended flight range ...***

Due to these waveforms' reliance on direct wave transmissions, their effective range is limited by the height or altitude of both the transmitting and receiving antennae. As a result, surface-based transmitters and receivers have a limited range even when communicating with aircraft cruising at higher altitudes, especially over long distances and the open ocean. When MV-22B squadrons conduct long-range deployments, they cannot maintain communications

***An MV-22B Osprey with VMM 262 "Flying Tigers" flies past amphibious assault ship USS America (LHA 6) during a communication exercise.*** *(Photo by LCpl Brienna Tuck.)*

organically. As a result, augmentation by radio relay aircraft is required and regularly documented in after-action reports as a shortfall.[3] The MV-22B's ability to communicate beyond line-of-sight (BLOS) requires improvement to operate and communicate effectively in the dispersed maritime environment forecast by the *38th Commandant's Planning Guidance*.[4] While the current equipment installed on the MV-22B is sufficient for landbased or coastal operations, the forecasted operating environment in the Indo-Pacific requires an improvement.

The MV-22B relies on SATCOM for its primary long-range BLOS communications. In a near-peer/peer conflict, satellite communications are susceptible to targeting and disruption.[5] In such a conflict, satellites will be readily targeted to degrade communications, navigation, and collections capabilities.[6] Loss of access to satellites will severely limit the distributed force's ability to communicate and coordinate actions. The MV-22B does possess the BLOS capability with its SATCOM equipment, yet it lacks further redundancy for long-range communication. The contested domain foreseen by the *38th Commandant's Planning Guidance* requires the redundancy of multiple waveforms to enable success in such an environment. The former Commandant, Gen David H. Berger, foresees Marine forces spread far and wide within the weapons engagement zone of enemy forces.[7] The ability to resupply, coordinate, and communicate with these stand-in forces will be critical to mission success. The range of the MV-22B can support these forces but specifically requires the ability to conduct command-and-control (C2) BLOS across these great distances. SATCOM cannot be the sole solution for this capability.

As a key logistical and assault support element within the ACE, the MV-22B will fail to nest within the C2 structure of distributed operations with its current communication capabilities. With the Pacific Ocean covering a third of the Earth's surface area, distances between land masses, coastal regions, and the naval force are large. As it currently stands, LOS communications are relied upon to facilitate the air C2 structure. As the Marine Corps and DOD focus on distributed operations, the enablers, the C2 structure, will need to adapt to operate BLOS.[8] The MV-22B will provide logistic support and tactical maneuver between dispersed operating areas and must be capable of nesting with the C2 structure that will be featured in this type of environment—one that can span beyond the horizon and requires redundancy in BLOS capability. This structure includes the naval surface fleet, air C2 agencies, and the ground forces supported ashore. As a supporting element of all these players, the MV-22B must increase redundancy in its ability to connect and communicate with them.

There is a proven technology that can solve for all the shortfalls with the current communications equipment of the MV-22B: HF radio. The HF waveform is not limited by LOS, provides redundancy for SATCOM, and is already employed across the DOD. High-frequency radio communications equipment exists for the Navy's CMV-22B (cargo and multi-mission variant) and the Japanese Self-Defense Force V-22. As the former Commandant directed the Corps to look to proven technology in favor of new and expensive solutions, HF radio is a perfect fit for the MV-22B.[9] High-frequency is a proven BLOS technology that far exceeds the reach of current equipment and provides a redundant backup to SATCOM.

High-frequency radio communications can match the extended range and endurance of the MV-22B filling the gap created between LOS and the aircraft's operational range. Figure 1 shows that HF radio waves can propagate further than VHF and UHF due to interactions with the ionosphere, allowing for long-range communication without a satellite relay.[10] This eliminates the requirement for LOS between transmitter and receiver and vastly improves communication ranges.

The MV-22B tiltrotor platform has been revolutionary in its ability to conduct long-range assault support operations. It is time for the communications equipment and radios onboard to match its flight profiles and capabilities.

High-frequency communications also provide SATCOM redundancy and backup. In a degraded environment where satellites are vulnerable, the need for redundancy in BLOS capabilities

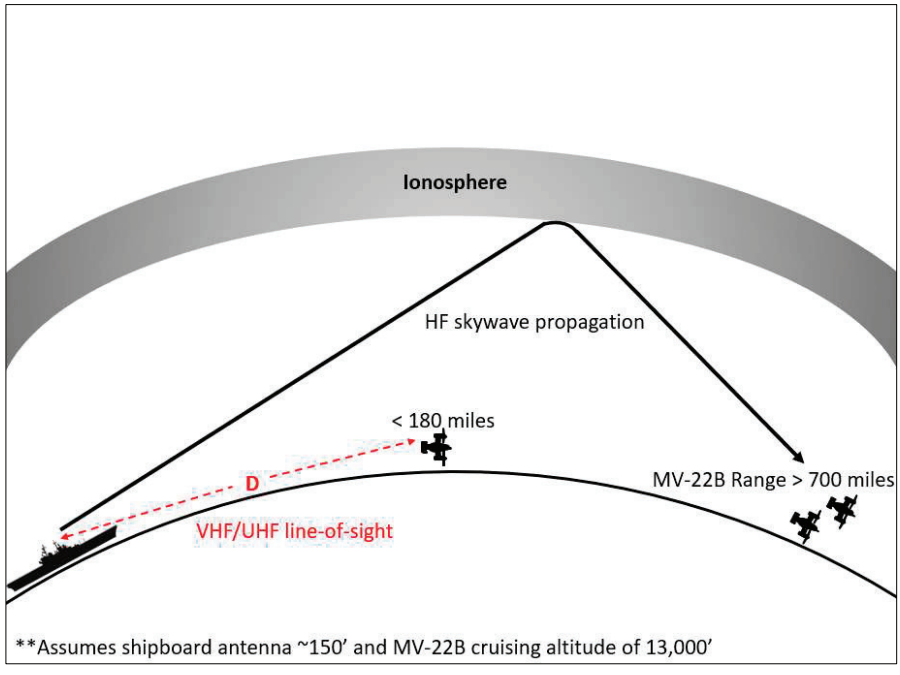


***Figure 1. This figure is an example of how HF transmissions can keep pace with the MV-22B, where UHF and VHF cannot.*** *(Figure created by author.)*

***Marines with 2/7 Mar conduct an insertion greater than 700 miles via MV-22B Ospreys operated by VMM 262 during Jungle Warfare Exercise 22.*** *(Photo by Sgt Kallahan Morris.)*

can be readily met with HF radio. The characteristics of HF communication allows for long-range communication, increases compatibility with the naval surface fleet, and reduces reliance on vulnerable satellite infrastructure. When SATCOM capabilities are lost, HF radio communication equipment allows for BLOS communications without reliance on satellite availability or allocation.[11] High-frequency provides redundancy and capability as a tried-and-true technology and is supported by familiarity across the DOD. It is a ready-made, capable, redundant backup that bridges the MV-22B's communications gap that is ever more apparent in the future fight. As forces are required to operate in contested waters, HF radio will provide redundancy and reliability to keep the MV-22B connected to the distributed force.

Implementing an HF radio communications capability will allow the MV-22B to fit into the C2 structure of a distributed maritime force, as seen by the *38th Commandant's Planning Guidance*. Due to its BLOS capabilities, the naval force and several prominent air C2 agencies utilize HF. These include air command and control agencies, such as the Navy tactical air control center, the direct air support center, tactical air operations center, and the Marine tactical air control center.[12] Reconnaissance and ground force assets such as low-altitude air defense employ HF; these are the forces that the MV-22B is specifically used to support.[13] Interoperability with ground force and naval surface assets increases dramatically with the addition of an HF capability. The propagation and readily available nature of HF communications equipment will allow the MV-22B to connect with distributed forces that may or may not have access to SATCOM or other means of communication. It will enable MV-22B crews and the Marine ACE to fully integrate with the Navy's surface fleet and effectively shrink the battlespace.

***An MV-22 Osprey, with VMM 262, conducts a long-range insertion with 2/3 Mar from Okinawa to Camp Fuji, Japan, during Noble Jaguar 2021.*** *(Photo by LCpl Kree Laing.)*

While HF radios can solidify the MV-22B's capabilities, many opponents argue that the barriers of acquisition, training required, and installation costs would outweigh the benefits that HF radio would bring. However, the equipment and footprint already exist to install HF radios of V-22s, as proven by the CMV-22B program of the Navy and the Japanese Self-Defense Force's V-22. The procurement processes and supply chains will mirror the Navy's pre-existing footprint and procedures, with training on maintenance and operation readily available. Installation costs will be minimized substantially due to the Navy's program and are minuscule compared to the cost of developing new alternative technologies.

Consequently, as its focus shifts to expeditionary basing and distributed operations, the Marine Corps must upgrade its primary assault support aircraft with HF radios to operate effectively in a degraded environment. In its current state, the MV-22B has a critical shortfall in its reliance on satellites to communicate beyond line-of-sight. By retrofitting the MV-22B fleet with HF

radios, the Marine Corps will enable the ACE to communicate across the vast expanses of the ocean. High-frequency radio will allow success and redundancy for dispersed forces spread far and wide in the maritime domain. So, instead of Tiger 31 flight operating alone and unafraid above the black expanse of the Pacific Ocean, they will have the far-reaching support of the naval surface fleet and Marine ground forces at their disposal.

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# Marine Corps Helicopter Limitations

## The impetus to procure an attack tiltrotor craft

by Capt Evan Ruppert

The Marine Corps is in the process of innovating and adapting to a future battlefield. This future battlefield is centered around the idea of "peer-level competition, with special emphasis on the Indo-Pacific" and distributed maritime operations (DMO).[1] A major challenge of conducting DMO with the current fleet of aircraft is the basic aerodynamic limitations of helicopters. Helicopters aerodynamically have speed and range limitations which have led to the AH-1Z and UH-1Y aircraft in the Marine light attack helicopter (HMLA) squadrons to be described as "operationally unsuitable for our highest-priority maritime challenges."[2] The Army has identified this same shortfall in helicopters and has initiated the Future Long-Range Assault Aircraft program to look for a replacement for the UH-60 Blackhawk; and on 5 December 2022, the Army has chosen its replacement as the Bell V-280 tiltrotor aircraft.[3] The mission of HMLA has always been to provide offensive air support, utility support, armed escort, and airborne supporting arms control. To continue the impactful effect of this mission during DMO, the Marine Corps must initiate a program like the Army's and replace its current light attack helicopters with tiltrotor aircraft.

Anyone looking at a map of the Indo-Pacific will see a maritime environment broken up with numerous island chains. In a future conflict taking place in this region, the range that vehicles can travel will have an amplified importance. As stated in the *2022 United States Marine Corps Aviation Plan*, the notional mission profile of an AH-1Z Viper attack helicopter, which is the main rotary wing attack aircraft utilized by the Marine Corps, is 110 nautical miles (NM).[4] That means the AH-1Z can travel 110 NM, have a 30-minute time on station for their mission, and fly the 110 NM route back to base. A map study of this region will show most islands in this area are well beyond that distance. For example, the distance between the island of Kumejima in the Okinawa Prefecture and the nearest southern island of Miyakojima, which is halfway between Okinawa and Taiwan, is 115 NM. To create an effective employment range of attack helicopters, forward arming and refueling points would need to be placed on numerous islands throughout the area. Each forward arming and refueling point has a logistical and security requirement which adds to the complexity of establishment and operation. Over the entirety of the Indo-Pacific region, this creates a forward arming and refueling point network that simply is not feasible. It is therefore required to employ an asset that has the range to extend far beyond the 110 NM range of an AH-1Z. Tiltrotor aircraft have a vastly increased flight range of helicopters. The MV-22B, the only current tiltrotor aircraft currently employed by the U.S. military, has a combat radius of 420 NM while and the Army's newly chosen V-280 Valor has an unrefueled combat range of 500+ NM.[5] These ranges can also be multiplied by the ability to refuel in air, which the MV-22B possesses and the V-280 could be modified to accomplish. This ability would extend the range to a theoretically infinite distance. Using the same island example above, the V-280 aircraft in its current state can make the 115 NM transit multiple times over again and have an extended time on station to conduct operations. The simple numbers in terms of range make it clear that tiltrotor aircraft have range abilities that no helicopter possesses and having a tiltrotor attack aircraft can be a solution to maritime challenges.

As the Los Angeles Raiders general manager once stated, "speed kills" in referring to his players who can outrun their opponents on the field. Although he was referring to professional athletes, the statement is equally viable in terms of aircraft. Specifically with rotary wing and tiltrotor attack aircraft, speed buys the Marine Corps two capabilities: survivability and escort ability. In terms of survivability, speed complexes enemy gunnery and decreases the transit time through an enemy weapons engagement zone. "Pulling lead is the most difficult aspect of air-to-air gunnery. Test and historical data show that gunners often fail to pull enough lead. Maintaining higher airspeed on the aircraft will defeat a majority of optically tracked, unguided projectile weapons."[6] Although this is only true in reference to optically guided anti-air threats, the decreased

***>Capt Ruppert is an AH-1Z Pilot who served in HMLA-469 "Vengeance" from 2018–2022. He is currently stationed in Pensacola, FL, and is training the next generation of Marine Corps Rotary Wing Aviators in the TH-73 "Thrasher" during their advanced phase of flight school training.***

transit time through an enemy weapons engagement zone is a further increase in survivability. The MV-22B Osprey has a cruising speed of 220 knots, 90 knots greater than the AH-1Z of 130 knots; and the V-280 has a cruising speed greater than 280 knots.[7] With a speed over twice that of an AH-1Z, the V-280's transit time through an enemy man-portable air-defense system weapons engagement zone will effectively be cut in half. This causes an enemy-man-portable air-defense system gunner to have significantly less time to acquire and employ their weapon system at the aircraft. Combining this with other flight tactics could be the difference between a successful mission and a downed aircraft.

Next to survivability, the most obvious need for speed is one the HMLA has been struggling with since the introduction of the MV-22B: the AH-1Z cannot provide a continuous attached escort to a tiltrotor aircraft. As stated earlier, the MV-22B has a drastically faster transit speed. When specifically speaking about an assault support operation where the MV-22B is inserting troops into a landing zone (LZ), the MV-22B starts its transition to helicopter mode three NM away from the LZ at the initial point (IP), starting at 220 knots.[8] Following the IP, the MV-22B will reduce airspeed below 120 knots (AH-1Z cruising speed) at only one NM before the LZ.[9] If the MV-22B Osprey is reducing speed only one NM away from their final landing, then the AH-1Z can only conduct an attached escort for that last mile prior to the landing. Although this is the most critical time an aircraft would need protection as it is most vulnerable on final approach to a zone, the lack of attached escort prior to the last mile is an unnecessary liability the Marine Corps has been forced to accept. The utilization of a tiltrotor attack aircraft such as the V-280 would perfectly pair with the tiltrotor assault support aircraft of the MV-22B and allow for continuous escort operations through the entirety of the flight route; something Osprey pilots have not had available to them since they first transitioned from the CH-46 to the MV-22.

Critics against incorporating a tiltrotor craft such as the V-280 as a replacement to the AH-1Z and UH-1Y in the HMLA would state that the V-280 is not currently designed for attack and maritime missions, and tiltrotor aircraft are more expensive than traditional helicopters. In the same way there are multiple variants of the UH-60 Blackhawk, the V-280 could be modified to many variants. The original UH-60 was designed only as a utility helicopter, but today numerous variants can carry multiple weapons systems including the AGM-114 Hellfire missile. The best example of heavy modification is the Navy MH-60R variant used to accomplish the anti-surface and anti-submarine warfare missions. On the MH-60R,

the airframe itself has been modified to fit an AN/APS-147 dipping sonar and AN/AAS-44 downward-facing radar to track targets.[10] If such excessive modifications can take place from the UH-60 original model, there is no doubt the U.S. military can invest in a variant of the V-280 to employ precision-guided munitions such as the Hellfire. If the mission commander requires a long-range strike against a maritime or island-based target, the V-280 could be an ideal platform to accomplish this mission and one that a traditional helicopter could never achieve. As far as maritime missions, the V-280 is unable to fold its blades and wings like a MV-22B to facilitate storage on an amphibious transport dock ship such as the Landing Platform Dock. This can be argued as a reason not to procure the V-280 for the Marine Corps, despite its obvious advantages, as the Marine Corps is an expeditionary force and must be able to embark on Navy ships. Although a naval variant has not been built, Bell has unveiled a naval variant design of the V-280 Valor.[11] If a prototype of this variant is built and evaluated, it could be utilized by the Marine Corps and allow for the V-280 to replace the AH-1Z and UH-1Y. This would continue to allow HMLA aircraft to embark on Navy ships and be utilized in support of MEUs. In response to the final criticism of the potential price, the first purchased military tilt-rotor aircraft, the MV-22, has an initial purchase price over doubling that of the AH-1Z at $72 million per aircraft.[12] With that price, the Marine Corps would only be able to afford half of the V-280s that it has H-1's in its inventory. However, despite the large price tag of the MV-22, the V-280 is much lower and has a cost comparable to the AH-1Z at around $30 million per unit. This would therefore be comparable from a fiscal standpoint and should not impact the procurement of new aircraft.[13]

As the Marine Corps reorganizes and refocuses its efforts to conduct DMO in the Indo-Pacific region, it is necessary to look at the effectiveness of all assets currently fielded. The Marine Corps has already made drastic decisions in the name of force redesign to replace traditional artillery with rocket artillery and divest all fielded tanks.[14] If the Marine Corps can make these large and sudden changes to strengthen its force, there should be no doubt that it can invest in a new program that has already been chosen by the Army—especially as the Marines have decided it will no longer purchase the AH-1Z and will need a replacement in the foreseeable future.[15] Choosing a tiltrotor craft as its replacement will be essential; threats to freedom of navigation in the Indo-Pacific region are only growing and the need for a viable attack platform with the speed and range to compete and survive is necessary. The speed and range limitations of traditional helicopters are becoming increasingly prohibitive to gaining a competitive advantage against near-peer adversaries. Whether it is conducting a strike mission against a target on an island 200 miles away or escorting a MV-22B Osprey from its point of origin to its LZ and then defending the troops that it disembarks; the U. S. Marine Corps must procure the V-280 Valor or a similar tiltrotor craft to occupy the essential light attack role.

***As the Marine Corps reorganizes and refocuses its efforts to conduct DMO in the Indo-Pacific region, it is necessary to look at the effectiveness of all assets currently fielded.***

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# Detect and Avoid, IFF, and Datalink

**Essential tools to integrate autonomous unmanned aerial delivery systems into air and logistics command and control systems**

by Maj William M. Schweitzer

***>Maj Schweitzer is the Marine Air Ground Task Force Headquarters Company Commander, II MEF Support Battalion. He was previously a Tactical Air Operations Center and Air Traffic Control Detachment Commander and is a Weapons and Tactics Instructor, Expeditionary Logistics Instructor, and Aerial Delivery Officer.***

Autonomous unmanned aerial systems (UAS) have made rapid advances over the past decade and represent substantial promise for the future of warfare. Marine logisticians are particularly interested in the use of autonomous logistics delivery UAS in the distributed operational environment. The Marine Corps recently purchased 21 autonomous aerial distribution tactical resupply unmanned aircraft systems and even more capable systems such as Kaman's Medium Unmanned Logistics Systems–Air are on the way.[1] The most significant problem for these larger autonomous systems is no longer the engineering challenge of lifting militarily significant payloads over useful ranges. Rather, it is integration into air command and control (C2) systems that were designed for piloted aircraft and only recently adapted for remotely controlled aircraft. The very aspect of these new systems that offer the greatest advance—no pilot—also raises flight safety concerns. Additionally, given the nature of future operations across the spectrum of conflict, in which exclusive-use military airspace is unlikely, there is an implicit requirement to make Marine Corps systems acceptable to civilian air traffic control agencies at home and abroad. Beyond that, there is the obvious need for Marine logistics air platforms to have the native ability to communicate with emerging realtime *logistics* C2 systems and the Marine Air Command and Control System. Unless there is a robust, comprehensive plan to integrate autonomous UAS fully into all these systems, we risk squandering the vast possibilities of this new technology and consigning it to the margins. This article highlights the basic capability tools that will enable Group 4/5 autonomous aerial delivery UAS to integrate successfully into all these C2 systems: detect and avoid, Mode 5 identification friend or foe (IFF), and LINK-16 datalink capability.

## Detect and Avoid

To understand the basic elements UAS need to fly in controlled civil airspace, we start with NASA's extensive unmanned aircraft systems integration in the National Airspace System Project and the resulting *Federal Aviation Administration's Integration of Civil UAS in the National Airspace System Roadmap*.[2] Recognizing the ultimate infeasibility of airspace restrictions alone to separate UAS from piloted aircraft in the national airspace (and this insight applies even more so in the battlespace), the most basic integration tool is a Detect and Avoid (DAA) capability:

> As Unmanned Aircraft Systems (UAS) make their way to mainstream aviation operations within the National Airspace System (NAS), research efforts are underway to develop a safe and effective environment for their integration into the NAS. DAA systems are required to account for the lack of 'eyes in the sky' due to having no human on board the aircraft.[3]

Simply put, the oldest rule of the sky—that the pilot is responsible to see and avoid other traffic—applies conceptually to UAS and will soon be a regulatory requirement. The technological means to accomplish this end include fused visual and infrared sensors and an Airborne Collision Avoidance System such as Traffic Alert and Collision Avoidance System or Automated Dependent Surveillance-Broadcast, along with a machine learning-enabled aircraft control system to respond to these inputs appropriately.[4] The redundancy of optical/IR sensors and the Airborne Collision Avoidance System is all the more important for military applications since the electromagnetic spectrum in a contested environment will be exploited and denied at times.

## Mode 5 IFF

Another basic tool that autonomous UAS will require to successfully integrate into air C2 systems is a robust IFF capability. The 1984 blue-on-blue shootdown of two Army UH-60 Blackhawks has served as an enduring reminder that IFF systems must be redundant, maintained, and operated meticulously.[5] But is this life-saving capability less important in *unmanned*

systems? First, even though many of these systems are designed to operate entirely without pilots, the MULE-A is based on a conventional helicopter platform and retains the "pilot optional" ability for a human to fly in it. So long as this capability exists, air defenders will have to assume that a human life is involved. Even if this special situation did not exist, however, the tremendous proliferation of enemy UAS—and therefore need for a fast-responding ability to disable or destroy them *en mass*—has only made the efficient, confident identification of friendly UAS at range even more important. We will certainly not have the time or resources to visually identify each bogey as with manned fighter intercepts of past wars. As one source says, "The UAS operator's identity, capability and intentions will likely remain elusive. On the other hand, 'If it ain't ours, it must be theirs.'"[6] The transponders on autonomous UAS, at the least, should adhere to NATO standards which as of July 2020 required all military aircraft to transition from the legacy Mode 4 to Mode 5, which has a far stronger encryption and better transmitter response prioritization. More to the point of this article, Mode 5 also includes a secure version of Mode S and Automated Dependent Surveillance-Broadcast position reporting, and therefore represents an obvious capability requirement for military Group 4/5 autonomous UAS.

## Datalink

Thus far, we have discussed elements of capability largely in terms of identification and airspace deconfliction. Doing these things begins to make autonomous UAS safe relative to itself and others, but it does not fulfill C2 integration requirements even for the Marine air command and control system, let alone for emerging logistics C2 systems. Thus far, we have only reached the territory of legacy helicopters, which leaves much to be desired in terms of realtime battlespace awareness. To address this *desideratum*, new helicopters like the CH-53K have native LINK-16 capability while legacy aircraft like the UH-1Y are working hard to retrofit it. LINK-16 enables a ready integration into the Joint Force, the Marine Air Command and control System, and thereby the common aviation C2 system. In addition to being jam-resistant due to its time division multiple access technology providing multiple, simultaneous paths through different nets, it features a relative navigation functionality that can provide flight safety-quality position reporting and inherent IFF capabilities even in a GPS-denied environment. LINK-16 can tell us where the UAS is, what it is carrying, when it lands, and where it is going next. It therefore has great potential to feed into the logistics common operational picture. This kind of realtime information has remained elusive for the logistics community for too long, and this kind of datalink requirement should be part of every future Group 4/5 system we acquire. Also, given the preliminary results from the add-on LINK-16 hardware on the UH-1Y/AH-1Z, a ground-up solution should be preferred.[7]

## Conclusion

Autonomous UAS for logistics delivery is an exciting prospect. We stand on the cusp not merely of swarms of small autonomous systems like the tactical resupply unmanned aircraft systems but also of Medium Unmanned Logistics Systems-Air and MARV-EL providing the LCE capability that was previously the exclusive province of medium-lift helicopter and tiltrotor squadrons in the ACE. The temptation at this point is to underestimate what it will take to integrate these powerful new systems comprehensively into the C2 environment, whether military or civilian. These systems should present end-users with a minimum of restrictions or limitations on the one hand, and with a minimum of risks to other users of the airspace on the other hand. As explained above, the cost of this balance is paid in terms of robust, overlapping technologies: detect and avoid, Mode 5 IFF, and LINK-16. One might object that such capabilities are at odds with the goal of limiting our electromagnetic signature. Yet, we need not imagine that these capabilities will all be used simultaneously; redundancy enables us to pick and choose as the tactical situation dictates. In the larger picture, however, we may have to accept that safe, useful autonomous UAS may be electromagnetic-noisy to some extent. I argue it would be better for systems like Medium Unmanned Logistics Systems-Air be electromagnetic-noisy but safe and effective rather than stealthy but unsafe or ineffective.

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# Halsey's Trials

## The case for aviation ground support reconnaissance in distributed aviation operations

by LtCol Matthew Schultz, Maj Tyler Sweet, Capt Randall Gregorius, 1stLt Seth McGann, 1stLt Joel Forwalder, Cpl Alastair Willix & the Gryphons of Marine Wing Support Squadron 174

VADM Halsey's trials and tribulations as the Commander of the South Pacific Area provide an invaluable case study of decision making during the conduct of shorebased, expeditionary distributed aviation operations in complex littoral terrain. Halsey's reflections on his first two important decisions as a theater commander illuminate a gap in contemporary aviation doctrine that must be addressed for the Marine Corps to realize its vision of distributed aviation operations.

VADM Halsey exclaimed, "Jesus Christ and General Jackson! This is the hottest potato they ever handed me!" as he stepped off a seaplane in Noumea, New Caledonia, on 18 October 1942.[1] He had just finished his second reading of a "SECRET" dispatch from the Commander-in-Chief, U.S. Pacific Fleet, ADM Nimitz. The message directed him to immediately assume command of the South Pacific Area and South Pacific Forces. Halsey's unexpected ascension to theater command left him "dumbfounded," and the dismal situation in the South Pacific Area gave him no solace.[2]

Halsey's immediate problem was getting Operation WATCHTOWER—the ongoing seizure of Guadalcanal in the Southeastern Solomon Islands—back on track. Guadalcanal, an island code-named "Cactus," was the keystone of his theater and the first objective in the U.S. campaign to isolate and defeat the Japanese advanced naval base at Rabaul—the enemy's principal strongpoint in the Northern Solomons. Unfortunately, the situation faced by Halsey's forces fighting ashore on Cactus over the past two months was "desperate."[3]

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The 1st MarDiv had commenced operations on Guadalcanal on 7 August, following an unopposed landing. Though the Marines seized their initial objectives ashore in rapid succession, conditions aboard the island and morale had steadily deteriorated under the compounding weight of sustained combat operations.[4] The Marines were entangled with a tenacious enemy—forces of the Imperial Japanese Army's 17th Army—whose combat power continued to grow thanks to reinforcement by the "Tokyo Express," the Japanese logistics network that ran northwest to southeast along the slot in the Solomon Islands. To make matters worse, the Marines faced serious supply shortages and relentless Japanese strikes from the air and sea. Yet the ground fight aboard Guadalcanal was only one aspect of the grim task Halsey had before him.[5]

Halsey's naval forces also faced continuous interdiction in the complex littoral waters of the Solomons. A combination of Japanese daily aerial strike packages and destructive nighttime surface raids, sortied from Rabaul, had exacted a serious toll on Halsey's naval task forces.[6] Further, with only one aircraft carrier—the *Hornet*—at his disposal in the entire South Pacific, Halsey knew that the loss of his most flexible aerial power projection asset in the theater would put the entire campaign in jeopardy.[7] Finally, Halsey's theater logistics system, which he described as a "shoestring," was in a perilous state, and he had inherited an unfamiliar, exhausted staff from his predecessor.[8] It was only Halsey's second day on the job, but he recognized that his ability to make sound decisions about the way forward would rest on operational assessments of the situation from his subordinate commanders. He decided to convene a conference aboard his flagship in Noumea to gather the assessments.

Halsey hosted the conference on 20 October in his cabin aboard the USS *Argonne*. It was a sobering affair. Halsey had flown his two commanders with the strongest pulse on WATCHTOWER—MajGen Vandegrift, Commanding General of the 1st MarDiv, and RADM Turner, Commander of Amphibious Forces South Pacific—from Guadalcanal to attend.[9] Neither arrived bearing good news.

While Vandegrift shared his "bitter" assessment of operations ashore, Turner "protested that the Navy was already doing its utmost" even as its pool of available ships dwindled further daily.[10] As the meeting adjourned, Halsey asked, "Are we going to evacuate or hold?"[11] Vandegrift responded, "I can hold, but I've got to have more active support than I have been getting."[12] Halsey told Vandegrift, "All right. Go on back. I'll promise you everything I've got."[13]

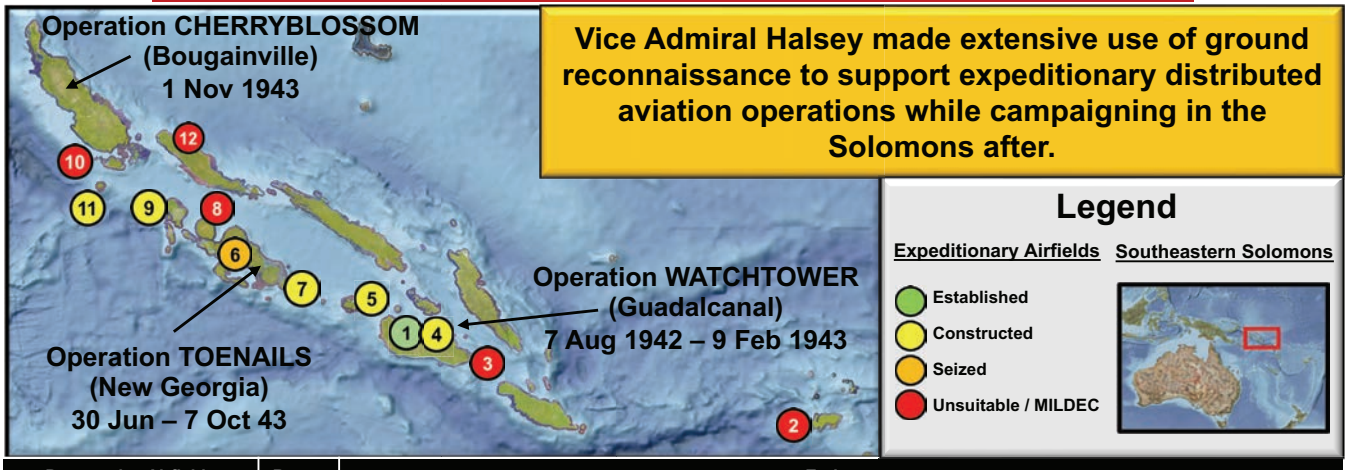
Halsey oriented on the most consequential problem he could solve with the limited resources he had available in the theater—his dearth of expeditionary airfields. As a naval aviator, Halsey recognized that in the absence of carriers, Henderson Field—his only aerodrome in the Solomons—could not support the sortie generation rate required to complete the seizure of Guadalcanal or contest Japanese episodic air and maritime superiority.

Henderson Field was a 2,600-foot airfield situated in northwestern Guadalcanal.[14] Described as an "unsinkable aircraft carrier," Henderson afforded its proprietor control of the skies in the Southern Solomons and the ability to interdict the vital sea lines of communication connecting the United States and Australia.[15]

Earlier that year, in June 1942, ADM Ernest King—the Chief of Naval Operations and Commander in Chief U.S. Fleet—first learned of the airfield after a network of local informants, known as the Coastwatchers, reported the commencement of Japanese construction activities near Lunga Point.[16] Understanding that it was "essential to stop the southward advance of the enemy at that point," King decided that the seizure of Guadalcanal, because of the airfield, would serve as the opening gambit for the U.S. offensive in the South Pacific.[17]

Vandegrift's Marines seized the field as an initial objective in WATCHTOWER, and the 1st Engineer Battalion

## SOPAC Ground Reconnaissance in Support of Expeditionary Aviation in the Solomons August 1942 – October 1943




| Prospective Airfields | Recon | Endstate |
|---|---|---|
| 1 Henderson Field, Guadalcanal | No | VADM Gormley declined ground reconnaissance. Seized by 1st MarDiv during Guadalcanal landings and improved. Operable 20 Aug 42. |
| 2 Ndeni, Santa Cruz Islands | No | Halsey's first "important decision." Enroute forces to include 14 NCB, re-directed to construct EAF at Aola Bay on 2 Nov 1942 |
| 3 Aola Bay, Guadalcanal | No | Halsey's second "important decision." Seized 4 Nov 42. 14 NCB construction at Aola Bay abandoned 25 Nov 42. Re-tasked to Koli Point. |
| 4 Koli Point, Guadalcanal | Yes | 14th NCB finds suitable terrain for EAF. Constructed the 7,300-foot Carney Field as an emergency divert to Henderson. Operable 16 Dec 42. |
| 5 Russell Islands | Yes | Reconnoitered Feb 43. Seized (unopposed) 21 Feb in CLEANSLATE. EAF constructed, halving distance from Guadalcanal to New Georgia. |
| 6 Munda, New Georgia | Yes | Coastwatchers report enemy airfield construction Nov 42. Reconnoitered over subsequent months. Seized 3 Aug 43 in Operation TOENAILS. |
| 7 Segi, New Georgia | Yes | Reconnoitered Jun 43. Found suitable. Seized 30 Jun 43 and EAF constructed by elements of multiple NCBs. Operable 18 Jul 43. |
| 8 Villa, Kolombangara | Yes | Reconnoitered ~ June 43. Defended by 10,000-man garrison. Suitable for EAF but high risk to force and time. Bypassed for Vella Lavella. |
| 9 Barakoma, Vella Lavella | Yes | Reconnoitered Jul 43. Defended by 250-man garrison. Suitable for EAF. Seized on 12 Aug 43. 4,000-foot EAF constructed by 58th NCB. |
| 10 Shortland Island | Yes | Reconnoitered Aug 43. Reconnaissance yielded insufficient information to pursue airfield construction. |
| 11 Treasury Island | Yes | Reconnoitered Aug 43. Found suitable. Seized on 27 Oct 43 as a diversion in support of CHERRYBLOSSOM. |
| 12 Choiseul | Yes | Reconnoitered Sep 43. Suitable locations for airfields existed but risk was too high. 27 Oct 43 raided ISO MILDEC during CHERRYBLOSSOM. |

***Halsey's reconnaissance and evaluation of expeditionary airfields in the Solomons.*** *(Image provided by author.)*

made immediate use of captured engineer equipment to extend it to 3,800 feet and open it for flight operations.[18] Henderson Field received the first elements of the "Cactus Air Force" of the 1st MAW thirteen days after the initial landings.[19] Though control of Henderson was a silver lining in a sea of problems for Halsey in late October, it was not without paradox.

While Henderson Field enabled Halsey to sustain forces ashore on Guadalcanal, interdict enemy naval assets afloat, and exercise episodic air superiority in the Southern Solomons, it posed an operational problem that the enemy could not ignore. Thus, the Japanese subjected Henderson to continuous interdiction from the air, land, and sea, rendering its utility to "the mercy of the weather and the enemy."[20] So long as the Japanese could mass and concentrate their combat power against a single installation ashore, Halsey's freedom of action would remain constrained by the imperative to retain his keystone in the South Pacific. Halsey grasped this keenly, writing in his memoir that "within forty-eight hours ... and despite my ignorance of the terrain, I had to make two important decisions."[21]

Halsey's first decision was to construct an airfield at Ndeni, the largest of the Santa Cruz islands, 330 miles east of Guadalcanal.[22] Ndeni's location was not ideal, but it was much closer than his nearest airfield on Espiritu Santo—550 miles southeast. On 31 October, Halsey deployed forces, including the Navy's 14th Naval Construction Battalion from the New Hebrides, to seize Ndeni and construct the airfield.[23] Unfortunately, just as Halsey's forces commenced their movement toward Ndeni, conditions aboard Guadalcanal deteriorated further, and on 2 November, Halsey re-tasked them to seize another enclave on Cactus instead.[24] Thus, having aborted his first important decision, he turned to his next one—where to build an airfield.

A second airfield on Guadalcanal offered an opportunity to relieve pressure on Henderson Field by complicating enemy interdiction and providing an alternate location for the Cactus Air Force. With time of the essence and forces on the move, Halsey leaned on a logical recommendation from RADM Turner—to construct the airfield at Aola Bay, 30 miles east of Henderson Field.[25] Halsey wasted little time in re-tasking elements of the 14th Naval Construction Battalion, along with the U.S. Army 14th Infantry Regiment and the 2d Marine Raider Battalion, to proceed to Guadalcanal, seize Aola Bay, and build an airfield.[26] The task force landed at Aola Bay on 4 November and broke ground on a month-long debacle in a swamp that was "utterly unsuited to a field."[27]

Unfortunately, Halsey had decided to build an airfield at Aola Bay with little knowledge of the terrain. Further, Halsey did not have the opportunity to consult with his principle aviation commanders—RADM Fitch, Commander, Air Forces South Pacific, or BGen Geiger, the CG of the 1st MAW—both of whom were unavailable to provide their input to inform his decision.[28] Halsey had assumed risk in pursuing construction at Aola Bay based on unvalidated assumptions that proved to be false, and it did not take him long to realize it.

***Halsey's forces established a ground reconnaissance school aboard Guadalcanal ...***

Within twenty days of landing forces at Aola Bay, Halsey scrapped the plan for the airfield and re-tasked the units to displace eighteen miles northwest to a place named Koli Point—a mere seven miles east of Henderson Field.[29] The landing force received their warning order for the move shortly after finishing their Thanksgiving dinner in the jungle and began their movement the following day.[30] The 14th Naval Construction Battalion reconnoitered Koli Point, found it suitable, and, within 14 days of securing the objective, constructed a 7,300-foot emergency divert airfield later named Carney Field.[31]

After seeing his first two important decisions as a theater commander go awry, Halsey recognized that the effective planning and execution of expeditionary operations ashore was contingent upon having a more comprehensive understanding of the battlespace. He needed the means to gather pertinent information about the operational environment, not only regarding the enemy situation and the viability of potential landing beaches but also whether the terrain was suitable for airfield construction. Halsey recorded these reflections writing, "from then on, I waited until I had all available information before I put a plan in motion." He turned to ground reconnaissance teams to collect on his information requirements, claiming that he never again "made a forward move without their help."[32]

Halsey's emphasis on ground reconnaissance stemmed from several factors related to what Col Merrill B. Twining, the operations officer of the 1st MarDiv, described as a "scarcity of reliable terrain information."[33] First, much of the littoral terrain in and around the Solomons in 1942 was unmapped and uncharted, leaving planners in some instances to rely on hand-drawn maps from displaced island residents.[34] Second, while aerial reconnaissance platforms improved Halsey's ability to sense and make sense of the operational environment, they were insufficient in developing an understanding of the nuanced aspects of terrain central to amphibious and shorebased expeditionary aviation operations. Third, while the Coastwatcher network in the Solomons was an invaluable resource for collecting on enemy activity and human terrain, it was not a viable source of information on variables such as surf zones, drainage, or the load-bearing capacity of soil.

Halsey's miscues with Ndeni and Aola Bay revealed his need for task-organized forces trained, equipped, and capable of collecting specific information requirements that could not be derived by any means other than boots on the ground. Halsey's forces established a ground reconnaissance school aboard Guadalcanal, and he began deploying teams to support his decision making through "thorough close reconnais-

sance by trained scouts."[35] Many of these teams included attachments of engineers and aviators to identify potential airfield locations.[36]

The first notable instance of Halsey employing ground reconnaissance teams occurred in November 1942 after Australian Coastwatchers reported that the Japanese were constructing a 4,700-foot airfield at Munda Point, 150 miles northwest of Guadalcanal, on the island of New Georgia.[37] Subsequent reconnaissance missions leading up to the seizure of the island during Operation TOENAILS were instrumental to Halsey in developing a holistic understanding of the operational environment. These missions assessed the viability of landing beaches, the capacity of mobility corridors, and the suitability of adjacent sites, including Segi Point on the southeastern tip of New Georgia, for potential airfields.[38] Though operations aboard New Georgia, conducted between June and October 1943, were challenging, the investment of time and resources into ground reconnaissance played a key role in the successful seizure of Munda as well as the construction of a new airfield at Segi Point by the 47th Naval Construction Battalion.[39] Conversely, Halsey also used ground reconnaissance to identify places to avoid.

Halsey originally planned to seize the island of Kolombangara—twenty miles north of Munda—as his next campaign objective, thanks to its proximity to New Georgia and the presence of an operational Japanese "fighter strip at Vila-Stanmore." However, after recovering his reconnaissance teams from Kolombangara, Halsey assessed that the island was fortified by "more than 10,000 troops dug into positions as nearly impregnable as Munda."[40] This information prompted him to consider a bypass policy to avoid Japanese strong points that offered a marginal return on investment and risked slowing campaign progress.

After reconnoitering other islands, Halsey decided to bypass Kolombangara and instead seize Vella Lavella—25 miles farther northwest. He made this decision because reconnaissance teams discovered that the island was defended by only 250 soldiers and had a suitable site for an airfield on its southern coast.[41] Halsey's forces landed on Vella Lavella on 15 August 1943, and the 58th Naval Construction Battalion began constructing an airfield at Barakoma.[42] That airfield received its first aircraft on 27 September and played an important role in supporting Halsey's next offensive against the last "obstacle on the road to Rabaul"—the seizure of Bougainville during Operation CHERRY BLOSSOM.[43]

> ***... it makes little mention of the criticality of ground reconnaissance in enabling expeditionary aviation operations ...***

Ultimately, Halsey's ability to generate sorties from Henderson Field on Guadalcanal, in addition to an assortment of expeditionary airfields on New Georgia, Vella Lavella, the Treasury Islands, and Empress Augusta on Bougainville, to name a few, proved critical in supporting the isolation and ultimate defeat of Rabaul.[44] His deliberate employment of ground reconnaissance was central to his ability to establish a robust network of distributed aviation sites that enabled the successful completion of his naval campaign in the Solomons.

## Applying Halsey's Lessons to Tomorrow

While aviation technology, platforms, and tactics have changed since Halsey's trials in the Solomons, the requirement for commanders to be armed with the right information to make sound decisions remains a constant. Contemporary aviation doctrine is replete with material on the topic of reconnaissance, but the majority of it focuses on air reconnaissance—one of the six functions of Marine Aviation. Strangely, it makes little mention of the criticality of ground reconnaissance in enabling expeditionary aviation operations despite the aviation combat element (ACE) possessing school-trained, multi-functional reconnaissance personnel in its Marine wing support squadrons (MWSS).

As outlined in *Marine Corps Tactical Publication 3-20B, Aviation Ground*

***Today's ACE can establish, deploy, and sustain aviation ground support reconnaissance teams without reliance other elements of the MAGTF in order to identify future shorebased operating locations.*** *(Photo by LCpl Logan Beeney.)*

*Support (AGS)*—principally provided by the MWSS—is Marine Aviation's primary expeditionary maneuver enabler. The MWSS is an exclusive formation to the Corps, and it provides the ACE with distinct expeditionary characteristics that set it apart from the aviation units of other U.S. Services. MWSSs are custom-built to support Marine and joint sortie generation, and they are uniquely resourced to enable expeditionary advanced base operations. MWSSs provide AGS with an array of aviation-oriented engineer and logistics capabilities that enable them to reconnoiter future operating locations, build expeditionary airfields, sustain forces, and support sortie generation in permissive and austere environments alike.

Unfortunately, the Marine Corps lacks an enterprise-wide, standardized approach to organizing and employing the MWSS' organic reconnaissance capabilities to support a MAGTF commander's collection plan and decision-making during expeditionary aviation operations. Additionally, there is no doctrinal, unified approach to integrating AGS-oriented reconnaissance into the Marine Corps intelligence, surveillance, and reconnaissance enterprise. This doctrinal gap creates an inadvertent void in the Marine Corps intelligence, surveillance, and reconnaissance enterprise regarding information germane to expeditionary aviation. The Corps can take a play out of Halsey's memoir and solve this problem with a low-cost, high-impact solution: establishing the aviation ground support reconnaissance team (AGSRT) in doctrine.

The AGSRT is a scalable, modular, multi-functional team task organized by an MWSS to collect AGS-specific information requirements that can assess the suitability, feasibility, and acceptability of future shore-based expeditionary aviation. The MWSS' combat engineers, all of whom are school-trained in engineer reconnaissance, serve as the core of the AGSRT, while capabilities from across the squadron are bolted-on according to mission requirements. Given the combination of the ACE's organic assault support platforms and unique MWSS capabilities—combat engineers, explosive ordnance disposal technicians, expeditionary airfield operations Marines, logistics specialists, and chemical, biological, radiological, and nuclear response technicians—an ACE commander can deploy, employ, sustain, and redeploy an AGSRT with little to no support from the other elements of the MAGTF. As such, AGSRTs offer the ACE organic, ground-centric eyes and ears forward that enables the commander to sense, make sense, and decide on how best to employ its limited expeditionary aviation resources across the continuum—from competition to armed conflict.

An AGSRT can assess, advise, and assist partner aviation units on the gamut of AGS activities—airfield damage repair, forward arming and refueling, airfield operations, forward aviation combat engineering, base recovery after attack, and aircraft salvage and recovery. Additionally, AGSRTs can support the ACE's operational preparation of the environment through activities such as coordinating host nation support and caching material required for sortie generation ahead of expeditionary advanced base operations. Finally, in addition to assessing the suitability and viability of potential shorebased aviation sites and serving as quartering parties ahead of aviation unit displacements, AGSRTs can also contribute to MAGTF deception and counter-reconnaissance operations.

History is replete with examples of expeditionary aviation operations, activities, and investments disrupting the plans of friendly and enemy forces alike. Take, for example, ADM King's decision to pivot the direction and timing of the naval campaign in the South Pacific Area based on Coastwatcher reports of Japanese airfield construction activities on Guadalcanal. In this light, even a low-signature AGSRT could deliver out-sized effects to disrupt an enemy's plans by diffusing adversary intelligence, sustainment, fires, and maneuver resources through a wide range of potential activities. These activities could include emplacing decoy forward arming and refueling points, advising partner forces in fouling airfields, and directing contracted laborers in deceptive engineer construction projects to name a few.

Given the growing potential of conflict in the contested littorals of the Pacific, the Marine Aviation community must find the right balance between

***Aviation ground support reconnaissance ensured that aircraft from Helicopter Maritime Strike Squadron 78 from the Carl Vinson Carrier Strike Group could conduct shorebased anti-surface and anti-submarine warfare supporting sea control and denial during Large Scale Exercise 2023.*** ***(Photo by LCpl Clayton Baker.)***

***A Marine Corps expeditionary airfield technician with MWSS-174 installs PE-36 anchors for prefabricated surface aluminum flat top nested airfield matting while training for expeditionary advanced base operations.*** ***(Photo by LCpl Hunter J. Jones.)***

the innovation of new concepts and the plagiarism of historic solutions as it pursues its vision of distributed aviation operations. Halsey's approach to integrating ground reconnaissance in support of expeditionary aviation during a naval campaign is a model worth incorporating into aviation doctrine. Doing so will generate unity of effort, shared situational awareness, and effective decision making across the aviation community. As Halsey learned in the Solomons, there is no substitute for information collected by experts trained in enabling expeditionary aviation with boots on the ground.

**Notes**

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# A Culture of Innovation Drives Acceleration!

## Rapid response to Corps' modernization efforts

by Mr. Stephen J. Bowdren

Innovation—the discovery of new ideas, methods, or technologies—is a necessary but insufficient condition to achieve the dominant warfighting capability edge needed to address both near-peer adversaries and other threats. Military history is replete with accounts of battles won not because of an advantage in the number of soldiers or platforms but rather by the side that employed a new technology—or a new combination of existing technologies—against an unwitting opponent.

At its heart, the Marine Corps' Force Design initiative an innovation strategy that directs the entire Marine Corps, in a phased and organized way, to conduct innovation activities (experiments, tests) across technology and concepts of operations against current and anticipated threats.[1] The acquisition community, fully engaged in responding to the Corps' modernization efforts, often misses opportunities to adopt innovation. As this round of Force Design is funded, technology and capability acquisition must innovate at scale to ensure our Marines dominate across their multi-domain mission sets.

Today, we are engulfed—and at times overwhelmed—by the dizzying pace of technological change, spanning across known areas and extending into soon-to-be-known domains. The list is long. But mere discovery is useless unless those technologies or concepts are adopted, integrated, tested, fielded, and improved at the right speed, scale, and cost to support our warfighters. And nowhere is innovation more important than in the acquisition domain where new technologies are delivered at scale as new programs or capability improvements to existing programs. We know what side we want to be on in any conflict: the side that maintains a dominant advantage that will deter—and if necessary defeat—an adversary. To achieve this dominance, the Marine Corps' acquisition community must develop a stronger innovation culture that can increase the pace of innovation adoption.

***Gen Robert B. Neller, the 37th Commandant of the Marine Corps, uses a HoloLens to manipulate virtual objects on 4 April at the Marine Corps Installations Pacific Innovation Lab aboard Camp Foster, Okinawa, Japan. The HoloLens is a realtime simulation where certain gestures move and open the simulation in different ways.*** ***(Photo by LCpl Tayler P. Schwamb.)***

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Most of the proposed solutions to improving the DOD's innovation adoption are focused on broad organizational or authorities changes to the Defense Acquisition System and the Planning, Programming, Budgeting, and Execution System. The recently issued report from the Atlantic Council's Commission on Defense Innovation Adoption outlines many of these recommendations that the DOD is considering implementing.[2] However, there is little attention on how we can improve innovation adoption at all echelons and formations within the Defense Acquisition System.

Oftentimes, the way we are organized, both the acquisition commands

and military formations are byproducts of the way we won the last war and can frustrate the pace of implementing innovations. After all, traditional military organizational structures, and how they fight wars, are optimized for operational execution and not for innovation. Orders must be given and followed, and experimenting in combat is high risk. In fact, it is hard to find a requirement to innovate in any military doctrine, process, or procedure. One common approach to spurring innovation in organizations is to create a centralized innovation group or cell that interested organizations can leverage. While this approach has its advantages, a notable drawback is that it can lead the rest of the organization to rely exclusively on that one group for innovation, assuming that it is someone else's mission.

The acquisition community has the mission focus and tools to be a full-fledged innovation partner in re-equipping the force for its 2030 (or sooner) posture. Acquisition professionals partnered closely with the requirements setters at the Deputy Commandant for Capability Development and Integration and funding managers at the Deputy Commandant for Programs and Resources are empowered to tailor acquisition strategies, plans, and schedules to deliver capabilities promptly. They are adept at finding new and creative ways to improve capability delivery within the resources they have. The attributes of an innovation culture are present to varying degrees across our acquisition community, but they often compete with a well-entrenched regulatory and compliance culture and a set of beliefs and behaviors wedded to traditions, habits, risk aversion, and a predisposition to assume that only marginal change is possible. In short, our latent innovation culture is often overshadowed by our compliance culture.

While the formal innovation ecosystem (e.g., Marine Innovation Unit, Office of Naval Research, Marine Corps Warfighting Lab, NavalX, Defense Advanced Research Projects Agency, Strategic Capabilities Office, Defense Innovation Unit, etc.) is an important source of ideas (and of increasing resources), the acquisition community has huge opportunities to demonstrate the innovation it can contribute through the prototypes, programs, and capability that it is fielding to the fleet. We need to become full members of the innovation ecosystem.

Former Under Secretary of the Navy James "Hondo" Guerts said as much, noting, "When organizations don't build in the ability to pivot quickly, they become very brittle." A recent *Gallup* report identified eight factors as the building blocks of agile workplace culture, summarized by Guerts in his "4 D's" to increase the Navy's organizational pivot speed and agility.[3] In short, decentralize, differentiate the work, maximize the power of the digit, and most importantly, develop talent. He believed that to truly empower innovation, one must first address infrastructure. Building a culture that values how we address failure and create spaces for psychological safety—knowing that the team is there to support their ideas and challenges in a non-confrontational way.[4] A truly innovative organization needs to understand that changing a culture is not only driven by factors within our systems and processes but also by the mindset we foster in our workforce.

***...our latent innovation culture is often overshadowed by our compliance culture.***

However, it is important to recognize the tensions between a culture of innovation and one oriented toward compliance. What are some indicators of an "innovation culture?" Of a "compliance culture?" How can we reconcile the two, keeping the best of both cultures? How do we resolve these contradictions that frustrate innovation adoption? How do we unleash our innate innovation energy to ensure we are key enablers and implementers of innovation adoption? How often is the acquisition community crowdsourced to help solve capability gaps, rather than for the fleet or Headquarters Marine Corps to assume that we are only focused on the program of record baselines?

***Maj Steven Murello (left), the Information Warfare Coordinator with I MIG, discusses autonomous robotic coding with MSgt Frank Hernandez, the data systems chief with 9th Communication Battalion, I MIG, during the Building Momentum Innovation Bootcamp at Camp Pendleton, CA, 30 September 2021. This event provided I MIG Marines the opportunity to test critical thinking with new technology and enhance unit capabilities with these new skills.*** ***(Photo by Cpl Aidan Hekker.)***

One way to gauge readiness to innovate is to assess whether your team or formation exhibits *yes-if* versus *no-because* behaviors.[5] A yes-if organization rises above process and procedural allegiance to find new ways to solve complex procurement and operational challenges. Yes-if teams anticipate, adapt, and thrive in dynamic environments. They take new approaches and test boundaries without fear of failure. Are we taking measured and deliberate risks, not only in executing our cost, schedule, and performance responsibilities but, in responding to fleet feedback and the need to keep the capability at an unfair advantage level? There are of course many occasions when programs need to say no, but that message is often best delivered to the fleet or others as a conversation about how to achieve the yes outcome. Other organizations that must anticipate, adapt, and thrive in rapidly changing environments have achieved great success in adopting a yes-if culture.[6]

There are five other areas that acquisition organizations should explore to gauge and improve their innovation culture.[7]

First, they should be tolerant of failure but not of poor workmanship or incompetence. Failures rooted in incompetence cost too much time or money to tolerate. We need to focus on achieving success while learning and avoid unnecessary repeated failures. Treat a failure as a "first attempt at learning" with the expectation that a professional, well-trained, and certified team will achieve success in its next attempt.

Second, be willing to experiment and take measured risks but be ruthless in establishing objective criteria to evaluate the results and take the next step or move on to the next effort. Continuous experimentation without a shared understanding of when to stop must be avoided.

Third, create an environment that fosters everyone's engagement and participation so that candid and data-centered views can be shared without fear of professional embarrassment or ridicule. Focusing on objective measures and data-centered discussions keeps the team focused on getting all ideas and solutions out in the open and avoids negative emotions.

Fourth, foster collaboration while continuing to acknowledge individual contributions. For better or worse, our performance management systems are focused on individuals, not teams, and government civilians are evaluated for their individual performance and achievements. Team performance is usually only evaluated by boards screening award nominations. Find ways to reward team achievement and collaboration by holding individuals accountable for promoting that behavior.

Fifth, keep organizational structures and decision making as flat as possible by using commander's intent and mission orders to encourage team-focused initiatives across the acquisition formation.

These are not necessarily easy contradictions to resolve or manage. Balancing a rising innovation culture with a compliance culture requires ambidextrous leadership at all levels to achieve seemingly incompatible objectives.[8] This is the acquisition innovator's dilemma: to ensure timely operational execution to deliver capability and capacity with enterprise processes, practices, and procedures while continually seeking novel technologies to improve what is in development or already fielded. In many ways, it is a smaller example of the competition between modernization and readiness that the Marine Corps is working its way through today via Force Design. And we know the seeds of success are present. Some program-specific examples below show what an innovation culture can achieve to increase capability delivery velocity through innovation adoption:

- Medium Range Intercept Capability: An innovative acquisition strategy to stitch together three existing Marine Corps programs of record together (Ground/Air Task Oriented Radar, Common Aviation Command and Control System, Composite Tracking Network), adapt a High Mobility Artillery Rocket System launcher, and leverage an international partner (Israel) to provide the missile and other elements (Iron Dome). Open architecture, risk reduction, avoiding long development cycles and new production lines, and looking to leverage the Israeli's tactical experience for test and evaluation purposes are all hallmarks of an innovative culture.


***MSgt Carlos Lemus, with Combat Logistics Regiment 25, 2nd MLG, discusses critical thinking and innovative technologies during a lunch and learn at the 2nd MLG Makerspace on Camp Lejeune, NC, 12 April 2019. The Makerspace is a collaborative environment for Marines and sailors to cultivate an innovative culture to explore new ideas to improve policies, procedures, or products to increase readiness.*** ***(Photo by GySgt Jason W. Fudge.)***

• Amphibious Combat Vehicle mission role variants procurement strategy: Use an engineering change proposal approach vice individual full rate production contracts for each lot to avert delays during months-long continuing resolution "no new start" limitations.
• Marine Air Defense Integrated System: Using existing commercial or military off-the-shelf systems (radars, effectors, vehicles) and a Navy warfare center to integrate greatly reduces risk by avoiding the development of new systems and all the work associated with a new procurement. Took risk in leveraging the warfare center as the lead system integrator and managing the technical baseline to ensure an open systems architecture approach for rapid tech insertions.
• Integrated Air and Missile Defense Roadmap Synchronization: Innovation in partnering closely with the Missile Defense Agency and PEO-Integrated Weapons System to ensure integration of Marine Corps ground-based air defense assets and Ground/Air Task Oriented Radar with Navy and joint mission threads and kill chains. This effort has no dedicated program manager or large staff and is a great example of cross-enterprise collaboration, embracing experiments and an environment well aligned to specific, integration and interoperability objectives.

Improving the Marine Corps' pace of innovation adoption will only be as successful as our innovation culture is strong. A weak culture will lapse into compliance and not creativity. Striving for a yes-if attitude towards our stakeholders sets the foundation for resolving the cultural contradictions we face in our day-to-day balance of leading execution with purposeful innovation to improve capability. Let us add some more stories to the few examples outlined here and become indispensable members of the innovation ecosystem.

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# Modernizing Ground Radio Maintenance

## Modern problems require modern solutions

by CWO2 Kevin T. Smidt

***>CWO Smidt is a Ground Electronics Maintenance Officer and serves as a Project Officer for Automatic Test Systems at Marine Corps Systems Command.***

It is no secret that the Marine Corps is in the midst of a historical transformation. Despite all the changes, radio communication remains the lifeblood of maneuver warfare, providing critical links for command and control, intelligence, surveillance, reconnaissance, and coordination. As technology rapidly advances, the maintenance and sustainment of communications and other electronic equipment must evolve to keep pace, not only with the ever-changing demands of a modern battlefield but also with an enemy whose capabilities are only accelerating. Central to this modernization effort is embracing technological advancements, such as artificial intelligence (AI) and machine learning software, coupled with automatic test systems. As the Marine Corps envisions a more agile and technologically advanced force with an emphasis on the importance of efficient logistics, the modernization of ground radio and electronics maintenance stands as a critical component of that goal. Our old maintenance strategy of *if it ain't broke, don't fix it* simply will not cut it in a contested logistical environment. If high school students across the county are using AI to get ahead of their peers, we can be sure that our adversaries are doing the same. We must lean into these technologies so we can increase the speed of maintenance processes to ensure reliable and effective communication in an ever-changing and technologically complex world.

### Finding Needles in a Growing Haystack

While the Marine Corps has made great strides in making information more accessible to technicians and maintainers, there is much room for improvement in how we access and find the right information that technicians need. Technical manuals, reports, and publications are scattered on multiple websites, such as Catalyst, Total Lifecycle Cost Management Operational Support Tool, and Global Combat Support System-Marine Corps—each with their own unique user interfaces and separate approval processes. Some of these interfaces are intuitive, but all require dedicated time to master their functionality. Even if you find the right source document, Marines still must resort to CTRL+F to search for keywords or import the data to Excel to try to find what they are looking for. To combat this, there are entire Teams pages, group chats, and toolboxes that have been created by maintainers to help Marines comb through the information they need.

As of now, it takes more than a dozen steps for a Marine to find information about a broken cable. It takes many, many more steps to find out where a replacement cable is located and get it ordered. Because of the administrative burden, it is common in communication shops to have select Marines trained on how to navigate these systems to make sure that the right part is requisitioned using the correct processes.

This problem is amplified in maintenance shops where technicians must research longer and more complex technical manuals, maintenance publications, and advanced maintenance procedures on systems such as Global Combat Support System-Marine Corps. For this reason, most senior non-commissioned and staff non-commissioned officer technicians spend their day on a computer searching for information or managing maintenance reports. Although managing maintenance processes is part of the job as you advance in leadership, far too much time is devoted to these details. It is a waste of time and talent to have our most experienced and well-trained technicians spend all their time behind a computer when they could troubleshoot advanced faults and pass down their knowledge to junior technicians. We must get our senior technicians back

***As technology rapidly advances, the maintenance and sustainment of communications and other electronic equipment must evolve to keep pace ...***

in the business of fixing things instead of being in the business of looking for things.

Adding a chatbot akin to ChatGPT to our Electronic Maintenance Support System laptops, along with pre-loaded publications and maintenance data, would greatly speed up the time it takes for Marines to find the answers they are looking for. By simply being able to ask the prompt what the national stock number is for a cable, for example, or if a part is currently available at the repairable issue point, hours could be cut from the downtime and repair of these systems. This functionality could also assist Marines in troubleshooting unfamiliar systems, which is something we are already dealing with as the speed and complexity of the gear coming to the fleet is only increasing. By giving Marines a chat prompt, they would be able to type in observed fault codes and symptoms and get a better starting point on where to begin their troubleshooting.

### *Two Is One and One Is None* Is Done

Unlike our previous fights in Afghanistan and Iraq, our next conflict will severely constrain what we can bring to the fight. Gone are the days of bringing along multiple spare systems as well as Quadcons full of repair parts. The strategy of pre-positioning gear and repair parts alleviates the logistical burden of what Marines must carry to the fight, but it does nothing to accurately predict what they will need when the time comes. It is still an educated guess that does not address change as new gear and strategies emerge. By using machine learning, we can generate predictive models that forecast when equipment is likely to fail based on historical data. AI and machine learning can go even further than predictive maintenance and cross into the realm of prescriptive maintenance by accurately recommending specific maintenance actions to prevent any major downtime.

These predictive models could be used to also forecast what individual parts are likely to fail. The data to start a feature like this already exists, but it is buried and hard to extract at a large scale. By using AI to extract and analyze the data, we will be able to rapidly identify the items we need to sustain our systems and warfighters. Instead of maintainers bringing a set of circuit cards and some spare cables with them in case they break, they could bring a couple of components with a high failure rate and a spool of coaxial cable with connectors because the model has shown them that those items are common across a majority of systems that they maintain—including the ones they may not be familiar with.

***By using machine learning, we can generate predictive models that forecast when equipment is likely to fail based on historical data.***

In a contested logistical environment where time and space are at a premium, bringing a variety of spare parts based on educated guesses will no longer work. We must also have the tools at our disposal to be fluid and able to shift as change inevitably happens. We need to focus on bringing the right things, backed by data, that we know we will need.

***An Electronic Maintenance Support System running diagnostics on a Joint Light Tactical Vehicle.*** *(Courtesy of MCSC.)*

### It's Good, but It Can Be Better

The radios and communication systems that are being fielded to the Marines have become more technologically advanced, but so too have the automatic test systems that will be available to technicians. The soon-to-be-fielded Hand-Held Radio Test Set (HHRTS), for example, contains an entire suite of testing and diagnostic functions in a single, hand-held form factor that Marines can carry everywhere. The HHRTS can radically reduce the amount of gear that a technician takes to the field or deploys with since it can replace multiple sets of test, measurement, and diagnosis equipment. Not only has the form factor been condensed, but these systems also give the technician the ability to build localized, on-demand test scripts for any current and future radio platform. These scripts

***Marines from 1st Electronics Maintenance Company, 1st MLG, reassemble a production model of the new HHRTS during a technical manual validation/verification event at Camp Pendleton, CA.*** *(Courtesy of MCSC.)*

allow a Marine to test what they need, when they need it, and get the results quicker than ever before. The HHRTS scripts are built using Python and have a program on the test set to help guide users on how to build their own custom scripts.

AI could also be used to speed up the transition from troubleshooting to repair. By having AI in a centralized hub, such as an Electronic Maintenance Support System, technicians could take the results of test routine scripts and have the system use technical manuals as source documents to suggest probable faults or further troubleshooting steps until the problem was found. If a problem was found on a circuit card, the AI could then search data for that card to see if there were any available test routines and then instruct technicians to test it on more specialized systems, such as the Circuit Card Assembly Test Station, to identify faulty individual components instead of replacing the entire card. The same process can also be used for hard parts using available data along with our additive manufacturing capabilities. By focusing on the interoperability of our current and future test and repair equipment, we can provide an extra layer of protection against contested supply chains by becoming both more efficient and more self-sufficient.

***In order for us to sustain a forward deployed and modernized force, we must be willing to use every tool available ...***

Although this brings incredible new capabilities to our maintainers, it still could be improved. We are fielding some of the most powerful maintenance gearsets to the Marines, but nothing links the systems together so they are interoperable with each other. By using AI, we could vastly speed up the process from the active maintenance phase to the closeout phase. Although it has not been perfected yet, AI is quickly becoming proficient in writing code in popular languages such as Python. In the near future, this would allow Marines to have AI write them custom scripts without having to do it themselves.

## Conclusion

Incorporating AI and machine learning into our maintenance processes and actions brings risks and issues that have yet to be resolved. Cybersecurity and bandwidth are major factors that will have to be figured out to proceed. I argue that the speed and efficiency that these systems can bring to the fight are well worth the risk. For better and for worse, Marines remain in a league of their own when it comes to breaking things. In order for us to sustain a forward deployed and modernized force, we must be willing to use every tool available to accurately predict what our warfighters need and get it to them the moment they need it.

The advent of AI is proving to be a watershed moment in human history. It is disrupting entire industries that were once thought to be untouchable. We must harness this technology to help us not only repair broken equipment but also help us reconstruct how we think about maintenance going forward.

USMC

# The Transformative Potential of Artificial Intelligence

## Revolutionizing the Marine Corps acquisition process

by Mr. Luis E. Velazquez

The Marine Corps Systems Command (MCSC) is entrusted with the technical and contracting authority for all ground weapon and information technology programs and has long been a beacon of innovation within the Marine Corps. It is here, within the corridors of the MCSC, that the future of military procurement is being reimagined through the integration of artificial intelligence (AI), particularly the application of large language models (LLMs). The Online Project Information Center (TOPIC) serves as the lynchpin in this transformative journey, holding a vast array of data critical to the strategic management of the acquisition process—a process that has become increasingly convoluted with the surge of technological advancements.

In the context of MCSC, TOPIC stands as the central repository for authoritative acquisition program information. It serves as the backbone of MCSC's data infrastructure, providing a web-enabled platform where approved acquisition and program management data are meticulously curated and stored. This centralized database is crucial for generating the reports and status updates needed by the commander of MCSC as well as higher, adjacent, and subordinate commands. It also acts as a comprehensive reporting tool for program managers (PMs), competency leaders, command executives, and other stakeholders requiring detailed insights into specific program information.

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The information aggregated in TOPIC is not only for the purpose of oversight and historical record but is also pivotal in streamlining the acquisition process. By adhering to the directives of *MCSC Order 5000.3B*, all programs are mandated to be entered into TOPIC, ensuring a single source of truth for all acquisition-related data. A primary objective of TOPIC is to alleviate the often-burdensome reporting requirements faced by PMs. By providing a centralized, accessible, and up-to-date repository of information, TOPIC enables more efficient management and oversight of programs, freeing PMs from the repetitive and manual tasks typically associated with data reporting.

Recently, MCSC started hosting AI summits with its most recent on 10 January 2024, marking another milestone in the MCSC's AI journey. Jointly hosted by the Deputy Commandant for Information and MCSC at the state-of-the-art XCorp facility of the Cyber Bytes Foundation, the facility, renowned for its trailblazing

**THE ONLINE PROGRAM INFORMATION CENTER (TOPIC)**
**Program Management Content**

| | | | |
|---|---|---|---|
| Program Name | Lead Service | Universal Need Statement | Portfolio Manager |
| Program Acronym | Milestone Decision Authority (MDA) | Acquisition Decision Memos | Program Manager |
| ACAT Level | Program Decision Authority (PDA) | Milestone | Team Lead |
| Acquisition Phase | Organization | Title | Marine Corps Program Code |
| Description | Date of Last LCCE | Date approved | Table of Authorized Material Control Number |

work in AI and cybersecurity, stood as the ideal venue for such a landmark event—underlining the significance of collaborative innovation in this domain. The summit was a critical confluence of minds focused on AI's role in defense where the future of the Marine Corps' technological AI capabilities was being forged. One of the prospects was the creation of an MCSC LLM that would be trained on TOPIC.

Drawing upon the insights from previous AI summits, such as those facilitated by the Office of Naval Research at the Naval Postgraduate School, the 2024 event was particularly notable for its interactive breakout rooms and live demonstrations of AI tools such as disconnected standalone AI model concepts. The AI summit's active engagement was pivotal in tackling the nuanced challenges of data management, infrastructure robustness, and competency development that stand as barriers to scaling AI across the Corps' acquisition processes.

The discussions on TOPIC and AI LLM integration during the summit had a clear focus: to harness the data from TOPIC to train AI LLMs, thereby enhancing the acquisition process. The insights derived from these discussions underscored the imperative to create robust, secure systems capable of utilizing the power of AI—all while safeguarding the data's integrity. TOPIC's data, a historical compendium of procurement patterns and outcomes, is a treasure trove that, when analyzed by AI, can yield predictive insights that could dramatically shift the MCSC's procurement paradigm, aligning it more closely with the evolving strategic objectives of the Marine Corps.

In the backdrop of these strategic discussions, the AI Summit also spotlighted the criticality of vendor assessment and management within the procurement process. It would be possible to leverage AI to scrutinize the data on vendor performance housed in TOPIC which could significantly elevate the MCSC's capacity to appraise vendor reliability, predict market fluctuations, and unveil potential supply chain disruptions. Such predictive prowess is invaluable, offering the Marine Corps

***Director, Operations Analysis Directorate, Headquarters Marine Corps Combat Development and Integration addresses the AI Summit, held on 10 January 2024, at Cyber Bytes Foundation in Stafford, VA.*** *(Photo by Luis E. Velazquez.)*


***10 January 2024—Cyber Bytes Foundation, Stafford, VA. Participants engaging in conversation at this year's AI Summit.*** *(Photo by Luis E. Velazquez.)*

***Attendees of the 2024 AI Summit view discussion panels.*** *(Photo by Luis E. Velazquez.)*

a strategic advantage in maintaining operational readiness and efficacy.

Yet, the path to AI integration within military procurement is fraught with complexities. Paramount among these, as highlighted at the 2024 AI Summit, is the safeguarding of data security. When dealing with sensitive military procurement information, ensuring the confidentiality and integrity of data used to train AI models is non-negotiable. The summit's deliberations also brought to light the inherent risk of biases within AI algorithms, advocating for stringent measures to assure equitable and unbiased decision-making processes.

Recently, the Marine Corps Tactical Systems Support Activity (MCTSSA) was designated a Science and Technology Reinvention Laboratory (STRL), which marks a significant milestone for the Marine Corps—enhancing its capacity for innovation and technological advancement. This new status grants MCTSSA increased operational flexibility, streamlined processes, and a sharper focus on research and development, particularly in areas critical to the Marine Corps' mission. As an STRL, MCTSSA can leverage simplified administrative procedures, such as expedited hiring and procurement, enabling it to attract top talent and engage more efficiently with industry, academia, and other partners. This is particularly beneficial for exploring cutting-edge fields like AI, where rapid advancements can transform military capabilities. With additional resources and funding, MCTSSA is better positioned to develop, test, and integrate AI technologies into Marine Corps systems, enhancing decision making, operational efficiency, and battlefield superiority. The STRL designation not only underscores the Marine Corps' commitment to maintaining a technological edge but also sets the stage for MCTSSA to lead pivotal advancements in AI, ensuring the Marine Corps remains at the forefront of modern military operations.

***In summary, MCSC's proactive engagement with AI through the TOPIC database and the insights garnered from the AI summits are creating a formidable force for change.***

Advocating for a strategic and phased approach, the Summit's consensus was clear: Integrating AI LLMs with sources of truth data such as TOPIC would be one of many incremental and targeted pilot AI projects. These projects, aimed at specific procurement sectors, offer a controlled environment for testing and honing AI models. This approach ensures a sustainable evolution of the systems, guaranteeing their efficacy and harmonization with the MCSC's operational ambitions and ethical codes.

As we integrate AI into the program office operations, MCSC would not just be adopting new technology; MCSC would be renewing its commitment to innovation and reinforcing its dedication to maintaining the Marine Corps' position at the pinnacle of technological leadership and operational excellence. The data within TOPIC, when coupled with the advanced capabilities of AI, positions the MCSC to revolutionize its acquisition process. The goal is an AI-enhanced procurement system that is not only more efficient and precise but also strategically attuned to the Corps' long-term objectives.

The ingredients for success in AI are on the table; combining the MCSC, MCTSSA STRL designation, AI Summits, AI LLMs, and TOPIC data for machine learning has the transformative potential of delivering an unprecedented AI LLM to the acquisition community, thus, enhancing the MCSC's acquisition processes that cannot be overstated. The strategic insights and collaborative efforts for AI are complex and infused with new technologies, the integration of AI into its operational framework is a decisive stride toward securing the Marine Corps' technological and operational dominance.

The development, integration, and testing will be shared with subsequent AI summits to provide further motivation for other agencies to further their AI research maturation and integration of AI capabilities. The inclusion at these summits of different Marine Corps offices, such as the Marine Corps Warfighting Laboratory, Deputy Commandant for Information, and Training and Education Command, exemplifies a comprehensive approach to AI development. This multidisciplinary collaboration is essential, as it brings together various perspectives and expertise and fosters an environment where innovation thrives. Through these joint efforts, the Marine Corps can leverage AI to not only refine procurement processes but also enhance the overall operational readiness and strategic execution of its mission.

In summary, MCSC's proactive engagement with AI through the TOPIC database and the insights garnered from the AI Summits are creating a formidable force for change. This progression ensures that the MCSC remains agile, adaptive, and ready to face the challenges of tomorrow. With each summit, workshop, and collaborative project, the MCSC is setting the standard for a future where AI and human expertise converge to create a procurement and acquisition process that is the epitome of innovation, efficiency, and strategic foresight.

USMC

# Training Systems Adoption Framework

## Exploring similarities between simulation training for software products and hardware systems

by Dr. Leili Green & Mr. Bernard Prevost

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In learning principles, the convergence of software and hardware simulation training shapes how individuals acquire skills. This exploration seeks to uncover the shared learning principles underpinning simulation training for two separate systems/program software and hardware capabilities. By delving into the cognitive aspects of adult learning, we aim to emphasize the familiarity and interconnectedness of distinct training domains.

This article explores shared learning principles between software utilization and operating complex systems, including vehicles, and employing simulation training. It presents a comprehensive framework for adopting similar solutions and maintaining consistent learning principles across domains. *Simulation training* is a transformative educational tool that enhances competencies across diverse fields, from software proficiency to complex operating systems.

Significant factors to consider are listed below:

### Learning Principles: A Unified Approach

Understanding the cognitive aspects of adult learning is paramount in both software and hardware training. This foundational principle is the cornerstone for effective learning in simulated environments, connecting visceral, behavioral, and reflective processing.[1]

The cognitive process begins with visceral processing, where learners respond emotionally to the training content. In software training, this could manifest as the user's initial reaction to the interface's complexity. In hardware training, this principle might involve the emotional response to operating heavy machinery within a simulated environment.

Behavioral processing follows, focusing on observable behaviors and actions. In software, users engage with the simulated product, navigating interfaces and executing commands. At the same time, in hardware training, the operators manipulate controls based on visual cues within the simulated environment. Reflective processing concludes the cycle, prompting learners to analyze and derive meaning from their experiences. Whether in software or hardware training, this stage encourages users to reflect on their actions, identify areas of improvement, and enhance their overall proficiency. By emphasizing these shared learning principles, both software and hardware training benefit from a unified approach—fostering a comprehensive and cohesive learning experience for individuals across diverse domains. The Train to Task Process may include the use of tools and methods—including, but not limited to, simulated environments or simulators/training systems—to achieve the required user proficiency for accomplishing assigned training tasks.

> **Simulation training *is a transformative educational tool ...***

### Features of Training Systems

Some detailed features of training systems are discussed in this section, including standalone mirrored software products with full actual capability in a mobile trainer to teach a complex software capability program. This article also highlights the importance of virtual reality (VR) and augmented reality (AR) technology and simulation training, as reported by "Virtual Reality and Its Applications in Education."[2] The integration of augmented reality and VR hardware capability/program simulators emphasizes the immersive nature of these technologies for a hardware capability and the potential of integrating similar technologies into a software training system.

### Human Factors Engineering (HFE) Integration:

HFE principles have been considered and incorporated in both training systems discussed in this article to enhance the training experience. Human System Integration considerations involve optimizing the placement of switches and buttons, efficiently utilizing scarce real estate, attention to visual and realistic elements, and incorporating visual displays. In short, visual displays cater to the user's field of view and dexterity—significantly contributing to training effectiveness. Additionally, it enables the measurement of 508 compliance, requiring the federal government to make electronic and information technology accessible to people with disabilities.

### Software Capability-Mobile Training Suite General Description:

The equipment used to support software capability training is a mobile system compromised of a software and hardware training system. Presently, the software capability training system mobile training suite has an Oracle User Productivity Kit software package installed, which is a standard training device with a standalone training capability that can be used in locations where network connectivity to an enterprise training environment is unavailable. This mobility feature allows flexibility in using the system without being on the MCN Network. As discussed in simulation training, simulator environments allow users to use the software program safely while allowing users to practice hands-on without impacting the actual capability.[3] Instructors use the system to develop scenarios of various difficulties and tasks like what users will be assigned; students' progress is traceable, and instructors can provide remediation. The software training requires precise visual display and similarity with forms and templates.[4] The mobile training system provides high-quality realism and navigation bars that allow students to familiarize themselves with the capability and improve their recognition of visual displays within the system. The power of technology embedded in the systems thus enhances a complex step-by-step process with a level of realism that seamlessly transitions the user from a training environment to a real-world capability environment. The HFE factors considered include the actual capability environment's form, fit, and function. The training system comprises commercial off-the-shelf hardware and transportable software consistent with the DOD Joint Technical Architecture and Marine Corps Technical Architecture Plan.

### Capability/Hardware Training System Suite–General Description:

Training systems provide training across domains and disciplines, simulated exercises, VR scenarios, and classroom-based learning—leveraging traditional and technology-enabled learning.[5] Drivers training systems provide tools and methods that can capitalize on the use of hardware and software to replicate the experience of operating vehicles while minimizing wear and tear of any platform, as well as provide substantial cost savings, minimizing fuel and other consumables.[6] These simulators increase learning at all levels, from the novice to the most advanced students. VR immerses students in realistic scenarios on land, sea, and the transition. Faults can be introduced to the students, and corrective actions can be learned and perfected while not damaging equipment or putting safety at risk. Learners can better prepare for challenging situations and varying terrain at any time. Instructor operators can provide instant guidance and playback to enhance progress and certification while tracking and reporting success and failure.

***Training systems provide training across domains and disciplines ...***

Delivery of educational content can be maximized by integrating digital and electronic technology by utilizing electronic classrooms. Courseware incorporates various technologies, allowing interactive elements, multimedia, and dynamic experience.[7] Videos, audio clips, animations, and images are easily presented. Student workstations with computers, laptops, or VR goggles provide a much better way to ensure learning while saving on printing costs. Curriculums can be updated in realtime to ensure the most up-to-date information is being taught. Procedure Troubleshooting Trainers can aid the learner in identifying the problem and error messages and understanding symptoms.[8] Problems are reproduced, and diagnosis can all be achieved under controlled conditions. Appropriate actions are learned while reducing costs, wear and tear, and injury. Part task install and remove trainers are hands-on mockups that give the learner a realistic representation of platform components such as control arms, shocks, wheel ends, and other vital items. The learner is now safe from equipment readiness if mistakes are made. Crew-level operator trainers provide specific equipment and individual station instruction that maximizes crew efficiencies by replication of the functionality and controls of actual equipment. Crews and teams, such as sections, can train together through real-world scenarios utilizing collaboration, coordination, and communication systems.

### Innovative Features: Shaping the Future of Simulation Training Visual Displays Enhancing Realism and Learning:

One of the critical features contributing to the efficacy of simulation training is the incorporation of advanced visual displays. These displays are pivotal in creating a realistic and immersive environment for trainees and provide a more authentic learning experience in software and hardware training scenarios.

For software training, intricate interfaces are rendered precisely, allowing users to interact with lifelike representations of software products. Visual displays simulate complex machinery in the hardware realm, providing trainees with hands-on experience without the associated risks. The visual displays bridge theoretical knowledge and practical application, fostering a deeper understanding of concepts.

**Eye-Hand Coordination: A Fundamental Aspect of Learning:**

In simulation training, hand-eye coordination is fundamental.[9] Both software and hardware training systems are designed to replicate real-world scenarios where precise coordination between visual perception and manual dexterity is crucial.

Users navigate interfaces seamlessly with visual attention and manual input for software training.[10] In hardware training, operators manipulate controls and instruments based on visual cues within the simulated environment. Simulation enhances hand-eye coordination and assists trainees in developing and refining these critical skills in a controlled setting, enhancing their proficiency in software utilization and hardware operation.

**Realism and the Safe Learning Environment:**

Simulators provide a safe yet realistic space for individuals to learn and master skills vital to adult learning.[11] The consequences of errors can be significant. Realistic simulations mimic the complexity of real-world scenarios and offer a controlled environment where trainees can make mistakes without real-world repercussions.

*Role of Funding:*

The successful integration of simulation training heavily relies on adequate funding. Whether applied to software or hardware systems, securing financial support is essential for developing, maintaining, and continuously improving training programs. Funding facilitates the acquisition of cutting-edge simulator technologies and ensures ongoing support for upgrades and innovations, fostering a dynamic and effective training environment.

*Leadership Knowledge of Simulation and Simulator Technology:*

The role of leadership in selecting and successfully implementing simulation training is pivotal.[12] A deep understanding of simulation technology among organizational leaders is crucial. Leaders need to comprehend the potential impact of simulation training on skill development, safety enhancement, and overall performance.

*Critical Role of Training Specialists:*

The expertise of training specialists is paramount in maximizing the benefits of simulation training. These specialists, well-versed in software and hardware systems, contribute to designing, implementing, and customizing training programs. Their role extends beyond technical proficiency, including a nuanced understanding of adult-learning principles.

***AI-driven simulators can dynamically adapt scenarios based on individual learning curves ...***

*Upfront Analysis and User Input:*

Before adopting any simulation or simulator, an upfront analysis capturing user input is essential. It involves actively seeking end-user input, understanding their needs, and considering their preferences. User engagement in the initial stages ensures that the chosen simulator aligns with their expectations and provides a meaningful and effective learning experience.

**Design Similarities and Distinctions: Bridging the Gap Between Software and Hardware Simulators:**

While software and hardware simulators share overarching objectives, certain design aspects distinguish the two. Software simulators that enhance digital skills focus on intricate interfaces, responsive user interactions, and lifelike representations of software products. The design prioritizes visual precision, enabling users to engage with software interfaces seamlessly.

Hardware simulators, designed for hands-on training with complex machinery, necessitate haptic feedback and a broader range of motion. The physical manipulation of controls, instruments, and machinery within a simulated environment using real-world scenarios is crucial for skill development. "Features and Uses of High-Fidelity Medical Simulations That Lead to Effective Learning" reported that engaging the user's sensory capability is a key to performance improvement.[13]

**User Community Willingness and Artificial Intelligence (AI) Integration: Shaping the Future of Simulators**

The willingness of the user community to embrace future simulator capabilities, including those infused with AI and automation, marks a pivotal turning point.

In the future landscape of AI-empowered simulators, instructors find themselves in dynamic roles: "in the loop" and "on the loop." Integrating AI into simulation training holds immense promise as we look ahead. Large language models, such as advanced AI systems, can revolutionize the adaptive nature of simulators. Moreover, AI-driven simulators can dynamically adapt scenarios based on individual learning curves, providing a personalized and optimized learning experience.

**Conclusion: Unifying Hardware and Software Training Environments:**

In conclusion, exploring shared learning principles and training system features highlights the interconnectedness of software and hardware simulation training. The emphasis on visual displays, hand-eye coordination, and realism is common in both domains, providing a holistic learning experience.

The standalone server and task trainers are parallels in hardware and software training, offering consistent visual feedback and accuracy with actual systems. Both environments simulate real-world scenarios, ensuring trainees develop and refine critical skills in a controlled setting.

This unified training systems adaptation framework emphasizes the symbiosis between software and hardware simulation training. It underscores the importance of adopting similar solutions and maintaining consistent learning principles across seemingly distinct domains, ultimately unlocking the full

potential of adult learning in diverse fields.

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*>Author's Note: The authors thank the individuals and leadership at the Program Manager, Logistics Integrated Information Solutions Marine Corps and Program Manager, Advanced Amphibious Assault program offices for their steadfast commitment and support in creating this article.*

# Making the Most of Other Transaction Authority

## Why it's critical to innovation

by Ms. Jennifer Hildebrandt

At the end of the Cold War, the focus of innovation shifted to the commercial sector—with the result being that commercial research and development (R&D) expenditures are now outpacing federal R&D by more than three to one. A significant portion of commercial R&D spending comes from the venture capital ecosystem and is concentrated in new startup companies. Recognizing this shift, Congress embarked on a series of acquisition reform efforts, beginning with NDAA-16 to transform from a Cold War-era defense acquisition system optimized to support government-funded and government-led R&D to an adaptive acquisition system with the flexibility to support both government and commercial R&D. One significant reform was the expansion of the Other Transaction (OT) Authority.

The OT Authority was created to give the DOD the flexibility necessary to adopt and incorporate business practices that reflect commercial industry standards and best practices into its award instruments; it also was designed to broaden the technology base by reducing barriers to entry for nontraditional defense contractors (NDCs). This generated a growing interest in using the OT Authority to identify, acquire, demonstrate, and transition innovative technologies to the warfighter more efficiently. When leveraged appropriately, OT Authorities provide the government with access to state-of-the-art technology solutions from traditional contractors, as well as NDCs, through a multitude of potential teaming arrangements tailored to the particular project and the needs of the participants.

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According to the Other Transactions Guide of 2023, OTs can help achieve the following benefits:

- Foster new relationships and practices involving traditional contractors and NDCs, especially those that may not be interested in entering into Federal Acquisition Regulation (FAR)-based contracts with the government.
- Broaden the industrial base available to the government.
- Support dual-use projects.
- Encourage flexible, quicker, and cheaper project design and execution.
- Leverage commercial industry investment in technology development and partner with industry to ensure DOD requirements are incorporated into future technologies and products.
- Collaborate in innovative arrangements.

While OTs can be structured in a variety of ways, there are two different DOD OT statutory authorities that can result in three different types of OT awards: research, prototype, and production.

*Research OTs* are authorized under 10 U.S.C. 4021 and are used for basic, applied, and advanced research projects. This was the original OT Authority given to the DOD more than 30 years ago and was generally intended to spur dual-use R&D projects. The use of this authority allows the DOD to take advantage of commercial economies of scale without burdening companies with traditional government regulatory overhead. The conditions of use are as follows:

- No duplications of research to the maximum extent practicable.

***The OT Authority was created to give the DOD the flexibility necessary to adopt and incorporate business practices that reflect commercial industry standards and best practices ...***

- 50/50 cost share between the government and other parties to the extent practicable.
- Competition to the maximum extent practicable.
- Standard contract, grant, and contracting action not feasible/appropriate.
- Review DODGARS Part 37 (Technology Investment Agreements, Appendices A&B for applicability).

*Prototype OTs* are authorized under 10 U.S.C. 4022, which extended the original research authority above to allow the DOD to acquire prototype projects or capabilities. Both dual-use and defense-specific projects commonly use the prototype authority, and this statute allows for the same flexibility in the contracting process as with research OTs. Prototype OTs are for projects directly relevant to enhancing the mission effectiveness of DOD personnel, improving platforms, systems, components, or materials proposed to be acquired or developed by the DOD, or improving platforms, systems, components, or materials in use by the armed forces. The conditions of use are as follows:

- All significant participants, small or nontraditional.
- At least one NDC or nonprofit research institution must participate to a significant extent in the prototype project.
- At least one-third of total costs must be paid by parties to the OT other than the government.
- A senior procurement executive for the agency determines, in writing, that exceptional circumstances justify the use of an OT.
- Cost-share is not required (if NDC participates) and fee/profit is negotiable.
- Competitive procedures to the maximum extent practicable.

*Production OTs* are authorized under 10 U.S.C. 4022(f) and allow a project that was competitively awarded as a prototype OT to segue into the production phase without the need for additional competition. Specific requirements must be satisfied before the transition to production can occur. If an agency anticipates the need for a production OT, the best practice is during the period preceding the solicitation. OTA solicitation documents and awarded agreements include provisions explaining the possibility of a follow-on production award. After a prototype OT is awarded and successfully completed, a production OT can be awarded as a non-competitive follow-on. This seamless transition accelerates the delivery of innovation to the warfighter.

Although there are few guidelines for leveraging the OT Authority, they do contain some restrictions. According to the 2023 *Other Transactions Guide*, research OTs do not have any statutory approval thresholds or requirements. Prototype and production OTs are subject to statutory approval requirements at various levels and are divided by dollar thresholds.

***The expansion of the OT Authority empowers the Marine Corps to cut overall costs for research projects ...***

These authorities are nondelegable above $100M. Please note: Commander, Marine Corps Systems Command has been delegated this authority up to $100M.

With the private sector being more innovative and tech-savvy than ever before, the Marine Corps can tap into this resource for cutting-edge commercial solutions. This, in turn, broadens the available industrial base by providing a pathway for companies and institutions to participate in the defense marketplace, particularly for those not interested or who cannot justify the expense of developing the unique business practices/process required to pursue FAR-based contracts. The OT Authority serves as a platform for collaboration to leverage commercial innovation and investments in technology, which enables more flexible and efficient project design and execution.

The Other Transaction Agreement (OTA) is an acquisition instrument that allows agencies to enter into transactions "other than" standard government contracts, grants, and cooperative agreements. OTAs are legally binding instruments that may be used to engage industry and academia for a broad range of research, prototyping, and production activities. They are not subject to the FAR, DOD FAR Supplement, and many other statutes and regulations associated with federal government contracting. OTAs provide a commonsense, flexible, efficient, and user-friendly way of linking government buyers with commercial vendors of advanced technologies. An OTA replaces nothing; it is simply an additional tool that Congress has authorized to help government program managers accomplish their missions. The DOD can award OTAs to an individual organization (such as a contractor) or to a consortium, which is a group of organizations focused on a specific technology area (for example, cybersecurity).

The expansion of the OT Authority empowers the Marine Corps to cut

| Organization | Up to $100M | $100-$500M | Over $500M |
|---|---|---|---|
| Commanders of Combatant Commands with Contracting Authority | Commanding Officer | USD(R&E) or USD(A&S) | USD(R&E) or USD(A&S) |
| Directors of Defense Agencies & Field Activities with Contracting Authority | Director | USD(R&E) or USD(A&S) | USD(R&E) or USD(A&S) |
| Military Departments | Senior Procurement Executive | Senior Procurement Executive | USD(R&E) or USD(A&S) |
| DARPA and Missile Defense Agency | Director | Director | USD(R&E) or USD(A&S) |

overall costs for research projects; allows for collaboration with nontraditional partners with promising technological capabilities; focuses on technical results; provides better tailoring based on changes in technology; and provides a streamlined vehicle that brings innovative research findings, state-of-the-art prototypes, and a smooth transition into production. The OT Authority provides the flexibility necessary to adopt and incorporate business practices that reflect commercial industry standards and best practices into its award instruments, and it broadens the technology base by reaching contractors not readily available to the DOD. This generates a growing interest in using the OT Authority to rapidly identify, acquire, demonstrate, and transition innovative technologies to the warfighter.

To further enhance the efficiency of utilizing this new authority, the Marine Corps Systems Command (MARCORSYSCOM) developed and manages the Consortium Other Transaction Agreement with Consortium Management Group Inc. (CMG) for both command, control, communications, computers in cyberspace (C5) and the Consortium for Energy, Environment, and Demilitarization (CEED). The consortium agreement was initially established in April 2018 with a five-year term. It was renewed for an additional five years in March 2023. There is no specified cost ceiling for this agreement. Cost thresholds are addressed at the project agreement level to optimize the capacity of the consortium agreement. CMG is a nonprofit, tax-exempt organization that manages the consortium and administers its OTAs with the government. C5 and CEED are consortia whose members represent industry and academia brought together to enhance the warfighter's mission effectiveness by leveraging the United States' science and technology base to rapidly advance and expand the Nation's military technological superiority in critical fields. These include information technology, cybersecurity, military engineering, manufacturing technology, environmental quality, energy, facilities and infrastructure, mobility, weapon systems, and munitions. C5 and CEED provide an operating framework for consortium members to collaborate with the government and each other to advance the development of technology and transition new capabilities to the warfighter through the use of the OT Authority. Both C5 and CEED are composed of traditional and nontraditional defense contractors, including both small and large businesses, for-profit and nonprofit entities, and academic institutions.

MARCORSYSCOM and CMG are entering into this OTA to provide for the establishment of an acquisition instrument to conduct research, development, test and evaluation, and follow-on production projects. This OT Agreement is authorized by 10 United States Code (U.S.C.) 4022 and/or as amended by future legislation. This agreement includes the basic terms and conditions under which C5 and CEED members will execute prototype projects. The general objectives of the OTA are as follows:

- Facilitate collaboration between the government and C5 or CEED members so that the government achieves greater awareness of emerging technologies in the commercial marketplace and industry achieves greater awareness of government needs.
- Provide for the use of this Agreement to order commands across the DOD to enable MARCORSYSCOM to better leverage technology development activities and resources.
- Deliberately mature specified technologies and demonstrate them in operationally relevant environments.
- Develop and mature technologies in a manner that enables rapid transition to the warfighter.
- Facilitate and ease the entry of NDCs into the defense marketplace. Provide for follow-on production at the government's discretion for prototypes determined to be successful by the government.

To effectively address the imperatives of *Force Design 2030*, the need to field innovative technologies to our forces ahead of the technology fielding rate of our adversaries is of vital importance. This is essential in creating battlefield advantages. The Marine Corps must pick up the pace of modernization and adapt to the changing character of warfare. They need to be able to exploit commercial R&D. The private sector is more innovative and tech-savvy than ever before, and the Marine Corps can tap into this resource for cutting-edge commercial solutions, which in turn, broadens the available industrial base by providing a pathway for companies and academia to participate in the defense marketplace, particularly for those not interested, or capable, of implementing the business practices and processes necessary to pursue FAR-based contracts.

***To effectively address the imperatives of* Force Design 2030*, the need to field innovative technologies to our forces ahead of the technology fielding rate of our adversaries is of vital importance.***

The successful application of the OT Authority provides for the quick development and acquisition of solutions for force readiness (i.e., R&D, prototype development, and transition through initial production). Utilizing the OT Authority will also help to reduce bureaucratic delays in program execution. Failure to find innovative ways to equip the Marines will pose a critical vulnerability to our future forces, which is why we must make the most of the OT Authority and its many benefits.

USMC

# Equipping the Marine

## Challenges and solutions to improve integration of manpower and training requirements

by Mr. Richard St. Amour

The identification of manning required to operate, maintain, and train new weapons systems, as well as determining the means to provide training, is a regulatory requirement for all Marine Corps acquisition programs. Acquisition program managers (PMs) utilize the Manpower, Personnel, and Training (MPT) process to accomplish this task. In today's acquisition environment, executing the MPT process is complicated by increasingly complex weapons systems and compressed acquisition timelines. It is further complicated by the lack of supportive MPT requirements and enterprise-approved methodologies and analytic tools necessary to provide consistent outcomes. Success is largely dependent on non-acquisition entities that do not operate under a single, coordinated acquisition timeline, and the process itself is not codified in a comprehensive, coordinated policy to guide timely execution and ensure accountability. All this leaves some to question the utility of the process. It is time for MPT stakeholders to come together and take a fresh look at the MPT process, how it is executed, and how it can better align with current acquisition strategies and other force development processes.

***>Mr. St. Amour is an Instructional Systems Specialist and has served as the Senior Manpower, Personnel, and Training Specialist for the Program Executive Officer, Land Systems since 2008.***

### The MPT Process

PMs are directed by DOD, Navy, and Marine Corps acquisition policies to address MPT through all phases of the acquisition process. There are too many policies to discuss in detail. However, a common theme when addressing MPT is for PMs to work in conjunction with the component MPT authorities to determine the most efficient and cost-effective manpower mix required; identify human performance characteristics within the user population; and develop options for individual, collective, and joint training for operators, maintainers, and support personnel. All of this is ultimately codified in the program's MPT plan to support major milestone decisions as directed in *MCO 5311.1E, Total Force Structure Process*.

The MPT process, as depicted in Figure 1, is a subprocess of Marine Corps Systems Command's (MCSC) integrated life-cycle logistics processes used to develop, implement, and sustain the system's product support package. It is also influenced by the application of human systems integration practices to optimize human performance and minimize total ownership costs.[1] It has three basic phases: planning, analysis, and implementation. The MPT process is a framework that guides a program team through the planning and implementation of the MPT product support strategy. The process is meant to be tailorable and iterative to best meet the needs of the program. This seems ideal when you consider the implementation of *DOD Instruction 5000.02 Operation of the Adaptive Acquisition Framework,* which moved away from a one-size-fits-all acquisition model to six different acquisition pathways, enabling PMs to tailor acquisition strategies to better align with the characteristics of the capability being acquired.[2] The execution of the MPT process, like many other acquisition processes, requires support from an integrated product team, but the MPT integrated product team is unique in that it relies heavily on representatives from key stakeholder agencies and activities outside the program office. While the program management team is responsible for MPT planning, analysis, and initial training and prod-

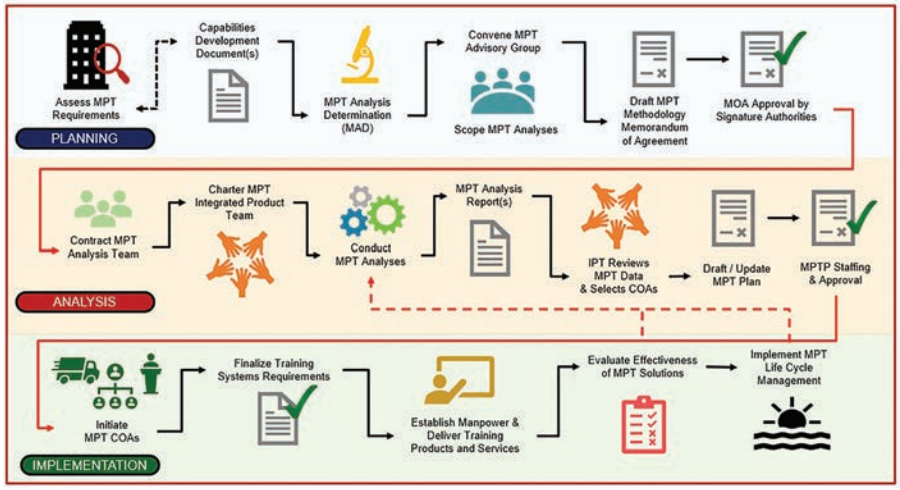


***Figure 1. Manpower, Personnel, and Training process overview.*** *(Figure provided by author.)*

uct support, it is the external agencies, primarily the training and manpower authorities, that are responsible for implementing the enterprise manning and training solutions. The PM can influence but has no authority over these organizations. For this reason, the MPT plan is submitted by the PM and approved by the Commanding General, Training and Education Command (TECOM) G3, and Deputy Commandant, Combat Development and Integration (CD&I)/Total Force Structure Division (TFSD).

There are four underlying aspects of the process that have been the root cause of many MPT process challenges, that if the MPT community could address, would significantly improve the integration and synchronized fielding of MPT requirements into the enterprise; they are: requirements generation, manpower estimation, MPT analysis tools, and MPT policy and guidance.

## Requirements Generation

Preliminary to the process, and fundamental to its execution, is the requirements generation process. The MPT process begins with the receipt of requirements via capabilities development document(s) generated by CD&I. In a perfect world, training capabilities and requirements are defined in concrete and measurable performance parameters or outcomes and are prioritized and fielded on par with the program and concurrently with operational requirements.[3] Far too often, though, MPT requirements are lacking ("pending MPT analyses"), ill-defined, or relegated solely to doctrine, organization, training, material, leadership and education, personnel, and facilities considerations, placing the full burden for developing enterprise training concepts and requirements on the PM. While it is true that PMs are responsible for developing options for training through various MPT and front-end analyses (FEA), it is TECOM—as the training development authority that should set parameters for training solutions during the capabilities-based assessment process. This would ensure weapons system training requirements support evolving enterprise training needs and can be identified and addressed in a timely manner well in advance of fielding.[4] This should include the overall training concept and initial requirements for any embedded training needs. TECOM should also set requirements for the insertion and integration of simulation and instructional technologies that support TECOM initiatives deemed key to increasing student production, producing more highly trained Marines, and reducing the training time and resources burden on the learning infrastructure.[5] Without initial training key parameters, the program office may not be appropriately resourced to conduct the needed FEA and initiate training systems development activities. If the FEA is conducted without them, any outcome creates derived training system requirements that must be weighed after many trade-offs have already been made and resources allocated. These derived requirements must then compete in the Program Objective Memorandum planning and programming process. There is no guarantee the requirements will be formalized in a capabilities requirements change document and funding approved when competing against higher program priorities. Even if approved, delivery of the training system to the training activity and subsequent program of instruction updates will likely occur well beyond initial fielding. This creates cost and schedule risks for implementing the training system and can impact instruction timeframes, student safety, and throughput. If PMs are to deliver training capabilities in line with the fielding of new systems and support TECOM initiatives, they need training key performance parameters upfront to provide direction for training systems capabilities development. The PM can then utilize FEA to support final training system fidelity and design decisions and refine acquisition and sustainment costs.

***In a perfect world, training capabilities and requirements are defined in concrete and measurable performance parameters or outcomes and are prioritized and fielded on par with the program ...***

## Manpower Estimates

Perhaps the most complicated component of the process that MPT authorities need to address is the development of manpower estimates. PMs are required to identify the total manpower needed to operate, maintain, train, and support a system to develop a program's independent cost estimate and life-cycle cost estimates.[6] Manpower estimates serve as the authoritative long-range forecast of manpower (military, civilian, and contractors), ensuring the availability of manpower resources in future years, the affordability of acquisition programs from an end-strength and civilian full-time equivalent perspective, and funding availability if contract support is required.[7] Deputy Commandant, Combat Development and Integration is the manpower authority and is responsible for approving the factors, assumptions, and methodologies used by the PM to develop the manpower estimate. The challenge lies primarily with estimating maintenance manpower. Manpower authorities have not established policy or dictated how maintenance manpower should be calculated; consequently, there is no "approved" enterprise formula or tool in use.

Programs typically calculate maintenance workload and manpower requirements utilizing a combination of equipment-to-maintainer ratios and formulas developed by other Services. Data for the calculations is pulled from the Global Combat Support System-Marine Corps or gathered from engineering and logistics reports delivered by the original equipment manufac-

turer. Over the years, authorities have questioned the accuracy of such data, and there is insufficient historical data on legacy systems to assess the collective workload for the many types of equipment sets maintained by a single occupational field. As a result, MOS field managers and Total Force Structure Division are hesitant to approve and act on estimates when there is little confidence in the methodology or data used. This can delay manpower decisions and place program milestones at risk if not resolved. Inaccurate or ignored estimates can also negatively impact maintenance planning and readiness. What is needed is a collective, formal effort from subject-matter experts from within the acquisition, manpower, and personnel authorities, MOS, and perhaps industry, to derive acceptable methods or models that PMs can use with confidence to project manpower requirements.

## Analytical Tools

No two programs are the same but the way that MPT analyses are conducted should be standardized to provide consistent results from which the MPT community can make sound, data-driven decisions. MPT analysis methods can vary from program to program. Unlike with the logistics and engineering communities, there are very few government-owned or government-approved MPT tools that can improve analytical rigor or speed up analysis timelines. Fortunately, there are individuals currently exploring alternative methods and initiatives that may change the way we do business. One such effort is the Ground Equipment System Sustainment-Integrated Team. This team was formed to address increasing demands for PMs to provide more accurate operations and sustainment costs, much of which are manpower driven. It includes representation from the cost, MPT, and logistics communities and the fleet. MPT authorities should exploit this effort to further examine methods to best calculate maintenance manpower requirements and formalize policy and procedures to support consistent estimation. In another effort, the Program Manager, Tactical Communications and Electromagnetic Warfare Systems, and Program Executive Officer, Land Systems have invested in the Mission Task Analysis Tool (MTAT) and the Manpower, Personnel, and Training Assessment Repository for Verification and Learning (MARVL). MTAT supports mission and job task analyses, workload assessments, training method selection, and MPT reporting. MARVL serves as a central repository for approved MTAT data for use by other programs and across the MPT enterprise. These tools are a significant improvement over paper-based approaches to capture, analyze, and maintain MPT data and have the potential to improve confidence in task analyses and manpower estimates. MTAT and MARVL are new tools now available for use but currently funded by programs that use them. We have initiated actions to establish this capability as a program of record to sustain it and support future enhancements. However, it will take several years and the commitment of many more programs before enough data is captured for MTAT and MARVL to reach their full potential and for these systems to become a go-to solution for the MPT community.

***... integrating MPT requirements is an enterprise activity ...***

## Policy and Guidance

Finally, in his *2019 Planning Guidance* regarding streamlining force development and acquisition processes, the former Commandant stated that over the past several decades, the laws, policies, and practices associated with this topic have changed significantly, but Marine Corps orders and directives have not kept pace. This still rings true today, and the MPT process is a prime example of that. The MPT process was originally developed in 2002 based on the Navy's Training Planning Process methodology to support what is now called a major capability acquisition pathway. The process was revised in 2009 and has since received only minor updates. The MPT process is documented solely in a process map. It is referred to in outdated MCSC policy letters and *MCO 5311.1E* in support of MPT planning requirements. *MCO 5000.27, Marine Corps Roles & Responsibilities for the Acquisition and Sustainment Process*, published October 2021, does outline key stakeholder roles and responsibilities in support of Marine Corps acquisition. However, unlike the Navy's *OPNAVINST 1500.76D Naval Training Systems Requirements, Acquisition and Management* policy (for Navy-funded, integrated Navy-Marine Corps programs) or the Army's *TRADOC Pamphlet 350-70-13 System Training MCO 5000.27* guidance detailing the procedures by which the "enterprise" integrates new MPT requirements. This lack of specific policy and guidance results in little accountability outside the program office to meet MPT process objectives in the timelines needed. This is not to imply that stakeholders and external agencies are not supportive of PMs and the process, but competing priorities, resource constraints, and constant turnover of personnel create an environment of perpetual churn creating program cost, schedule, and performance risks. For example, delays in implementing instruction for a new system at the Formal Learning Center may force the PM to extend new equipment training and expend resources beyond what is budgeted. To better support programs, the process must align with current adaptive acquisition strategies. We should also assess if MPT process responsibilities are appropriately placed given inherent authorities and look for ways to streamline and expedite process activities and documentation requirements. Perhaps other non-acquisition, MPT-related directives should also be reviewed to ensure policy and process are mutually supporting. The bottom line is that integrating MPT requirements is an enterprise activity that is best accomplished when we have enterprise-level policies and processes.

## Conclusion

The MPT process in its current configuration and how PMs derive manpower and training requirements have not evolved to keep pace with programs following any of the current DOD adaptive acquisition pathways. As stated in *Training and Education 2030*, the learning requirements of the Corps are increasing at a rate that warrants reconsideration, and we must strive to deliver more capable Marines. This requires the timely and effective integration of training systems and instructional technologies. PMs want to support TECOM initiatives that ultimately benefit the Marines operating and maintaining their systems, but they need proper requirements and resources to meet that intent. Our Marines are our most precious resource, but tools and methods to estimate manpower are insufficient and lack credibility. MPT authorities need to establish standard estimating methodologies for PMs to accurately estimate manpower and support manpower planning. Above all, the MPT process itself must be updated, perhaps reengineered, to better support program and enterprise objectives. Executing the MPT process is a team sport. We must redefine roles and responsibilities and establish business rules for timely compliance and the synchronized integration of MPT capabilities. There is too much at stake and resources are too precious to leave executing the MPT process to chance.

**Notes**

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# Marksmanship Simulator

## Advanced Small Arms Lethality Trainer (ASALT)

by Mr. Todd Butler & Mr. Jonathan Barkdoll

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***>>Mr. Barkdoll is a Systems Engineer supporting Marksmanship, Synthetic Training Systems, Program Manager Training Systems.***

In September 2023, Program Manager Training Systems, based in Orlando, FL, awarded Valiant Global Defense Services, Inc., a three-year task order for the Advanced Small Arms Lethality Trainer (ASALT)—serving as the prime contractor spot, with Conflict Kinetics as their key subcontractor. The task order was awarded under the Training as a Service category of the MAGTF Training Systems Support Indefinite Delivery, Indefinite Quantity contract.

ASALT is a capability nestled under the Indoor Simulated Marksmanship Trainer (ISMT) ACAT IV (M) Program of Record. Importantly, ISMT and ASALT are separate and distinct capabilities focusing on different squad weapon systems. For example, initial ASALT weapons include M18, M4, M27, and M240, while the ISMT allows training on most weapons assigned to infantry units to include crew-served weapons.

***... the Advanced Small Arms Lethality Trainer (ASALT) ... is a capability nestled under the Indoor Simulated Marksmanship Trainer (ISMT) ...***

By providing a novel environment for Marines to train with multiple limited exposure, moving, and adaptive AI targets, ASALT intends to address gaps identified in the November 2018 Marine Corps Rifle Marksmanship Lethality Capabilities-Based Assessment in a way that is not possible in other training contexts or systems.

Specifically, ASALT will aim to capture rich human performance metrics that may optimize and better inform warfighter training. If a Marine is assigned to a new base and there is an ASALT fielded there, his scores will follow him to the new site. The key components of ASALT Training as a Service include the following:

- Supporting Marine Corps individual and collective marksmanship training to enhance proficiency, confidence, and lethality in a dynamic training environment. ASALT shall require Marines to move while engaging multiple targets, limited exposure targets, and moving targets.
- Providing a turnkey capability that includes operations and maintenance support, with contractor ownership and management of all system hardware and software. The Government will provide government facilities at each ASALT location. Contractors shall provide personnel to operate the system and instruct Marines through stationary and moving marksmanship drills. Operators/trainers will provide verbal feedback to participants on the execution of scenarios.
- Offering capability that measures and improves human performance in target acquisition, marksmanship skills, and critical decision making, by automatically capturing human performance data points to include reaction time, shot placement, and target identification.
- Providing a capability comprised of screens, projectors, computers, software, simulated weapons, and operators/trainers. The capability shall be comprised of flat and 180-36-degree screens to create an immersive environment.
- Increasing warfighter's speed and ability to identify targets, process information, and effectively react to stimuli.
- Providing after-action reviews.
- Providing detailed training usage data to support cost-benefit analysis and human performance improvements.

Incorporating marksmanship simulators into the military training continuum is not a novel concept. In fact, research on this topic within the DOD dates back more than four decades. However, a recent literature review conducted by the Naval Health Research Center's Expeditionary Cognitive Science Group (ExCS) highlights an unfortunate lack of rigor and significant variation across studies regarding the lethality impact marksmanship simulators may have on warfighter performance. Many studies suffered from small sample sizes, improper control groups to test simulator benefits (e.g., transfer of skills), the use of courses of fire with inherent ceiling effects, and a lack of live fire groups when attempting to validate simulator capabilities.

While the task of validation is challenging even in the most favorable conditions, it becomes almost impossible without the capability to collect granular data at scale. Previously, technology gaps in the live-fire range resulted in a lack of quantifiable lethality data, which meant that the comparison and integration of live-fire and simulated training data were extremely limited. However, innovations in fire and data capture technology within the Marine Corps mean rigorous research is now feasible.

The Infantry Marksmanship Assessment (IMA) is a multi-phased live-fire marksmanship assessment co-developed by ExCS and Marine Corps to test an infantryman's marksmanship proficiency and lethality potential. It currently stands as the primary lethality/marksmanship metric at the Schools of Infantry East and West and the Infantry Officers Course, with new monthly data from fleet IMAs. Data from the IMA is collected through the Joint Marksmanship Assessment Package (JMAP). JMAP consists of a customizable electronic score sheet and timer system that measures both time and accuracy (separate and combined scores) during marksmanship qualifications. JMAP was co-developed by the Office of Naval Research and PractiScore and is currently funded under an Office of Naval Research Phase 2 Small Business Innovation Research grant with an upcoming transition to PM Training Systems as a program of record. Notably, the combination of the IMA and the JMAP enables the collection of granular live-fire marksmanship data at an unprecedented scale. This live-fire data can now be paired with the ASALT system's data. Through Program Manager Training Systems' partnership and extensive collaboration with Weapons Training Battalion (WTBn) Quantico and the ExCS Group, it will be possible to validate and optimize training and use cases within ASALT.


***ASALT concept design.*** *(Graphic provided by author.)*

> ***Live fire is always a priority and desired, but range access and ammunition availability make it challenging.***

ASALT's initiatives and priorities will be integrated into the simulation and technology line of effort within Training and Education Command Marksmanship Campaign Plan. Live fire is always a priority and desired, but range access and ammunition availability make it challenging for Marines to get the desired repetitions for marksmanship improvement and sustainment. The project team aims to support WTBn in discovering and


***ASALT intends to address marksmanship gaps in a way that is not possible in other training contexts or systems.*** *(Photo provided by author.)*

aligning where simulations best fit to improve and sustain live fire. To this end, research efforts will first focus on marksmanship validation to understand the similarities and differences between the simulator and live-fire situations.

The ASALT Project Team is committed to assessing how simulators can best augment the Marine Corps' Advanced Marksmanship Training Program (AMTP). AMTP is designed to improve the marksmanship ability of participants, develop advanced marksmanship instructors, and provide a template for marksmanship instructions going forward. This ten-day program provides a baseline level of knowledge to maximize the effectiveness of the shooter's weapons and equipment and build efficiency into movement and shooting tasks.

A key component of AMTP is that it provides a methodology enabling graduates to train, maintain, and develop their skills outside the formal course. This is where ASALT can help provide a training venue for Marines to practice, maintain, and track their skills at home station locations. Notably, core AMTP methodology is only taught at WTBn rather than on ASALT by system operators/trainers. That being said, ASALT could also prove valuable for AMTP-trained Marines to share this methodology with their units. After validation efforts conclude, the ExCS Group will also assess ASALT's ability to train, measure, and improve cognition and decision making in tactical scenarios, which cannot be readily achieved on live-fire ranges. This portion of the research effort will evaluate the potential performance transfer from training in the ASALT to collective live-fire and force-on-force training. This will include assessing shoot/no-shoot decisions, maneuver decisions, and the relationship between physiological stress and decision making.

Ultimately, findings will provide insights to leadership on the advancements made toward achieving the objectives of Force Design, which focus on developing more mobile, distributed, and lethal small units, capable of fighting and winning in contested environments. Through understanding and embracing the inherent differences and capabilities of live and simulated training, along with the knowledge of the relationships between lethality metrics within these training modalities, the Marine Corps will be in the position to leverage this capability to improve and sustain live-fire training at a level that has never been done within the DOD.

ASALT will be fielded to eight locations with initial operational capability achieved in FY2024 with delivery to Twentynine Palms, CA; Camp Pendleton, CA; and Camp Lejeune, NC. Twentynine Palms and Camp Pendleton have been installed and are ready for training. Camp LeJeune is scheduled for June 2024 installation. Future task order delivery locations include School of Infantry–East (NC), School of Infantry–West (CA), MCB Hawaii, Camp Barrett (VA), and Okinawa. Guam will be installed on the FY2026 follow-on contract.

***ASALT will provide data-driven marksmanship and cognitive performance feedback to support informed decision making by Marine Corps leadership.***

In summary, alignment with Training and Education Command's Marksmanship Campaign plan, along with the SMEs and scientists at WTBn and ExCS, ensures ASALT program capabilities will support the Marine Corps' overall live-fire strategies. By providing immediate feedback for the individual Marine, which can then be rolled up to squad, platoon, company, etc. unit performance, ASALT will provide data-driven marksmanship and cognitive performance feedback to support informed decision making by Marine Corps leadership.

Lastly, and most importantly, for this effort to be successful, we need Marines to train in the ASALT to begin accumulating and analyzing this critical data. To all the Marines, especially the ones at initial fielding locations, get in the system as soon as possible. Put ASALT to the test and help us unlock the full potential of the latest investment in Marine Corps lethality enhancement.

USMC

# The Need for Speed

## Think Amazon but for acquisitions

by Maj A. C. Puraty, Ms. M. E. Banks, Capt A. B. Heron, Mr. J. A. Aurilio & Mr. B. J. Prevost Jr.

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Recent developments with the fielding of the Amphibious Combat Vehicle (ACV) have shown the need to improve proficiency while concurrently minimizing risk to force during this critical transition of the assault amphibian community from the legacy Assault Amphibious Vehicle to the 21st-century digital platform. To quickly meet the needs of the FMF with this transition, the Program Manager Advanced Amphibious Assault Suite of Training Systems (PM AAA STS) team developed and seamlessly executed a rapid prototyping acquisition that provided a path paved with innovation and intent. The goal? To rapidly develop fieldable Driver Trainer Simulator prototypes demonstrating new capabilities with the most advanced technology industry had to offer while meeting an urgent military need. The team capitalized on the flexibility of a middle-tier acquisition strategy Other Transaction Authority (OTA) Agreement and then competitively prototyped three different ACV driver training systems (DTS) in less than ten months. As a comparison, the typical timeframe for developing a new capability with the level of complexity of the ACV DTS is two to five years. PM AAA's STS team defined, developed, and procured a capability that will enhance proficiency and enable Marines to meet future qualifications and certifications for effective ACV employment. Three key tactics enabled mission success: the use of an OTA; team empowerment; and an iterative design evolution process driven by realtime Marine operator feedback.

As the Marine Corps continues to modernize the force and stay ahead of the pacing threat, the burden to move quickly within our acquisition programs remains a relevant priority. This article seeks to provide one example of how to deliver a vital capability at or ahead of the speed of relevance to meet a need for our warfighters. Using novel approaches and operating with a sense of urgency enabled, the PM AAA STS team can deliver a product within the acquisition environment at speeds representing a quantum leap in delivery time and efficiency. As an aside, we like to refer to our approach, tongue in cheek, as the "Amazon of acquisition," since our approach and delivery results are so groundbreaking.

***Driver training system consisting of VR goggles, mixed reality steering wheel, gear shift, marine propulsion controls, and a two-direction of freedom chair.*** *(Photo by VR Training.)*

### OTA Benefits

PM AAA evaluated several contracting approaches and chose a middle-tier

Acquisition OTA because of its benefits. Using a middle-tier acquisition program strategy streamlined and reduced many of the regulatory/statutory requirements that increase oversight and speed of development and fielding. Additionally, this course of action allowed the team to draft and release a Request for White Paper in coordination with a consortium of validated industry partners that resulted in eleven proposals submitted in response to the team's RFP. Within ten days, the team was able to review and down-select to two vendors for competitive prototyping. The team used a series of metrics and interviews with the finalists to make a final recommendation to PM AAA leadership that centered on proposed software engine solutions, hardware approach, and the detailed rough order of magnitude cost proposal by each vendor. The team recommended vendors who used industry-wide common software engines that were not proprietary, and it also studied the rough order of magnitude cost proposal to ensure a significant amount was focused on software development.

While the use of the OTA provided significant flexibility and speed, it was not without its challenges. The team ran into its first significant delay during the development of the statement of work (SOW) and agreement. Extensive legal review was required for the SOW and OTA since the documents were not able to use existing and understood Federal AFAR-based language. This setback was not foreseen and resulted in a thirty-day delay as the contracts were modified to provide clarity and protect the government's interests.

Using an OTA also enabled the team to focus on the test and evaluation phase through multiple interactions whereby the team and industry partners could directly engage and gather valuable feedback for both hardware and software requirements and needs from the operational user. The cooperative environment enabled the industry to rapidly iterate and recreate ACV surf-zone interactions in realtime that had not yet been physically tested through experienced critiques. The OTA process differs from traditional methods in that the interactions with contractors are much more collaborative. With a traditional approach, requirements are provided to industry to build, test against, fix, and then test again—thereby increasing the schedule. During an OTA, industry can get realtime feedback, enabling them to fix on the spot or close to the point of testing. This allowed the STS team to explain and refine performance specifications with the contractors during the development phase enhancing the contractors' prototypes. Another advantage of the OTA process was that it shortened the timeline for the competitive prototyping phase due in large part because the contractors were provided development paths with prioritized objectives to mature their prototypes. This allowed the individual industry teams to creatively progress at their own speed, giving them freedom of action to pursue the team's intent. PM AAA's task to field an ACV DTS within one year is on schedule because of a team effort between the program office and industry. This team effort was made possible through resourcing and support from the program office to the team, which enabled exclusive focus on interactions with the STS team and industry. Based on this approach, the OTA effort has resulted in three viable prototype designs that will benefit the ACV community.

***The OTA process differs from traditional methods in that the interactions with contractors are much more collaborative.***

The field user evaluation (FUE) was conducted over a five-day period at Camp Pendleton, CA. It utilized fleet and schoolhouse Marines of all ranks who had varying levels of experience with the ACV. The FUE was designed as a test and evaluation of how well the system met stated requirements; this is a unique use for this type of event made possible by the OTA. Due to the nature of the performance specification and how requirements were prioritized, the team was challenged to devise methods that interpreted qualitative data into quantitative measurements.

The team structured three different methods of evaluation for the FUE. The first method was Design Interactive's Imitate software to collect more than 450 surveys from Marines on their opinions of how the vehicle operated during different scenarios. Using the large sample size, the team was able to quantify the various opinions into a scoring method for each area of evaluation. The second evaluation method used team members to evaluate the systems strictly on the performance specification, assigning a score for each of the more than seventy requirements to be evaluated by each vendor's simulator prototype. This was then averaged out for each section, providing a series of comparative scoring. The third method was to evaluate training effectiveness. The team used Marines with no experience on the ACV and measured their ability to execute tasks, tracking time and accuracy for each. This information was then compared across each vendor's simulator to help inform a production decision. Being able to design and execute the FUE was unique to the OTA process and ensured a rapid movement from prototyping to the production phase.

## Rapid Refinement

The ACV DTS was born out of a concept aimed at replicating and blending vehicle employment and training curricula using state-of-the-art simulation technology in a small form-fit-function packaging that could be employed worldwide. The approach required industry to replicate the ACV driver's station, complete with more than fifty unique functions, to include a driver's display panel with re-

alistic and accurate vehicle and engine performance displays. The simulation also required the creation of a first-in-the-field complex and realistic surf zone with multiple wave types, variable wave heights, littoral currents, randomized wave periods, and directions, all controlled by a physics-based simulation engine.

***Overhead view from the after-action review module of a simulated ACV-P approaching well deck of a simulated vessel through a virtual surf zone.*** *(Photo by VR Training.)*

The development timeline was approximately five months from the contract award to the final FUE. The team determined that a critical component of the development would be feedback to the vendor on their software due to the shortened timeline and the need to create a functional surf zone. This was communicated through the performance specification, which listed approximately seventy requirements for the vendors to meet while incorporating twenty-one training and readiness tasks with twenty-six faults, warnings, and cautions to be programmed. All parties understood that completing all requirements would not be possible, so vendors were given prioritizations to help shape their approaches and what capabilities they would pursue. This was done so as not to limit the individual vendor's software development but also to give them maneuver space to show what their software could be capable of. The current plan is to complete development during the production phase with the matured technology. Discussions were held weekly at the beginning of the project between the vendors to answer requirements questions as further understanding was achieved.

Limited user evaluations were also conducted to provide feedback from Marines at the Assault Amphibian School, Amphibious Vehicle Test Branch, and 3rd Assault Amphibian Battalion. The use of these personnel was critical because data did not exist for most of the vehicle actions/reactions in a surf zone. A series of iterative development cycles were completed by each vendor to increase fidelity in their simulators based on direct user feedback. The vendors frequently made refinements to software and hardware in realtime in reaction to the Marines' input. The team also used the limited user evaluations to refine their data collection efforts for the FUE. On several occasions, Marines were sent to the vendor's facilities to work side-by-side during software development and refinement. Altogether these rapid refinements ensured the overall success of the prototyping phase, as the pace of development was nonstop.

## Team Empowerment

PM AAA leadership empowered the team to make decisions, use resources, draw upon subject-matter experts, and communicate this empowerment to the entire program staff regularly. PM AAA leadership ensured frequent touchpoints with the team where frank discussions of friction were encouraged so that obstacles could be mitigated or removed. The level of support provided by the Assistant Program Manager (APM) PM staff was exceptional. Being able to interact with primaries for critical discussions and their connections within the acquisition community was essential to the success of the project. Specifically, APM Contracts was able to draw upon multiple resources for advice on how to accomplish the required documentation to complete the project. Additionally, being able to draw upon APM Engineering insight in drafting the performance specification and APM Logistics guidance for maintenance and sustainment questions significantly enhanced the team's ability to support the vendors. PM AAA leadership used every opportunity to communicate to the program office staff their vision of how they wanted the project supported. This resulted in a synergy among the staff that consistently ensured decisions were made at the lowest level, fast-tracking the project's completion. Using the example of the Mine-Resistant Ambush Protected program, many of the bureaucratic hurdles encountered were knocked down through full empowerment of the team and through reducing the ability of anyone in the Project Management Office to say no to the team lead, apart from the program manager. By doing so, critical stakeholders were forced to find novel solutions to challenges with a *how can we* versus a *why can't you* approach. While this created risk, it reinforced the need to have trust in your subordinates to do the right thing and always reinforce with consistent touch points.

PM AAA provided significant resources to the team for this project that extended beyond the Research Development Test and Evaluation funds that were assigned. The team was assigned support members from engineering, contracts, safety, test and evaluation, logistics, and human systems integration. Being able to draw from this pool of expertise during the planning and execution of the project streamlined meetings and eliminated delays due to lack

of information. The team very rarely had requests for information (RFIs) outside of the group during any phase of the development. Working with key individuals also allowed the team to reduce delays during legal review, safety review, and routine routing of documents/briefs for approval. Having empowered decision makers armed with intent at the points of friction reduced delays at every step. Having flexibility with personnel, travel funds, and support from PM AAA to respond at breakthrough speed was critical to the project's success.

## Recommendations

Pull in all stakeholders and competencies at the beginning of the process to ensure their respective equities are accounted for as early as possible. Plan for significant legal review and/or conduct significant work on the SOW and agreement with heavy legal involvement before selecting vendors for test and evaluation. It is critical that the team of stakeholders include legal equities to get them up to speed early and reduce the time needed for understanding and review later.

By engaging the amphibian assault capability integration officer at the beginning stages of the project, Combat Development and Integration (CD&I) ensured their active participation as the resource sponsor and advocate for training devices. Their input and briefs to senior USMC leadership were essential in gathering widespread acceptance and support for the training system. PM AAA recommends future program offices work closely with their CD&I counterparts to achieve the same results.

The limiting factor throughout this project was time—specifically, time for the vendors to receive and implement constructive feedback. PM AAA recommends proactive information sharing and responsiveness to RFIs. We were able to do this because of the subject-matter experts who were part of the team and their ability to pull information from the FMF.

***The creation of a first-of-its-kind complete complex ACV training system in less than ten months has demonstrated the ability of our acquisition arm to move quickly to deliver vital capability ...***

## Conclusion

Much has been written regarding the pace at which acquisition has and is moving against our peer adversaries. PM AAA, specifically the PM AAA's STS team, demonstrated that an organization of motivated individuals tasked with an urgent mission can move quickly. To do so required novel approaches to execution and delivery. Three of these efforts were the utilization of an OTA, iterative and rapid refinement of requirements throughout the rapid prototyping phase, and empowerment to the lowest level from senior decision makers. The creation of a first-of-its-kind complete complex ACV training system in less than ten months has demonstrated the ability of our acquisition arm to move quickly to deliver vital capability to Marines to improve proficiency and mitigate risk to force.

*>Authors' Note: Special thanks for the editing and advice provided by Col T.F. Hough, Mr. C.G. Melkonian, and Mr. R.J. Garza of PM AAA.*

# 10th Marines

## Artillery modernization and support to the 2d MarDiv

by the Officers of 10th Marines

The release of *Force Design 2030* has precipitated significant changes in the structure of 10th Mar. The regiment maintains a two-battalion structure following the cancellation of activation plans for the 3d and 5th Battalions, resulting in adjustments to the capability and support provided to the 2d MarDiv. The divestment of cannon artillery, paralleling the larger divestment of infantry regiments and battalions, was accompanied by the establishment and consolidation of the division's High Mobility Rocket Artillery System (HIMARS) capability within the 2d Battalion. The establishment of the Fire Support Battery consolidated the regiment's fire support teams—long the mainstay liaison capability to its infantry counterparts—under one command while the incorporation of longer-range target acquisition systems complemented the introduction of a division organic long-range precision fires capability. Throughout this evolution, 10th Mar expanded its support to the 3d MarDiv and combatant commanders worldwide through expanded support to the Unit Deployment Program while maintaining its presence embarked aboard Camp Lejeune-based MEUs, increasing its global footprint.

These structural changes affect the regiment amid a rapidly evolving operating environment. The hard lessons of recent conflicts such as the 2020 Nagorno-Karabakh War and the ongoing war in Ukraine loom large as 10th Mar adapts its learning to generate forces capable of thriving amidst global crisis and contingency operations. The threats posed by adversaries' integrated sensors and fire complexes, the increased prevalence and capability of unmanned systems on the battlefield, and the increasingly contested nature of the electromagnetic (EM) spectrum are but a few of the operational realities that drive an increased distribution of forces on the battlefield. The Service has followed suit, and the Marine Corps' current Service-level Integrated Training Exercise and MAGTF Warfighting Exercise provide a demanding, distributed environment where 10th Mar operating concepts have been put to the test.

***Marines with Hotel Battery, 2/10 Mar, under tactical control of Task Force 61/2 fire rockets simultaneously from two M142 HIMARS during Formidable Shield in Andoya, Norway, on 10 May 2023.*** *(Photo by LCpl Emma Gray.)*

While 10th Mar of today may look different, its responsibilities as the Marine Corps' Service-retained cannon and rocket artillery regiment endure. Regardless of ongoing change, 10th Mar remains postured and capable of supporting global force tasking while retaining a combat-credible capability to respond to crisis and contingency. As the regiment mans, trains, and equips in support of the 2d MarDiv, the challenges posed by contemporary threats, force structure changes, and a distributed battlefield drive defined changes in how it organizes for combat to support maneuver. It is a much more scalable and flexible artillery regiment than ever before, employing more diverse weapons systems, advanced targeting acquisition capabilities, and an improved ability to man and train capable fire support teams; 10th Mar continues to capture valuable lessons learned to optimize its support to the *Follow Me Division* in any capacity required.

### The Arm of Decision

If it has done nothing else, the regiment's structural changes under *Force Design 2030* have shattered convention in the realm of legacy concepts of support to the 2d MarDiv. While the regiment retains two-for-two artillery battalion parity with the division's infantry regiments, the battery-level organization of 10th Mar disrupts traditional ratios of support. The regiment's present organization consists of seven cannon batteries and three HIMARS batteries tasked with providing support to eight infantry battalions and the ad-

ditional fire support needs of the 2d Light Armored Reconnaissance Battalion while retaining a capability to support MEF-level requirements with long-range precision rocket fires or cannon artillery as needed. This problem of capacity is further strained by the reality that at any given moment upwards of 40 percent of the regiment's firing batteries are forward deployed—or preparing to deploy—in support of global force tasking.

These structural changes and their impact on conventional methods of support exist in the context of a broader landscape of operational challenges stemming from both contemporary adversaries and the operating environment. They do not, however, change the foundational demand placed on the regiment. As 10th Mar continues to fulfill its mandate to effectively organize for combat in fulfillment of its fire support tasks, it is much more than simply an artillery regiment in support of a division.[1] The regiment has evolved into an exceedingly flexible organization, provisioning scalable fire support from the regimental to cannon and rocket platoon levels, supported by a tailored approach to tactical mission assignment at all echelons informed by the threat, force structure, and the distributed nature of the battlefield.

*Legacy Ratios of Support and Habitual Relationships*

Traditionally, the direct support tactical mission has been the hallmark of the artillery battalion, with "minimum adequate support" considered to be one artillery battalion for every infantry regiment.[2] This paradigm implied that one infantry battalion required one cannon artillery battery (or six howitzers). The regiment's artillery battalions are no longer optimized to maintain direct support relationships with infantry regiments, a reality driven as much by its reduced quantity of cannon artillery as by the non-uniform structure of its battalions. (Five cannon batteries are organized under the 1st Battalion while all HIMARS batteries are retained under the 2d Battalion.)

In addition to the inability to maintain legacy ratios of support to maneuver units, the bifurcation of the traditional liaison capability retained within 1st and 2d Battalions to the regiment's new fire support battery redefined the traditional approach to fire support coordinator (FSC) responsibilities in support of infantry regiments. The regiment's loss of battery to infantry battalion parity did not extend to its fire support teams, and regimental fire support team officers in charge have subsumed the roles of regimental FSC from the artillery battalion commanders, taking the "habitual" relationships of yesterday with them. This has its own advantages, as this field grade officer, rather than splitting responsibilities between that of an artillery battalion commander and FSC, is completely focused on the planning and employment of fires and effects, coordination and deconfliction of fires, and the disposition of the platoon's fire support teams. In the performance of these duties, the regimental FSC is fully integrated into the infantry regimental commander's staff and in the best position to have an impact on fire-related decisions. This splitting of responsibilities has made the provision of fire support to maneuver units a more collaborative process, and the artillery battalion commander remains an invaluable stakeholder in providing support to maneuver units in cooperation and collaboration with the FSC. This collaborative relationship has been exercised and refined during Service-level exercises, doing much to optimize artillery tactical missions and organization for combat in support of the maneuver commander's concept of fires.

***The regiment has evolved into ... scalable fire support from the regimental to cannon and rocket platoon levels ...***

*Tailorable Employment and Tactical Missions at all Echelons*

The regiment's solution to bridging the gap posed by contemporary threats, evolving force structure, and the challenges posed by the distributed battlefield has been one of a flexible approach to tactical mission assignment at all echelons. While the distribution of firing platoons and batteries across the battlespace is a necessary step to improve survivability in the face of emerging and evolving threats, it is also driven by the regiment's requirement to meet its fire support tasks in support of maneuver forces operating at greater distances. Platoon-level operations for cannon and rocket artillery are often necessary to ensure that *zones of fire* maintain their ability to support *zones of action* in a distributed environment, a reality that has reciprocal effects on tactical missions at the battalion level.

The distribution of a reduced quantity of cannon artillery systems increasingly makes general support the tactical mission of choice at the battalion level, wherein the battalion is required to support the force *as a whole* while remaining prepared to support subordinate elements therein.[3] An artillery battalion assigned the general support tactical mission while employing distributed firing platoons is thus better able to measure its tempo of support to maneuver, ensuring that it meets essential fire support tasks for the force while retaining dedicated firing capability to respond to immediate requests by forces in contact at subordinate echelons.

An increased proficiency in distributed operations also means that tactical missions are relevant and viable at the battery and platoon levels, providing 10th Mar with a flexible means through which to tailor support to individual formations, maintaining the ability to weigh more responsive fire support to specific maneuver units if required. This is especially relevant for the regiment's increased quantity of long-range precision fires. HIMARS batteries, organized in three platoons of two launchers each, are exceptionally flexible firing agencies that can be task-organized to provide tailored and responsive fires to multiple echelons of

command through the deliberate application of tactical missions to the battery and platoon levels. Their effectiveness is bolstered as well by structural changes that have introduced dedicated billets for fires plans officers at the artillery battalion, supporting battery-assigned liaison officers with interfacing and integrating effective precision fire support with higher echelons of command.

*Impacts to Effects of Fires*

While the scalable and flexible employment of firing units at every echelon helps compensate for shortcomings in traditional ratios of support, the regiment's reduced capacity of cannon artillery does force a reappraisal of the traditional effects of fires provided by the division's organic artillery. Without the capacity to sustain traditional direct support relationships, batteries and battalions are challenged to provide ammunition-intensive suppressive effects to individual infantry formations while at the same time retaining sufficient capability to support units across the breadth of the GCE.

Fielding a reduced structure of cannon artillery against ever more capable adversaries, the regiment's ability to provide suppressive fires is increasingly unsustainable in favor of a more optimized approach to destruction and neutralization fires, enabled by the regiment's HIMARS capability and its ability to achieve precise effects at range. While this allows the regiment to retain its ability to degrade or render key adversary capabilities incapable of accomplishing their missions, it also increases the requirement for the supported unit's targeting processes to employ the finite, yet lethal, resources at their disposal most efficiently. Supported units are not alone in meeting these requirements, being reinforced by the weight of the regiment's fire support battery.

## Fire Support Battery

As structural reorganization within the Regiment's firing battalions has disrupted historical habitual relationships with 2d MarDiv's infantry regiments, a new unity of effort has emerged with the establishment of the Fire Support Battery, 10th Mar. Active since October 2022, the 10th Mar was the first artillery regiment to establish a fire support battery by *Force Design* artillery modernization efforts. The transfer and consolidation of 1st and 2d Battalion's fire support platoons, further supported by the integration of the 2d MarDiv Fire Support Coordination Center, created a singular unit that is structured to source habitually aligned fire support teams to the division's infantry regiments, their battalions, and 2d Light Armored Reconnaissance Battalion. For the first time, a unified headquarters platoon and command element exists to support efforts to man, train, and equip fire support teams for combat operations in support of scalable fire support solutions for maneuver formations. The result is better-trained fire support teams for global force tasking, crisis response, and contingency operations.

***Cpl Erick Leon, right, a Queens, NY, native and a field artillery cannoneer with 1/10 Mar, fires an M777 towed 155 mm howitzer during field training on Camp Lejeune, NC.*** *(Photo by LCpl Jonathan Rodriguez Pastrana.)*

The cascading effects of the fire support battery's establishment extend well beyond the consolidation of dedicated support to maneuver. The consolidation of the division's fires and effects integration expertise continues to support the development and refinement of high-quality, standardized fire support team training and evaluation packages—overseen and executed by the battery's training and headquarters sections—to provide a uniform capability to the regiment's supported units. The consolidation of the regiment's tactical air control party program has also improved its ability to generate and train quality joint terminal attack controllers and joint fires observers for the division. This has correspondingly increased the battery's ability to harness its manpower and equipment resources to better task organize scalable fire support teams for emergent crisis response requirements and taskings, providing a tailorable capability when required.

This new structure is not without its growing pains, and the establishment of the fire support battery did not singularly eliminate the regiment's challenges in the areas of unit lifecycle management and equipment. Fire support teams, while better trained under the present fire support battery organization, remain affected by occupational-specialty shortages.[4] Because of these issues, the fire support team force generation often struggles to keep pace with the pre-deployment training cycles of overlapping global force management requirements. Similarly, an enduring need exists to continue to modernize communications and optics equipment toward systems that are lighter, less power-consuming, and better optimized for

the joint environment. The fire support battery is better postured than ever to address these challenges, and the resulting consolidation of expertise within the regiment has brought about a new unity of purpose in the liaison capability 10th Mar provides the division.

## Target Acquisition Advances

As the establishment of the fire support battery sustains and advances 10th Mar's habitual liaison capability to supported units, the regiment's organic target acquisition capability has equally benefitted from new technology and employment concepts in support of the division. The 10th Mar Target Acquisition Platoon is at the leading edge of modernization efforts in cooperation with Combat Development and Integration and Marine Corps Systems Command to field and test new equipment. The Regiment's Block 2 AN/TPS-80 Ground Air Task Oriented Radar (G/ATOR), a ground weapons locating variant optimized to acquire and track hostile indirect fire, and Scalable Passive Acoustic Reporting and Targeting Node (SPARTN) are together more potent than their predecessors.[5] This advanced equipment is paired with the benefits that come from structure growth, and a benefit of the 12th Mar's transition to the 12th Marine Littoral Regiment is the subsequent inheritance of counter-battery radar teams divested from the 3d MarDiv. These structural gains will further increase the regiment's sensor capacity by two G/ATOR and two Lightweight Counter Mortar Radar systems—welcome additions to 10th Mar as they further contribute to shortening kill-chains and enhance support to 2d MarDiv and II MEF's counterfire needs.

As of January 2024, the regiment has completed fielding half of its allotted G/ATOR systems and is already benefitting from this exceptionally capable system which drastically outperforms legacy AN/TPQ-46 Fire-Finder radar systems in its combat capability, allowing the regiment's counterfire capability to keep pace with its evolving organization for combat. The radar's extended range has opened opportunities for new and creative employment concepts for the target processing center's liaison capability between radars and firing agencies. Increased target processing center's employment at the MEF and division fire support coordination center levels improves target acquisition and proactive counterfire capabilities at these echelons while better familiarizing them with counter-battery capabilities.[6] This will bridge the maneuver's counterfire acquisition and delivery capability at the extended ranges of an increasingly distributed battlefield.

***Marines with Headquarters Battery, 10th Mar, 2d MarDiv conducting G/ATOR operations in support of 1/10 Mar aboard Camp Lejeune, NC, on 24 January 2024.*** *(Photo by Cpl Jose Rovirosahi-dalgo.)*

This year also introduced another much-needed upgrade to the regiment's target acquisition suite with the introduction of the SPARTN system. A passive acoustic sensor whose primary function is to report acoustic events, the SPARTN provides an improved capability to cue G/ATOR emissions on detections that meet unmasking criteria. This complementary relationship between the SPARTN and G/ATOR increases system survivability and provides a more resilient counterfire capability to the 2d MarDiv. The SPARTN's significant reduction in size, increased communications capability, and longer battery lifespan is directly aligned with supporting effective coverage in support of any level of sustained, distributed operations. Together, these advances represent the regiment's contribution towards ensuring that counterfire remains the shield that allows the 2d MarDiv to wield its sword of supremacy in any crisis or contingency operation.

## Future Change and Opportunities for Optimization

While the 10th Mar remains postured to support the requirements of the 2d MarDiv, the regiment's organization will not remain static in its march toward the future operating environment. The regiment's current operating concepts and organization for combat yield continual lessons on areas for investment germane to effective fire support employment both now and into the future while future structural changes will continue to adjust its organization and support to the division.

### *Areas for Further Optimization*

The regiment's reduced density of cannon artillery formations and the corresponding emphasis on destruction and neutralization fires requires greater investment and prioritization in employment techniques for dual-purpose improved conventional munitions, rocket-assisted, and family of scatterable mine projectiles over traditional high

explosive variable-time combinations. While these presently available munition types can assist in offsetting the prohibitive expenditure rates required to achieve firepower and mobility kills on armored equipment, long-term investment in the capabilities of cannon artillery must emphasize greater infantry access to longer-range cannon fires to support their mission-essential tasks and complement the expanding range of sensing capabilities at every echelon.

As the ongoing conflict in Ukraine illuminates, cannon mobility also requires further investment. The conflict has in many cases highlighted the disadvantage that towed artillery formations encounter in a high counter-battery threat environment, where the ability to reposition on short notice equals advantage and often survival.[7] The Marine Corps' current Medium Tactical Vehicle Replacement is not optimized for keeping pace with increased infantry mobility, nor the requisite displacement times to avoid contemporary counterfire threats. The age and usage rates of the Medium Tactical Vehicle Replacement have also affected ongoing operations, as availability rates have decreased upwards of 60 percent in the past decade.[8] In light of these realities, alternative prime mover options incorporating a lower tongue weight and smaller chassis merit increased consideration, while voices advocating for the Marine Corps to more seriously explore adopting a self-propelled cannon artillery system deserve additional attention.

While the batteries and platoons of 10th Mar continue to demonstrate an increased proficiency at distributed operations, cannon, and HIMARS batteries must continue perfecting these techniques while equipped with the requisite communications equipment to support dispersion at the cannon section and rocket launcher level to maintain uninterrupted command and control. Legacy communications equipment employed across traditional wavelengths does not adequately meet this aim. Very high-frequency systems, employed in a nearly exclusively omnidirectional pattern, increasingly make firing units vulnerable to rapid detection and targeting. Similarly, time-intensive techniques for the effective employment of high-frequency communications are regularly outpaced and outclassed by the effective usage of new wideband communications technologies; these systems are not currently available in quantities sufficient to support an increased number of independent and distributed firing formations throughout a non-contiguous battlefield. Ongoing exercise participation at the Service-level has validated the benefits of wideband satellite communications systems over legacy waveforms, and the capability merits serious consideration for future investment across the Marine Corps' artillery formations.

*Change on the Horizon*

The regiment's contemporary lessons learned and operating concepts are in many ways a foundation for its future force structure and roles within the division. Current fire support systems and liaison capabilities to supported units are only a waypoint towards the complete structure changes outlined in *Force Design* concepts.

Endorsed by the 2023 Artillery Operational Advisory Group and currently underway in conjunction with Combat Development and Integration, the positive changes from the establishment of the fire support battery may one day see the organization grow to a battalion-level command. This fire support battalion would provide its commander the authority required to compete for resources in the form of personnel, money, and equipment within the regiment. Presently, the fire support battery rates 342 Marines and sailors as part of the table of organization, and while on-hand numbers are smaller, they will only continue to grow based on Headquarters Marine Corps manpower projections. The command element and staff appropriate to manage this large organization would greatly enhance the future battalion's ability to functionally manage a formation that serves a division headquarters, two regiments, eight infantry battalions, a light armored reconnaissance battalion, and myriad emergent requirements and requests that demand fire support expertise. A future fire support battalion will improve the regiment's ability to meet 2d MarDiv's demand for adaptable and relevant fire support teams.

The regiment's current cannon and rocket artillery structure will further change with the fielding of the Navy-Marine Corps Expeditionary Ship Interdiction System (NMESIS) in the coming years. 10th Mar has remained keenly invested in Service-modernization initiatives through involvement in NMESIS development and extended user evaluation to best forecast impacts to future organization and operations.

***The regiment's current cannon and rocket artillery structure will further change with the fielding of the Navy-Marine Corps Expeditionary Ship Interdiction System (NMESIS) in the coming years.***

10th Mar anticipates transition of initial batteries to NMESIS as early as fiscal year 2026 and maintains the planning horizon required to ensure initial units identified to receive training are prepared to develop best practices and recommendations for system employment.

The introduction of NMESIS to the 10th Mar will see the regiment go through a subsequent reduction of cannon artillery batteries, placing a greater onus on the efficient employment of the division's organic cannon artillery capability in support of recurring and emergent operations. The introduction of a naval interdiction capability within the 2d MarDiv will no doubt have a marked impact on the proficiencies and capabilities demanded of 10th Mar. Facing these changes, the regiment's ongoing success in furthering

the efficient and flexible employment of distributed firing agencies, integrating long-range precision fires systems and employment techniques within the division, and improving its liaison capability and target acquisition complexes are laying the foundation upon which 10th Mar's future capability will stand. While missions and fire support systems will change, the adaptability and foresight that has long been the hallmark of Marine Corps artillery professionals will continue to ensure the regiment remains best postured to support 2d MarDiv now and into the future.

## Conclusion

As its structure and concepts of employment continue to evolve, 10th Mar stands as one of the most flexible formations within 2d MarDiv. The regiment continues to meet the challenges of contemporary threats, the implications of ongoing force structure changes, and the challenges of an increasingly distributed battlefield with an approach to innovation that has redefined its organization for combat and allowed it to keep pace with its enduring responsibility to provide timely and accurate fires in support of the *Follow Me Division*. 10th Mar remains postured to sustain its support to global force tasking while maintaining scalable cannon and rocket artillery formations ready to respond to crisis or contingency requirements.

The regiment's current successes do not overshadow areas where it can benefit from continued investment and optimization. Increased investment in the mobility of the Marine Corps' cannon artillery will go far in enabling the survivability requisite for the modern battlefield, a demand reinforced by the 10th Mar's reduced capacity of cannon systems and reevaluation of the effects they provide. Similarly, Service-level solutions to manpower constraints will help ensure that firing batteries and fire support teams can continue to man, train, and equip at a level of parity with maneuver formations now and into the future.

While structural changes have, in many ways, shattered convention in the areas of legacy ratios of support to maneuver units and traditional approaches to tactical missions, the result is a more dynamic artillery regiment that is better postured to maintain effective support to the division. This is no small accomplishment, and great credit is due to the Marines and sailors whose daily efforts ensure that the 10th Mar remains 2d MarDiv's *Arm of Decision*.

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**Notes**

1. The four fire support tasks are supporting forces in contact, supporting the commander's concept of operations, integrating fire support with the scheme of maneuver, and sustaining fire support. Headquarters Marine Corps, *MCTP 3-10F, Fire Support Coordination in the Ground Combat Element*, (Washington, DC: 2018).

2. Current doctrine acknowledges the battalion as the echelon "normally" assigned a tactical mission. Headquarters Marine Corps, *MCTP 3-10E, Artillery Operations*, (Washington, DC: 2018).

3. Ibid.

4. Field artillery officer, fires and effects integrator, and joint terminal attack controller respectively.

5. The regiment fields the Block 2 G/ATOR system. The Block 1 G/ATOR system provides the Marine Corps with an air-defense and surveillance radar capability.

6. "Proactive counterfire" is a vital component of mid- to high-intensity conflicts to limit or damage hostile fire support systems and is incumbent on allocating proportionate target acquisition assets, normally at the MEF and division levels. For more information, see *MCTP 3-10F, Fire Support Coordination in the Ground Combat Element*.

7. Sam Cranny-Evans, "The Role of Artillery in a War Between Russia and Ukraine," *Royal United Services Institute*, February 14, 2022, https://rusoi.org.

8. Availability rates based on data maintained through Global Combat Support System-Marine Corps R12, analyzed by 1/10 Mar from 2012 through 2024.

# The Cold Hard Truth

## Enhancing cold weather capability through NATO integration and trainer certification

by LtCol Nathan Knowles, Maj Mark Deal, Maj Zack Pinkerton & 1stLt Michael Adlum

In a message preceding the June 2023 update to *Force Design 2030,* the 38th Commandant cautions that "the Marine Corps does not have the luxury of focusing on a single threat, to the exclusion of all others, and basing our design on such a narrow point of view. We are building a force capable of executing our concepts, not exclusively tailored to them."[1] While priorities in manning, training, and equipping the force are designed to counter the pacing threat in the Pacific, we will fail to satisfy our role as the Nation's expeditionary crisis response force if we do not heed this warning. The Marine Corps is renowned for its adaptability and aptitude in diverse environments, but its proficiency in cold weather operations is lacking. During the First World War, the Alpine front proved to be a crucial battleground where both sides leveraged their technological advancements and industrial prowess to extend the conflict into the inhospitable terrain of the Alps.[2] Today, most regions adjacent to politically volatile areas where we may need to operate are classified as "cold regions." As globalization and technology continue to progress, the circumstances that led to conflict in the Alpine front between the Italian and Austria-Hungarian Empires over a century ago are becoming more challenging and more likely today. 2d MarDiv has been heavily involved in cold weather capability development via Marine Rotational Force Europe (MRF-E) deployments and ongoing training. 2d Combat Engineer Battalion's recent deployment as MRF-E 23.1 gained additional insights into how the Marine Corps can rapidly close this cold weather proficiency and capacity gap. This article proposes that the Marine Corps significantly improve its cold weather training and equipment by fully integrating with the NATO-endorsed cold weather training in Norway and other Scandinavian countries or risk failure in its mission as a global crisis response force.

***>LtCol Knowles's bio was unavailable.***

***>>Maj Deal 's bio was unavailable.***

***>>>Maj Pinkerton's bio was unavailable.***

***>>>>1stLt Adlum 's bio was unavailable.***

### Cold Weather Training Policy: A Model

In November 2023, II MEF released its cold weather training policy, outlining the commander's guidance regarding cold weather operations, which is complemented by the 2d MarDiv's cold weather training addendum to its tactical standard operating procedures. This is a necessary and positive movement, but at the time of this article's writing, II MEF and 2d MarDiv are the only FMF commands to publish such documents. Units slated to conduct cold weather training, exercises, or operations through the Global Force Management process are assigned MCT 1.6.12 (Conduct Cold Weather Operations). The II MEF policy acknowledges that no mission essential tasks or training and readiness events exist for Marine Corps Task 1.6.12. In place of this, the policy directs specialists, namely communicators, medical staff, and key leaders (from the unit's primary occupational field) to attend a Basic Cold Weather Leader Course to provide the unit with cold weather trainers. II MEF mandates twelve trainers per company, which breaks down to four of each specialist category. Cold weather training for medical and communications personnel requires specialized expertise, which makes them unreliable planning factors for a unit's cold weather training cadre. However, they play essential roles in other capacities and cannot be overlooked. This effectively reduces

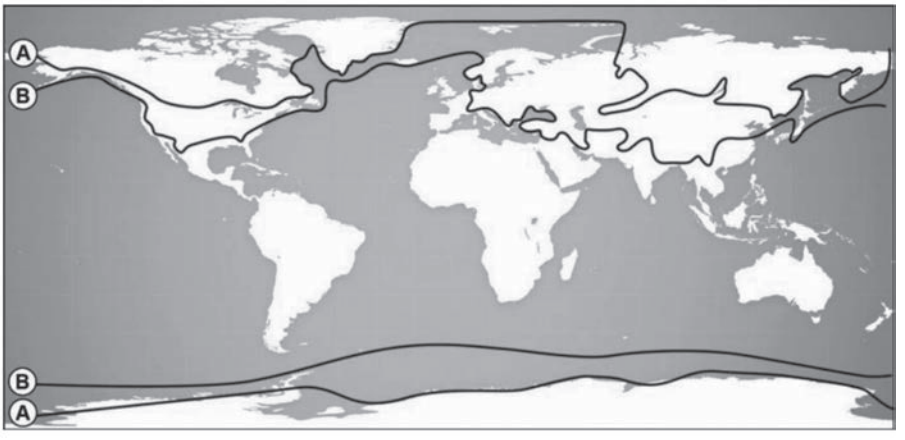



***Figure 1-1 from* MCRP 3-35.1D/ATTP 3-97.11 Cold Region Operations. *In the Northern Hemisphere, the area north of line A is termed "extreme cold" and between lines B and A is termed "moderate cold." (Washington, DC, Headquarters, Department of the Army, 2011.)***

the instructor-to-student ratio for the primary MOS of a deploying/training unit to 1:36, or one per platoon assuming a 145-person company. II MEF's policy is a good start, but the recommended trainer-to-student ratio should be 1:12, with separate accounting for communication and medical personnel. After-action reports recommend at least one trainer per squad or a minimum ratio of 1:12, which ensures cold weather expertise is integrated at every level. To minimize cold weather injuries and increase unit effectiveness in cold weather operations, cold weather instructors should be produced from leadership at every echelon, from squad to battalion operations shop.

This ensures that cold weather expertise is inherently built into every echelon of decision making and tactical employment of the formation. The division and MEF documents implicitly acknowledge the significant problem of throughput to train the required number of cold weather cadre within a unit by addressing another essential facet of effective cold weather training: the venue. Specifically, they list approved courses that Marines can attend to satisfy this requirement as the Service's Mountain Warfare Training Center (MWTC), joint command cold weather programs within the United States, and Nordic partner nations' cold weather programs. While the joint cold weather programs have benefits, this article focuses on the Nordic or NATO programs because they are required as a prerequisite to participate in NATO exercises above the Arctic Circle and bring the added benefit of developing interoperability and integration with NATO Allies.

## The Burden on MWTC: Scope and Throughput

The Winter Mountain Leaders Course at MWTC is the service's primary venue for training cold weather subject-matter experts (SME). *MCRP 3-35.1B*, *Mountain Leader's Guide to Winter Operations,* serves as a reference, according to its foreword, "for trained winter mountain leaders to use during operations in the snow."[3] This statement significantly downplays the complexities of cold weather operations but neatly encapsulates our underdeveloped understanding of training and operating in the cold. The foreword admits that rapid personnel turnover, a short winter season, and numerous training commitments prevent MWTC from meeting the Service's training requirements, thereby complicating the II MEF cold weather policy prescriptions.

The training center in California was first established in 1951 for the Cold Weather Battalion, tasked to provide cold weather training for replacement personnel bound for Korea. As its current name offers, MWTC is, first and foremost, a *mountain warfare* training center and is good at its namesake. The base center is cited at 6,762 feet in elevation, the training areas reach nearly 12,000 feet, and the winter season, though relatively short, can provide six to eight feet of snow and temperatures of negative twenty degrees Fahrenheit. To no fault of the exceptional MWTC staff, the Service's bid for cold weather training success was placed at a world-class training facility where extreme cold weather and heavy snowfall are the mountain's seasonal conditions, not the training's emphasis. MWTC does not offer a "Winter Leader's Course." They are *mountain leaders courses* with winter or summer concentrations. All courses at MWTC train and educate students on the impacts of compartmentalized, mountainous terrain on warfighting functions like movement and maneuver, command and control, force protection, and fires. MWTC emphasizes the mountainous operations, as they have the staff and facilities to do so.

MWTC offers two iterations of the Winter Mountain Leader's Course from January to April, which is meant to produce the Service's premier cold weather experts and command advisors. These two courses make a maximum of 90 winter mountain leaders each year to support the entire FMF. The course's instructor cadre comprises Marines trained at MWTC's Summer and Winter Mountain Leader's Courses. They are certified in operational risk management and systems approach to training and education, receive formal instruction experience, and are designated basic mountain warfare instructors (MWI). Though tremendously capable individuals, these MWIs are only privy to the knowledge and experiences provided by the same institution in which they will instruct, resulting in a closed loop of information and practices being passed onto themselves repeatedly. Only about twenty percent of the MWIs receive further certification to become senior or master instructors. Considering the MWI must be proficient in mountaineering in any climate, only some of these additional certifications are related to cold weather training. Sending MWIs to subsequent courses proves time-consuming and expensive for the limited human resources, and their proficiencies need to cover diverse skills like swift water rescue, rigging, and rock face climbing. Developing true mastery in cold weather operations is a competing requirement among the MWI's responsibilities. Those who spend the requisite years to earn follow-up certifications spend considerable time away from instructing, and many will not receive orders back to MWTC to propagate their fortified knowledge.[4]

***To minimize cold weather injuries and increase unit effectiveness in cold weather operations, cold weather instructors should be produced from leadership at every echelon ...***

## Leveraging Centuries of Experience

With its extensive history in cold weather warfare, Norway offers un-

paralleled expertise in training military personnel for such environments. The Norwegian-sponsored Centre of Excellence–Cold Weather Operations (COE-CWO) is one of only three NATO COEs, and it offers several cold weather courses, including the NATO Winter Instructor Course. This course is praised for its comprehensive curriculum that covers many of the same training objectives as Winter Mountain Leaders, both placing particular emphasis on training the individual to, in turn, train their home units. Both use historically relevant case studies and practical applications in the austere training areas to demonstrate the impact that winter conditions and mountainous terrain have on operations and sustainment. A critical difference between the two winter courses is that the Norwegian hosts truly understand this environment from living their entire lives in it, just as their ancestors and neighboring ancestors have for centuries. A considerable issue differentiating Winter Mountain Leaders from Norwegians and sister Services like the Army is their time and experience in the cold weather environment to qualify them as SMEs.

In contrast to our Norwegian counterparts who grow up in the extreme cold and are trained by the same, our cold weather SME, the Marine Winter Mountain Leader, was taught by a cadre with limited qualifications with the *MCRP 3-35.1B* mentioned above to serve as a largely singular reference for "operations in the snow." The difference between the cultural starting points and frames of reference for understanding the impacts of the environment is significant. As just one example, the indigenous people of Scandinavia's northernmost reaches, known as the Sámi, have over 200 words in their language to describe snow.[5] Each unique term characterizes the snow in ways that articulate critical details like trafficability, shifting weather patterns, or susceptibility to avalanches. Each word is packed with meaning like a "verbal combined obstacle overlay," relating tremendous meaning regarding the impact of the environment on people and things. This comprehensive understanding is vital to the Sámi, as their livelihood depends on semi-nomadic herding of reindeer across vast expanses of arctic terrain with complex and fluctuating conditions. Although the Sámi and Norwegian lineages are distinct, they share the same terrain and many of the same practices.

Similarly, the Norwegian language has over 100 terms to describe snow for the same reason. When the conditions dominate everyday life for up to seven months out of the year, it becomes necessary to communicate "wet snow that has frozen to the ground and became hard" and "light snow that is drifting but spread out" as simply *skare* and *heideska*.[6] The Norwegian and Sami cultures are intertwined with the climate in which they exist, a climate the Marine Corps needs to be prepared to dominate. Their culture is centered around the cold and snow in agriculture, transportation, construction, and recreation. Children are taught from a young age the hazards of living in the extreme cold, preventing and identifying common cold weather injuries, and even performing ice breakthrough drills in school to rehearse if such a thing were to happen. Those who serve in the Norwegian Armed Forces (Forsvaret) have their lifetime of experience, plus generations of those before them, to thrive in the environment that is home to them. By fully integrating with these courses and the instructors they provide, the Marine Corps can tap into a limitless pool of knowledge and experience. Experience already integrated into the Norwegian NATO COE curriculums but lacking in CONUS training options.

***Developing true mastery in cold weather operations is a competing requirement ...***

## Bridging the Gap

II MEF, specifically 2d MarDiv units, have benefited from the Norwegian NATO COE-CWO for years to hone and develop cold weather skills and fill Service deficiencies in training quality, throughput, and equipment sourcing. The Service should formally recognize these NATO COE cold weather programs and assign course identification codes. Select experts at MWTC could audit these courses through the previously recommended cold weather exchange program for official recognition by Training and Education Command. Commanders have no formal mechanism to track and identify Marines who have already attended NATO COE courses, which obstructs talent management within the FMF. A simple and necessary solution is to formalize these programs with CIDs to enable the Service to properly track the skills of its cold-weather instructors as they move from unit to unit. This could also allow the Service to make more effective MWTC instructors by tracking Marines with high certification from NATO COE-CWO to serve at MWTC and get more impact from their short time there.

Further, the NATO COE courses could serve as an official relief valve for the student throughput that MWTC struggles with. In the long term, this sets the foundation for an enduring exchange program with the Norwegian cold weather experts, similar to the one already with the British Royal Marines. Though potentially not the case in all Nordic countries, Forsvaret mandates that every foreign service member that trains in Norway, in any capacity, be trained in cold weather basics. The Norwegian NATO COE made it clear that the Marine Corps' Winter Mountain Leaders fall below the standard accepted by the Norwegians to certify primary cold weather training instructors necessary to make a unit effective. A Norwegian instructor on staff at MWTC could advocate any changes required to update this relationship, thus potentially certifying more trainers in CONUS.

Within the past year, MRF-E 23.1 and elements assigned to Nordic Response 24 have leaned heavily into the Norwegian Centre of Excellence's courses to prepare for named exercises above the Arctic Circle, namely by send-

ing key leadership at echelon to NATO Winter Instructor Course. These Marines' training was complimented by the training previously executed at MWTC and made for a more informed cohort of cold weather specialists. This resulted in greater survivability across the force. According to MCRP 12-10A.1, *Small Unit Leader's Guide to Mountain Warfare Operations,* "a standard Marine Corps infantry battalion suffers 15 to 30 injuries during summer operations and 30 to 45 injuries during winter operations while training at the MCMWTC."[7] From this, it can be inferred that fifteen injuries can be attributed uniquely to the cold during mountain exercises that typically last less than two months. MRF-E 23.1 sustained seven cold weather injuries in a battalion of 611 Marines from January to April 2023 while executing unit cold weather training, company-level live-fire events, and the ten-day Joint Viking 23.

Additionally, II MEF has already begun recognizing some of the equipment disparities between individual issues items used at MWTC compared to deployments to the high North. They have considered after-action reports that echo Norwegian advocation for things like wool base layers and leather boots and apprehension toward GORETEX or cotton blends. II MEF Unit Issue Facility (UIF) now offers the coveted wool mesh base layer and cap to units slated for cold weather operations or training. Every UIF must follow suit as the same issues are felt by FMF units drawing from IMEF UIF. Multiple rotations of MRF-E have found the "Mickey Mouse" boots woefully inadequate for sustained operations due to their inability to manage moisture properly. The Norwegian overboot is a perfect low-cost solution at roughly $90 per pair. When paired with the UIF-issued extreme cold weather boots and quality Moreno wool socks, these overboots work very well. Even better is the Norwegian overboot combined with their simple and durable leather boot, which locks into the overboot directly. Unfortunately, no U.S. company produces a similar overboot, and the current fiscal policy with the Buy America Act hinders UIF from stocking these proven and better-quality items. For these reasons, the Service must seriously consider a persisting partnership with the Norwegian COE staff to promote international collaboration on best practices for cold weather operations. The direct partnership will affect change faster than years of after-action reports. The MWIs at MWTC are true professionals in mountaineering, but squandering an opportunity to cross-train with proper subject-matter experts in cold weather operations and survival would be irresponsible for the growth of the force. This partnership would prove mutually beneficial and present no risk. There is enough evidence to infer a causal relationship between integrating Nordic practices and unit capability.

**While still being refined, 2d MarDiv's efforts with II MEF have significantly addressed Service gaps in cold weather training and equipment.**

## Conclusion

The only thing more dangerous than no training is inadequate training. We tolerate the latter by delaying the opportunity for one of our most specialized training centers to collaborate with globally recognized experts in cold weather operations. Openly pursuing a partnership with our allies that possess a more thorough understanding than we do sets a healthy precedent and begins to solve the deficiency in the capability we can organically provide regarding military operations in the austerity of frigid climates where we will be expected to fight and win. While still being refined, 2d MarDiv's efforts with II MEF have significantly addressed Service gaps in cold weather training and equipment. The Service must follow this lead and take the necessary next steps for progress to continue. Service recognition of the Norwegian NATO COE-CWO curriculum strengthens interoperability and the partnership. It corrects many of these training and equipping deficiencies, thereby addressing the 38th Commandant's warning about readiness in diverse environments, including cold weather.

### Notes

1. Gen David H. Berger, *Force Design 2030: Annual Update June 2023,* (Washington, DC: 2023).

2. Mauricio Nicolas Vergara PhD, "Nature's Tragic Role at the Alpine Front during World War I," *Journal of Advanced Military Studies* 13, No. 1, (2022).

3. Headquarters Marine Corps, *MCRP 12-10A.2, Mountain Leader's Guide to Winter Operations*, (Washington, DC: 2018).

4. Patrick Kinser, "The Making of a Mountain Warfare Instructor," *Marine Corps Air Ground Combat Center Twentynine Palms*, February 26, 2010, www.29palms.marines.mil/Articles/Article/498757/the-making-of-a-mountain-warfare-instructor.

5. Condé Nast, "What We Can Learn from the Sámi Tradition of Reading Snow," *Condé Nast Traveler*, December 2020, www.cntraveler.com/story/what-we-can-learn-from-the-sami-tradition-of-reading-snow.

6. Holmen Lofoten, "Words for "Snow,"" *Holmen Lofoten*, April 26, 2020, www.holmenlofoten.no/words-for-snow.

7. Headquarters Marine Corps, *MCRP 12-10A.1 Small Unit Leader's Guide to Mountain Warfare Operations*, (Washington, DC: 2018).

# Littoral Mobility via Small Boats

**What's our heading?**

by 2d Assault Amphibian Battalion

> ***"Since men live upon the land and not upon the sea, great issues between nations at war have always been decided-except in the rarest cases either by what your army can do against your enemy's territory and national life or else by the fear of what the fleet makes it possible for your army to do."***
>
> ***—Julian S. Corbett***

> ***"The littoral environment is where we will fight our future battles, and the Marine Corps must be prepared to operate in this dynamic and challenging environment."***
>
> ***—Gen David H. Berger, 38th Commandant of the Marine Corps***

As described in the *Maritime Expeditionary Warfare Report 2023*, released by the Marine Corps Capabilities Development Directorate, "The Marine Corps' interest in combatant craft (small boats) is focused on capabilities for littoral maneuver and security, as well as littoral reconnaissance and counter-reconnaissance (RXR)."[1] The *Maritime Expeditionary Warfare Report 2023* goes on to highlight I MEF and III MEF investments into continued support to the experimentation, integration, and development of tactics and utility of small boats for littoral RXR in EABO and littoral maneuver.[2] Yet, throughout the report, there is no mention of the 2d MarDiv, II MEF's small boat experimentation and force generation efforts. This includes 2d MarDiv's trained, evaluated, and forward-deployed small boat detachments—an apparent yet significant disconnect. From the various players and platforms exploring and experimenting with littoral mobility, there is a need for Service synergy and a holistic approach toward implementation. Does the Marine Corps intend to be in the small boat business long term? In this respect, is the Service best managing its finite resources? Disjointedness abounds regarding small boat employment, and there is a severe lack of Service-directed focus toward littoral maneuver initiatives; a new heading under a unified vision is necessary.

*Force Design 2030* directed the Marine Corps to strengthen its ties with the Navy and support distributed maritime operations. In implementing this approach, the 38th Commandant of the Marine Corps, Gen David H. Berger, said, "As the preeminent littoral warfare and expeditionary warfare service, we must engage in a more robust discussion regarding naval expeditionary forces and capabilities not resident with the Marine Corps, such as coastal/riverine forces, naval construction forces, and mine countermeasure forces."[3] Likewise, *Force Design 2030* guidance and the operational concepts of Stand-In Forces and expeditionary advanced base operations (EABO) describe a future where Marines exploit the maritime domain for maneuver, logistics, and sensing using various manned and unmanned surface and aerial platforms. In this regard, initial ventures into Marine Corps small-boat employment have attempted to align broader Navy and Marine Corps interoperability. After-action reports and lessons learned from 2d MarDiv's Battalion Landing Team (BLT) 1/8, 24th MEU following redeployment in 2022 indicated that without Amphibious Assault Vehicles (AAVs) or Amphibious Combat Vehicles (ACVs), the lack of surface connectors imposed significant limitations on the Amphibious Ready Group (ARG) and MEU's littoral mobility. At the same time, back at home stations, the Service's three MEFs and Marine Forces Reserve (MFR) increased efforts to expand the Marine Corps' role in littoral mobility mission sets, especially by way of small boats.

Still, these initiatives need a unified vision to not detract from the economy of force.

Operating absent Service guidance and independent of one another, several units across the Marine Corps are experimenting with small craft. For example, in 2020, the 15th MEU deployed with Marine-operated small boats to support over-the-horizon reconnaissance and scouting. In this capacity, Marines from the First Light Armored Reconnaissance Battalion (1st LAR Bn), 1st MarDiv, operated eleven-meter Naval Special Warfare (NSW) Rigid Hull Inflatable Boats (RHIBs). A year later, in 2021, the 24th MEU deployed with reconnaissance Marines operationally trained on the eleven-meter RHIB to augment existing Navy boat crews in their visit, board, search, and seizure (VBSS) mission. Furthermore, in 2023, the Second Assault Amphibian Battalion (2d AABn), 2d MarDiv, built a formal training pipeline, including Navy-supported standard operating procedures, to task-organize a littoral mobility boat detachment that deployed with BLT 1/6, 26th MEU. Likewise, 2d AABn also trained and task-organized a boat detachment to BLT 1/8, 24th MEU, scheduled for deployment in 2024; another 2d AABn boat detachment is in its generation phase and will deploy with BLT 3/6, 22nd MEU, in 2025. All to say, positive work has been done across the Service in the small boat domain. However, the good idea cut-off time has come, and lessons learned need now be captured and applied for more efficient application of resources and better Service collaboration.

***Operating absent Service guidance and independent of one another, several units across the Marine Corps are experimenting with small craft.***

## 2d AABn Small Boat Detachment Development and Experimentation in Lieu of ACVs

Beginning in earnest in 2019, the Marine Corps commenced the transition from the legacy AAV to the next-generation ACV. During this process, in the wake of the tragic July 2020 AAV accident that claimed the lives of eight Marines and one sailor, the CMC signed an indefinite moratorium (outside major theater contingencies) on waterborne AAV operations in September 2021. This resulted in the immediate cessation of AAV deployments in support of MEUs. Consequently, critical 1000–6000 level amphibious operations training and readiness standards and general operational experience have measurably atrophied across the assault amphibian (AA) community. Presently, zero percent of 2d AABn's company-grade officers, three percent of its staff non-commissioned officers, and five percent of non-commissioned officers have conducted amphibious operations in their assigned AA billets. Shortly after that, due to a confluence of factors, the Service reprioritized ACV fielding causing a delay to II MEF units. Already lacking in AAV waterborne operations, ACV fielding delays significantly reduced the amphibious lift and amphibious combat capability of the 2d AABn and the 2d MarDiv, particularly toward mission-essential tasks.

Moreover, the lack of AA operations across the broader Service created obvious and considerable risk. For example, often described as one of the most complex military operations, the 2020 Marine Corps University Press release, *On Contested Shores: The Evolving Role of Amphibious Operations in the History of Warfare*, described the amphibious assault as "the most challenging type of military operation."[4] That said, it is worth pointing out that upon ACV receipt, it will have been well over five years since Marines and sailors from the 2d AABn last conducted amphibious training from an AA platform. The ACV fielding plan forecasts II MEF fielding in the first quarter of fiscal year 2025; at this point, zero percent of 2d AABn will have conducted amphibious operations in their respective AA positions.

Nevertheless, 2d MarDiv and the 2d AABn focused beyond the new platform and on the capabilities that AA Marines offer MEUs and the broader fleet. Capitalizing on historical naval integration, training, education, and presence in the maritime domain, 2d AABn immersed itself with littoral mobility skillsets. Instead of ACV fielding, 2d AABn took the lead role of small boat experimentation to generate deployable, combat-ready formations supporting Global Force Management requirements as a part of II MEF.

To mitigate the risk of further degradation of AA skills and naval integration, 2d AABn maintained its

***2d AABn Marines with the 26th MEU aboard the USS* Mesa Verde *(LPD-19) conduct maritime reconnaissance while operating in the Mediterranean Sea, 6 February 2024.* (Photo by SSgt Jesus Sepulveda Torres.)**

amphibious capacity via small boats. 2d AABn incorporated littoral mobility by sourcing maintenance, logistics support, and training from across the DOD and external contracts coordinated with local vendors to sustain the materiel readiness of its boat locker. 2d AABn utilized unit-owned seven-meter and eleven-meter RHIBs for CONUS-based training. In 2021, 2d AABn procured four seven-meter RHIBs from the U.S. Navy Surface Warfare Center, Caderock Division Norfolk. In 2022, the unit procured two eleven-meter NSW RHIBs from California's Surface Warfare Center's Boat Inventory Manager. Upon composite with the MEU, Marines operate the organic ARG RHIBs per a Memorandum of Agreement between the ARG/MEU leadership. Per tables of equipment, small craft assigned to ARG ships are seven-meter RHIBs, eleven-meter NSW RHIBs, and eleven-meter Willard RHIBs.

By implementing *Force Design 2030*, 2d AABn utilized small boats to create effective and deployable teams. Doing so also enabled 2d AABn to gather valuable experimental data for future concepts and retain AA expertise. The certified boat teams trained by 2d AABn can perform a range of crucial tasks, including ship-to-shore movement, deception, and scouting, as well as providing added maneuverability and security for ARG/MEU operations on various fronts.

As noted, 2d AABn's small boat capabilities are deployed with the 26th MEU and are in pre-deployment training with the 24th MEU. For the 26th MEU, the ARG sourced six eleven-meter RHIBs for 2d AABn Marines to operate. Across the ARG, 2d AABn Marines assigned to the 26th MEU have conducted decentralized operations between the Dock Landing Ship and the Amphibious Transport Dock, with three VBSS-focused crews on one ship, and three littoral maneuver-focused crews on a separate ship. 2d AABn's boat detachments consist of (28) Marines: (6) 3-man boat crews, a maintenance detachment (trained mechanics can also serve as a boat's fourth crewman), and a detachment commander/staff non-commissioned officer-in-charge. The detachment can man up to six craft and conduct unified or split-ARG operations.

2d AABn developed a robust and efficient littoral mobility training and certification pipeline to meet and deliver capabilities to the MEU. Derived from Navy formal schools and Coast Guard procedures for small boat operations, 2d AABn trains and certifies boat teams in nine months. Training for small boat detachment coxswains consists of three levels. Level 1 coxswain training consists of basic familiarization, on-the-job training, and the North Carolina Boater Safety Course or Boat U.S. Foundation Online Boating Safety Course. Level 1 coxswain-trained Marines are not authorized to operate RHIBs. Level 2 coxswain training consists primarily of the Navy's Center for Security Forces Coastal Riverine Force (CRF) Coxswain Level I course. Completing this course certifies operators on the eleven meter jets and eleven-meter NSW RHIBs. Notably, these are the same training courses attended by U.S. Navy boat crews assigned to the ARG. Finally, Level 3 coxswain training increases proficiency in tactical small boat operations. This training includes the Center for Security Forces' Level II Coastal Riverine Force CRF Coxswain Course, Crew Served Weapons Course, and VBSS I. In total, the in-depth formal small boat training continuum lasts nine weeks.

***... 2d AABn's small boat detachments have swiftly adapted to changing circumstances ...***

Additionally, from a materiel readiness standpoint, 2d AABn's boat detachments also provide maintenance capability through Marines who have attended the Navy's Surface Warfare Schools Command RHIB Maintainer course, Expeditionary Warfare Training Group Pacific Caterpillar Diesel Engine Mechanics Course, and the Surface Warfare Schools Command Cummins Diesel Mechanics Course. The Marine maintainers also assist Navy boat teams in maintaining organic ARG equipment, collectively improving readiness through blue/green collaboration.

Significant efforts have also been made to equip 2d AABn small boat detachments with a robust communications infrastructure. In the dynamic and challenging maritime environment, extensive communications for a littoral mobility maneuver unit are indispensable for seamless coordination, information dissemination, maintaining momentum, and overall operational control. 2d AABn's small boat detachments possess an array of advanced communication assets that include but are not limited to very high frequency, ultra-high frequency, and Mobile User Objective System on the move. Integrated into the ARG/MEU's overarching network, 2d AABn's small boat detachments have swiftly adapted to changing circumstances, responded to emerging threats, and coordinated their actions with higher and adjacent naval assets to thereby contribute to the wider success of the ARG's operations.

In addition to the Navy-led formal licensing, mechanical, and operational employment schools, 2d AABn cross-coordinated and constructed a rigorous pre-deployment training pipeline with the Navy before change in operational control (CHOP). For example, before the 26th MEU, 2d AABn's small boat detachment conducted multiple seven to ten-day underway periods with the ARG's USS *Mesa Verde* and the USS *Carter Hall*. Actions included integrated planning with deck crews for launch and recovery operations and the successful execution of littoral maneuvers in the form of BLT raids, VBSS, a forward-deployed defense in depth, EABO resupply, sensor structure development, coastal patrolling, and port security operations. Doing so created early interoperability with the ARG, exposed Marines to MEU littoral operations, and better prepared the small boat teams for certification through BLT 1/6 and 2d AABn's Pre-CHOP

Marine Corps Combat Readiness Evaluation. Upon CHOP to BLT 1/6, 2d AABn's small boat detachment entered the MEU's pre-deployment training program, achieving training and certification again through the Expeditionary Operations Training Group. 2d AABn Marines assigned to small boat detachments supporting the 24th and 22nd MEUs have followed the same path focused on littoral and distributed operations addressed in *Force Design 2030*. This thorough and codified approach to organize, man, train, equip, and employ Marine-led boat crews is an important takeaway that should be considered by the Marine Corps Combat Development Command in its efforts to standardize small boat training pipelines and fulfill littoral mobility requirements.

## 2d AABn Lessons Learned

Data points and lessons learned from forward-deployed small boat operations and CONUS-based training all prove tactical and operational-level success resulting from 2d AABn's littoral mobility initiative. As mentioned, Marine-operated small boats provide highly trained resources and additional capacity to the ARG commander across the spectrum of littoral operations, particularly in green-to-brown-water transition areas or in riverine environments. As a multi-purpose asset, 2d AABn's small boat detachments have also provided increased mobility, scouting, and screening capabilities, enhancing ARG/MEU reach and effectiveness. Also, unaccompanied by AAVs or ACVs, 2d AABn's small boat detachments have primarily supported the BLT as a littoral-lift company facilitating maneuver in the maritime domain at high speeds and long ranges. For example, (4) eleven-meter RHIBs can transport a reinforced infantry platoon or another similar task-organized unit of up to 40–50 Marines, 190 nautical miles at 40 knots and in challenging conditions up to sea state 3 (wave heights averaging 2 feet with winds of 14–16 knots). Of significance, this range and speed permit over-the-horizon operations and greater distribution for landings, raids, or deception operations.

Furthermore, 2d AABn's small boat detachments serve the littoral mobility mission in a dedicated capacity. Not tied to a ship's company, and because of their robust training regimen of Navy and Coast Guard formal schools conducted in conjunction with Marine Corps warfighting functions, 2d AABn's scalable boat teams have enabled commanders' flexibility for the MEU and ARG. Likewise, Marine boat teams have improved troop-to-task and resource management of Navy boat crews by allowing sailors to cross-deck the ARG. On the other hand, ARG sailors employ small craft and serve littoral tasks as a collateral duty or in a safety/general-purpose responsibility, often removing their specialty skills from where they are most needed. Trained through a maneuver warfare lens to provide dedicated capability, results generated by 2d AABn's boat teams give credence to the consideration for the Navy and Marine Corps to permanently assign Marines to the ARG/MEU's littoral mission requirements.

## Small Boat Initiatives and Operations Across the Marine Corps

Acknowledging the extensive work done by 2d AABn, 2d MarDiv, and II MEF to generate forces and combat capability through small boats, it is critical to point out that various other stakeholders are vying for this investment, too. Multiple Marine Corps units operate autonomously without funded programs of record or Service-specific direction to solve the littoral mobility shortfall. In other words, recognizing the unique challenges posed by littoral environments, where coastal and shallow waters demand specialized vessels, several Marine Corps units have embarked on distinct initiatives to procure or develop suitable craft and operational designs. In congruence with Corbett's "fleet perspective" and the *38th Commandant's Planning Guidance*, these distinct and separate small-boat initiatives reflect the shared recognition for increased littoral capabilities in dynamic maritime theaters that support broader naval campaigns. But what is our unified heading?

Besides 2d AABn, other FMF units and MFR also conduct small boat concept development and experimentation. Also within II MEF, 2d MLG is heavily involved in maritime distribution and littoral sustainment exploration across multiple lines of effort. 2d MLG actively operates and employs the AMY and RECKLESS general-purpose unmanned surface vehicles for littoral distribution and route proofing. 2d MLG also utilizes an organic 42-foot riverine craft for experimentation and small boat crew proficiency training. From a cross-coordination standpoint, 2d MLG has regularly engaged with Norwegian, Finnish, and Swedish maritime forces focusing on crew training and littoral distribution, including interoperability training with the 50-foot Swedish SAAB Docksta CB-90 and 82-foot LSV Fast Supply Boat. 2d

***2d AABn Marines with Maritime Special Purpose Force and BLT 1/8, 24th MEU, conduct VBSS training aboard the James River Reserve Fleet near Joint Base Langley-Eustis, VA, October 2023.*** ***(Photo by 1stLt Christian Guevara.)***

MLG also partnered with 2d MarDiv during Fleet Battle Problem 2023/ Large Scale Exercise 2023, leveraging 2d AABn's small boat detachments to execute maritime logistics, manned-unmanned teaming, and maritime medical evacuations.

Separately, in I MEF, 1st LAR Bn and First Reconnaissance Battalion (1st Recon Bn) have partnered to procure and crew eleven-meter RHIBs in support of West Coast MEUs, performing a variety of missions, with a focus on VBSS operations, maritime domain awareness, littoral reconnaissance, and specialized insertion operations.[5] Like 2d AABn small boat detachments, 1st LAR Bn Marines crew eleven-meter NSW RHIBs and serve as the boat assault force for VBSS operations. In previous years, ARG sailors served on the boat assault force as a collateral duty. Also, as with 2d AABn's small boat detachments, 1st LAR Marines dedicated to manning boats and supporting VBSS teams have afforded ARG/MEU commanders the capability of adequately trained and highly skilled teams to execute VBSS tasks.

Outside of VBSS operations, 1st LAR Bn and 1st Recon Bn also focused on maritime/littoral reconnaissance and maritime domain awareness. In contrast, 2d AABn focuses on littoral mobility, lift, and security operations. In coordination with the Marine Corps Warfighting Lab (MCWL), 1st LAR Bn will begin to experiment with Multi-Mission Reconnaissance Craft (MMRC) in the coming months. Utilizing a variety of configurations, the MMRC has been in capability development for several years as part of *Force Design 2030*, placing a premium on increased reconnaissance capability, survivability, lethality, and endurance over the eleven-meter NSW.[6] Continued experimentation between MCWL and 1st LAR Bn will focus on small boat operations in a distributed maritime environment supporting EABO.[7] Undoubtedly, I MEF units have gained valuable lessons and insights that accompany those achieved by II MEF, but they also operate exclusively on Service-direction and resource prioritization no less.

Moreover, MFR has also set conditions to procure two different yet complementary small boat platforms utilizing nearly twenty million dollars of National Guard Reserve Equipment Appropriations. In October 2023, Headquarters Marine Corps formally redesignated two AA companies within 4th AABn, 4th MarDiv, Marine Forces Reserve, as littoral craft companies (LCCs). The LCCs will operate a variant similar to the MMRC and made by the same vendor: the Whiskey Project Group. While separate from the MCWL-led littoral maneuver/mobility experimentation with 1st LAR Bn, 4th AABn's efforts are complementary. Moreover, 4th AABn's newly created LCC will provide littoral mobility support to Marine Special Operations Command during Exercise Raven 2024, deploy a contingent of LCC Marines to Sweden in the summer of 2024 for interoperability training with Swedish small boat crews as part of Exercise Archipelago Endeavor, and deploy to U.S. Southern Command's area of responsibility for small boat theater security cooperation missions in the summer of 2024 with the Colombian Marine Corps. More to these ends, MFR and the 4th AABn are developing Marine Corps tasks, mission essential task lists, and training and readiness standards to inform structural changes and doctrine, organization, training, materiel, leadership and education, personnel, and facilities requirements that accommodate small boats.[8] Comparable to 2d AABn, as an alternative to AAVs and ACVs, 4th AABn is bridging the AA experience gap through littoral mobility and small boats.

## The Way Forward and the Need for a New Heading

The time has come to capitalize on the lessons learned from littoral mobility experimentation via small boats to avoid further Service-wide disjointedness and mismanagement of resources. Numerous questions require Service answers, synergy, and a holistic approach: Which concept development efforts have borne sufficient fruit and shown sufficient value? Have Marine-led small boats enhanced the capabilities of supported commanders to the point that there will be continued demand from Navy and Marine senior leaders? What is the most efficient and effective platform? Which unit is best suited to own and operate a small craft? And, as with all things, can the Service afford it?

***Littoral mobility via small boats directly aligns with* Force Design 2030*, expands commanders' flexibility, supports the Naval fleet(s), and improves the Service's amphibious capability.***

Littoral mobility via small boats directly aligns with *Force Design 2030*, expands commanders' flexibility, supports the Naval fleet(s), and improves the Service's amphibious capability. However, several units are doing roughly the same mission in different ways. It is prudent for the Marine Corps to capture the littoral capabilities gained and the many lessons learned through small-boat exploration. As it applies to the question of who owns and operates small craft, is LAR the best suited for this task? MLG? Recon? AA units? Doctrinally, there are significant overlaps in small boat and AA littoral/riverine operations. Littoral mobility requirements are similar to AA units' tasks to serve as a surface connector and provide lift to the supported unit. Like small boats, AA unit training and education focuses on operator, crew, and section-level qualification and certification standards. AA units are also staffed and well-equipped to

***2d AABn Marines with Maritime Special Purpose Force, 24th MEU, conduct open-sea, eleven-meter rigid-hull inflatable boat operations during Amphibious Squadron, MEU Integration in the Atlantic Ocean, December 2023.*** ***(Photo by GySgt Merle Bolton.)***

perform preventative and corrective maintenance for diesel powerplants and aluminum hulls.

However, as mentioned, the ACV will likely arrive at 2d MarDiv, II MEF, in the first quarter of fiscal year 2025. Correspondingly, ACV operations will take priority, and 2d MarDiv will sundown its small boat initiative upon redeploying 2d AABn's littoral mobility support to the 22nd MEU. 2d AABn and the AA community do not have the manpower or capacity to sustain littoral mobility and ACV operations without a change (growth) in structure. 2d AABn's small boat detachment Marines will return to their respective AA formations with their equipment repurposed to MEUs and to support the CMC-directed Assault Amphibian Safety Boat program of record for ACV operations. Conveniently, the Assault Amphibian Safety Boat also calls for the use of eleven-meter RHIBs.

Ultimately, a unified vision for littoral mobility via small boats is first needed to focus efforts and maximize resources across the Marine Corps. Service-wide prioritization on sourced littoral mobility missions and by which units, utilizing what craft, should then follow. Through successful innovation, the 2d AABn and the 2d MarDiv have made substantial strides in this application, playing a pivotal role in the small-boat discussion. Given future warfare's accelerated and ever-changing characteristics, especially within the littorals, the Marine Corps must prioritize small-boat direction and efficiency. Let's chart a unified course and move out.

**Notes**

1. Headquarters Marine Corps, *Maritime Expeditionary Warfare Report*, (Washington, DC: 2023).

2. Ibid.

3. Gen David H. Berger, *Force Design 2030*, (Washington, DC: 2020).

4. Timothy Heck and B.A. Friedman, *On Contested Shores: The Evolving Role of Amphibious Operations in the History of Warfare* (Quantico: Marine Corps University Press, 2020).

5. Marine Corps, *Maritime Reconnaissance Platoon Training and Qualifications Standard Operating Procedures,* (Washington, DC: 2023).

6. *Maritime Expeditionary Warfare Report*.

7. Marine Corps, *Maritime Reconnaissance Platoon Capabilities Brief, 1st LAR Bn & 1st Recon Bn*, (Washington, DC: 2024).

8. Marine Corps, *Littoral Craft Company Training Continuum Brief*, (Washington, DC: 2023).

# Battles of Andrew Jackson

## Tactics in Conventional and Unconventional Environments

by Mr. Joseph Miranda

When conducting expeditionary warfare in the 21st century the commander can expect to fight in both conventional and unconventional environments. The spectrum of conflict runs from peer competitors to local insurgents. Maximizing the special abilities of forces can become critical to seizing victory.

Decision Games' *Andrew Jackson's Battles,* appearing in *Strategy & Tactics* magazine issue 346, includes two major battles of the War of 1812. The first of these battles is Horseshoe Bend (27 March 1814) in which a small American army under the command of GEN Andrew Jackson defeated the Red Stick Creek Indians (also known as the Muscogee) in their fortified encampment. The second is New Orleans (8 January 1815), where GEN Jackson commanded an army of regulars and militia defending a position against an assault by a veteran British army under the command of GEN Pakenham.

Both scenarios use a common game system and include their own maps and orders of battle. The game system is designed to model battles of the 18th and early 19th centuries. Units are usually at the battalion level with some special companies and are rated for their combat and movement values (the lower left and right numbers on the illustrated unit counters). There are functional differences between infantry, light troops, cavalry, and artillery (the latter can fire at range). The combat results table provides various outcomes, usually in terms of disruptions that cause units to lose combat effectiveness. They can be rallied to good order by making a check against their morale rating.

***>Mr. Miranda is a prolific board wargame designer as well as being the past editor of both* Strategy & Tactics *and* Modern War *magazines. His designs include a wide range of topics from the classical era to the near future, and have covered combined arms, low-intensity conflict, and hybrid operations. He is a former Army officer and has conducted numerous professional seminars on modeling and simulation. Mr. Miranda has also authored several Decision Games special interest publications to include an upcoming issue on the First Indochina War.***

Leaders are a major factor in play since they provide combat bonuses and enhance the ability of friendly forces in their vicinity to rally. The result of all this is that a small but highly trained army will have an edge over a larger but less disciplined force.

The War of 1812 was fought from 1812 to 1815 between the United States and Great Britain. The war began in part due to British impressment of American sailors into the Royal Navy, in part because there was a considerable faction in the United States pushing for the annexation of Canada (then a British colony), and in part because of British infringements on American sovereignty in what was then the western states between the Appalachians and Mississippi River. The United States declared war on Great Britain on 18 June 1812, and the British mobilized for another war in North America. While many of the big battles were fought along the U.S.-Canadian frontier and on the Great Lakes, another theater opened up in what was then the American Southwest, the territories that became the states of Alabama, Mississippi, Louisiana, and Florida. And it was on this frontier that Andrew Jackson came to the forefront.

### Maneuver at Horseshoe Bend

A major threat in the southwest territories was in the Indian tribes which had coalesced around what were termed the Red Stick Creeks (named after a war club they commonly used). The Red Sticks were supported by the British from bases along the littoral of the Gulf of Mexico. Andrew Jackson himself originally hailed from the Carolinas, later moving to Tennessee where he practiced law and became involved in the politics of the new state. On 30 August 1813 Creek warriors stormed Fort Mims in what is today Alabama. The U.S. government commissioned Jackson as a general of the militia. He then assembled an army of frontiersmen, volunteers, and allied Indians and marched south against the Creeks.

Jackson was known for being a stern disciplinarian, vital for keeping militia and irregulars in good order. He also trained his troops to high standards and provided supplies for his army, critical for health and morale. For all this, he became known as Old Hickory.

Over the ensuing months, Jackson won actions against the Creeks at Talladega (9 November 1813) and in several other minor fights. Still, the Creeks had plenty of fight left in them. Finally, Jackson led his army against the Red

Sticks at the Tallapoosa River in central Alabama. At a place on the river called Horseshoe Bend, Red Stick Chief Menawa fortified a position and waited.

Jackson's army was mostly militia and volunteers but also included the U.S. Army 39th Infantry Regiment (actually, a battalion in size). There was a sizable contingent of mounted riflemen (colloquially known as mounted gunmen) plus some Choctaw warriors. On 27 March 1814, the battle commenced.

Jackson's plan was to conduct a two-pronged attack. His regular infantry and militia would fix Menawa's warriors in their defenses while his deputy, GEN John Coffee, led the cavalry and Choctaws around to attack the Creeks from the rear. The ensuing battle was one of the hardest fought in the history of the frontier to this date, culminating in a fierce melee involving fixed bayonets, tomahawks, and sheer determination. Finally, the Creek morale broke and Jackson's men won the day. He followed up his victory by consolidating U.S. control of the southwest.

## Defense of New Orleans

The Louisiana Purchase of 1803 gave the United States control of the mighty Mississippi basin, vital for communications and trade in the west. New Orleans was the vital port controlling access to

***Horseshoe Bend: GEN Coffee's reconnaissance in force. Note: map detail shows only the southern flank of the battle.***

***U.S. forces: GEN Jackson has dispatched GEN Coffee with a maneuver force to move around the southern flank of the main Red Stick position on the Tallapoosa River. Coffee's force includes Russell's scouts, battalions of Tennessee and Volunteer mounted rifles, and a contingent of allied Cherokee warriors. Jackson himself is off the north edge of the map deploying his army for the anticipated assault on the Red Stick entrenchment and village.***

***Red Stick forces: The "Warband" marker is used to model the fog of war, with component units held off the map until revealed. The Warband includes the Eufaila warriors plus two smaller groups of scouts. It will not be until the U.S. forces move into proximity with the Warband that the component units will be placed in or adjacent to the marker's position, thereby providing valuable information about Red Stick dispositions.***

the river. The city became the target of a British expeditionary force commanded by GEN Edward Pakenham, a veteran of the wars against Napoleon Bonaparte. The Royal Navy, which dominated the Caribbean Sea, landed Pakenham and his army in mid-December 1814 with the goal of marching up the riverbank and taking the city. Jackson raced to New Orleans, beating Pakenham.

Again, Jackson assembled an army to include regular U.S. Army regulars, militia, freedmen volunteers, Indians, French settlers, Baratarian pirates, and a contingent from the Marine Corps. Jackson built defensive lines on each side of the Mississippi. The main entrenchment (or "Jackson") line was on the northeast side of the river, reinforced with bales of cotton (effective in absorbing incoming rounds). The right flank of the Jackson Line was anchored on the Mississippi River with the left flank screened by a cypress swamp which inhibited the movement of large units.

On the foggy morning of 8 January 1815, Pakenham launched his redcoat regiments against the Jackson Line. Jackson's men responded with accurate artillery, rifle, and smoothbore musket fire which shot up the advancing British columns. The assault was halted in some confusion. Pakenham himself was wounded and would die on the battlefield. Meanwhile, a British attack on the southwest bank of the Mississippi had succeeded in taking the American defenses there, though this move led nowhere. With further attacks on the Jackson Line rendered futile, the commander of the British reserve, GEN Lambert, broke off the action and withdrew the survivors from the field. The army embarked on ships and departed for bases in the Caribbean.

Jackson had won the battle by exploiting the strengths of his various unit types. He deployed the militia behind defenses where experience had shown they were more likely to maintain a steady defense. The regulars stiffened the entire position while the artillery swept across a cleared field of fire. This is shown in the New Orleans scenario with entrenchments providing additional benefits to the defense as well as a bonus for units making rallying attempts in them. And having leaders like Jackson up front further enhances morale and combat efficiency. Getting the right leaders to the right point can be decisive.

While New Orleans was fought after the Treaty of Ghent was signed (24 December 1814), the War of 1812 did not officially end until 17 February 1815 with Congressional ratification.

## Multi-Spectrum Victories

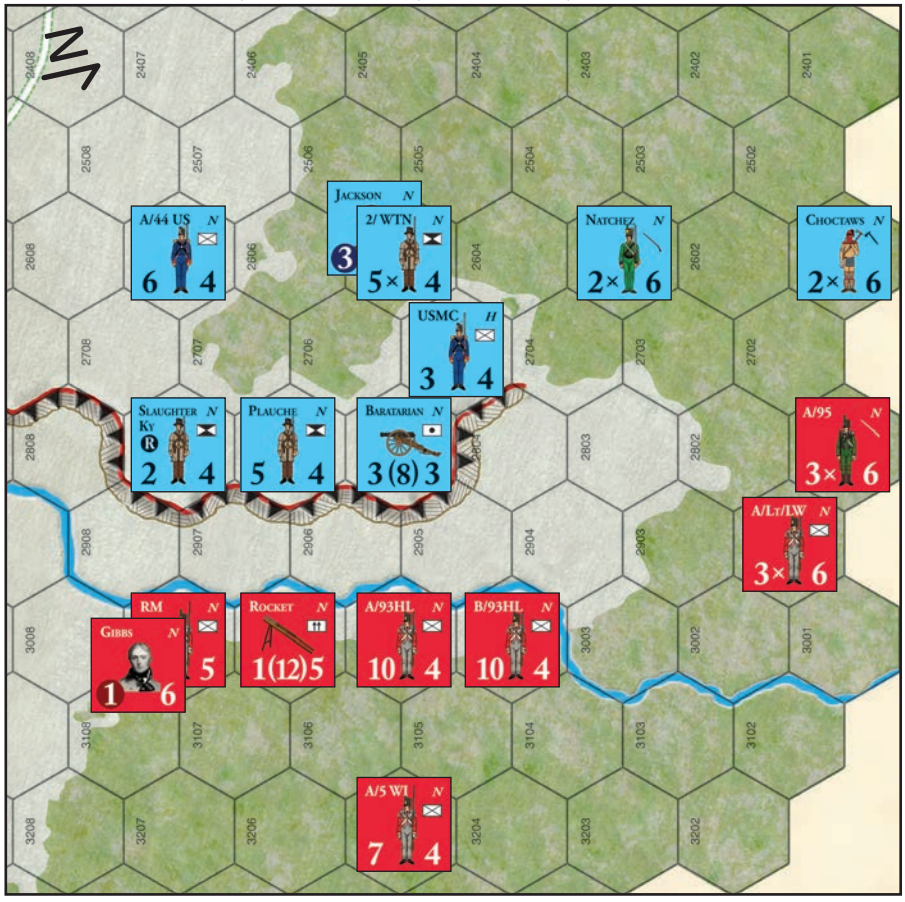
Both Horseshoe Bend and New Orleans had a political impact beyond the results of the battles themselves. Both battles established the viability of American arms against both conventional and unconventional foes and did much to open up the emerging frontier. They also showed the importance of selecting the best leaders to command armies on campaign.

USMC

***New Orleans, British assault against American left flank. Note: map detail shows only deployment on the northeast flank.***

***U.S. forces: The Line Jackson entrenchment left wing (left to right) includes Kentucky rifles, Plauche's militia, the Baratarian artillery, and a Marine battalion, the latter anchoring the open flank of the position. Backing the line is a detachment of the 44th Infantry, U.S. Army. Screening the far left flank are detachments of Natchez light infantry and Choctaw Indians. Andrew Jackson is rallying the 2/West Tennessee militia which was disrupted earlier in the action. The circled "2" is the unit's morale, which will modify the rally attempt.***

***British forces: GEN Gibbs commands a brigade to include (left to right) a battalion of Royal Marines, a rocket battery, and the 93rd Highlanders. 5th West Indian Regiment is in reserve. To the brigade's right are detachments of the 95th Regiment and converged light infantry companies. Both of the latter can exploit their mobility to work their way through the cypress swamp.***



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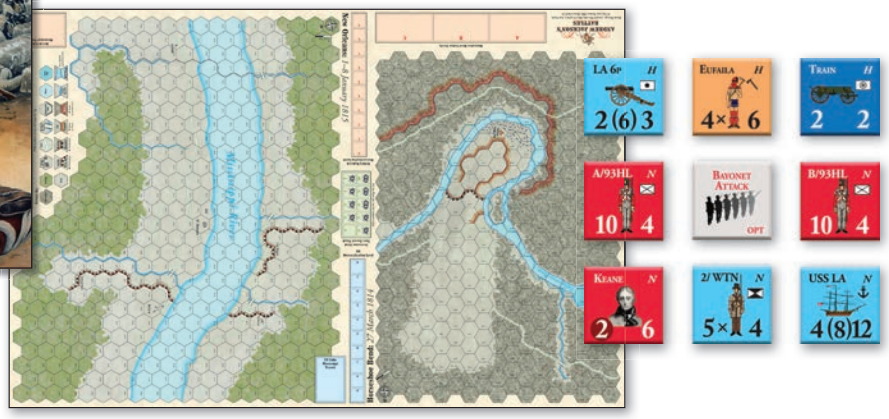
**Andrew Jackson's Battles** is a tactical simulation of battles on the American frontier during the early 19th century, concentrating on the two major actions (Horseshoe Bend and New Orleans) in which Andrew Jackson participated. While these battles often involved relatively small armies for the era, they proved decisive in shaping the future of the United States. Each game in the system is based on one battle of this period, with its own map, special rules and counters representing the military formations which participated in the original action. The rules model the overall effects of the weapons and tactics in an era in which regular tactics were tempered by frontier fighting, and include combat, leadership and morale.



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**Corrupt Bargain: The 1824 Presidential Election**. A 2-4 player game about the 1824 election (John Quincy Adams vs. Andrew Jackson vs. Crawford vs. Henry Clay) that was the first election in which no candidate achieved a majority in the Electoral College. In part because the constitution allowed for only the top three candidates to be considered by the House of Representatives, Clay (the fourth place candidate who was also Speaker of the House) threw his support to Adams (the second place candidate) and Adams was able to secure a victory with a majority of the vote by states. Players must decide with every play whether to focus on campaigning for the popular vote, the state vote, or gaining advantages. Games can generally be played in 60-90 minutes. Mounted game board of the United States in 1824, 200 cards including 80 event cards describing the various events during the election and the time period. Like **Bleeding Kansas**, the game mechanics are simple but tactical card play and strategic plans are plentiful. The game can also be played as a 2 or 3-player game, each with different strategies and potential paths to victory.

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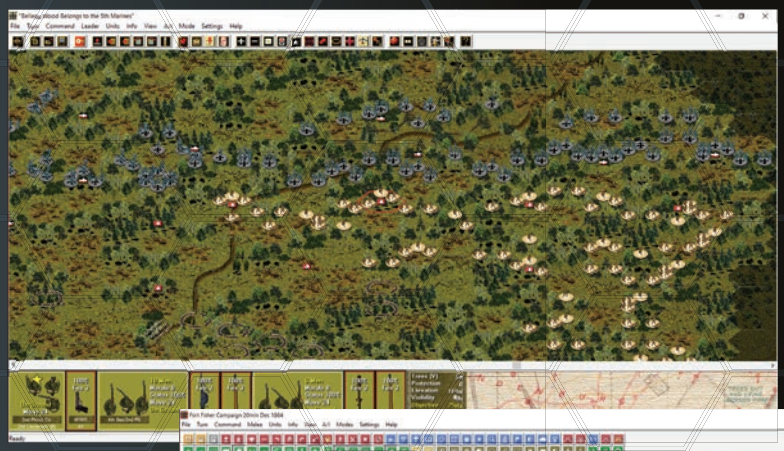

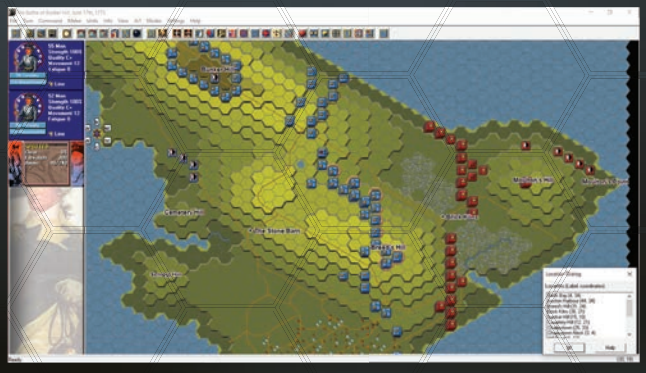


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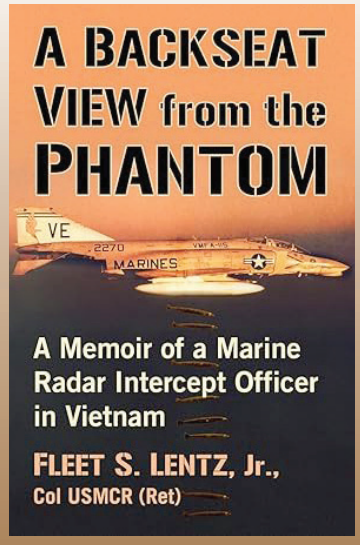
# A Backseat View from the Phantom

reviewed by Dr. Fred Allison




A BACKSEAT VIEW FROM THE PHANTOM: A Memoir of a Marine Radar Intercept Officer in Vietnam. By Fleet S. Lentz. Jefferson: NC: MacFarland & Company, Inc, 2020.
ISBN: 978-1476682075, 218 pp.

After the peace accords were signed in January 1973 that ended the Vietnam War, some Marines remained at war. These were the Marines of MAG 15—or Task Force Delta. This organization consisted of two Marine fighter squadrons, VMFA-115 and 232, an A-6 squadron VMA(AW-533), detachments of CH-46s and KC-130s (VMGR-152), and Marine Air Base Squadron 15 (about 2,200 Marines).

Home for Task Force Delta was Nam Phong, Thailand, a deserted Thai airbase. In three weeks, hard-working Marines, Seabees, and an Air Force airlift had made the base minimally habitable and operational. In May 1972, Task Force Delta moved in. Their mission was to conduct interdictory air strikes against communist forces in Laos, Cambodia, and—before the Peace Accords—in Vietnam. The Marine fighter squadrons also flew Linebacker missions, the bombing campaign of North Vietnam.

This is a book that needed to be written. First, it draws attention to this little-known part of the Vietnam War. Marine squadrons along with numerous Air Force and Navy squadrons had been mobilized to support South Vietnam against a North Vietnamese invasion in April 1972 (Easter Offensive). This bold and massive conventional invasion was eventually rolled back and "peace" ensued after the January 1973 Paris Peace Accords "officially" ended U.S. participation in Vietnam. But the Marine squadrons did not go home, for them, there was no peace. They continued to fly strike missions from a Thailand base, sometimes guided by CIA forward air controller pilots (otherwise known as the Ravens, against Communists in Laos and Cambodia, all the way into August 1973. This addendum to the war is truly a forgotten, but important, part of the war.

Important also is that the author of this book, Col Lentz, writes from the perspective of a Marine F-4 Phantom, "backseater," or radar intercept officer (RIO). Very little is known about RIOs and their important role in flying the Phantom in combat. Unlike the Air Force F-4s, Navy and Marine F-4s did not have flight controls in the rear cockpit. The RIO was not a co-pilot, his job was doing the radar work and weapons system, communications, and backing up the pilot on everything else. Lentz's details on the RIO's work in combat are compellingly educational.

***This is a book that needed to be written. First, it draws attention to this little-known part of the Vietnam War.***

Col Lentz was a junior RIO in Marine Fighter Attack Squadron 115 (VMFA-115). He writes in the first person. In a series of vignettes, Lentz illustrates—through engaging writing—fighting, living, and working at the Rose Garden. The challenges of flying and maintaining sophisticated strike fighters and bombers in this environment were monumental. Nevertheless, the Marines did it and did so in good fashion.

Col Fleet Lentz's book makes this forgotten part of the war less forgotten. His account of living and working at Nam Phong gives the reader a great depiction of what it meant to be expeditionary. In typical Marine irony, they dubbed it the "Rose Garden" after Lynn Anderson's popular contemporary country and western song

***>Dr. Allison is a retired Marine Major and served as an F-4 Phantom, Radar Intercept Officer from 1979–1992. He served as a Field Historian in the Marine Corps History Division from 1996–1998. He obtained his doctorate in 2003 from Texas Tech University and his dissertation was on close air support developments in the Marine Corps. He is retired from the Marine Corps History Division where he served as the Oral Historian from 2000–2020.***

and a Marine recruiting poster entitled, "We Don't Promise You a Rose Garden." Living conditions were horrible. They approximated conditions at World War II jungle bases more than modern Vietnam-era airfields. The only thing modern about it was the 10,000-foot concrete runway.

His details and first-person accounts of combat flying put the reader in the Phantom's backseat to get a good first-person account of the RIO's mission. He writes in a straightforward manner. He keeps his descriptions simple and explanatory so that non-aviation types will stay engaged.

The reader gets a good dose of Vietnam-era Marine fighter aviation culture. Happy hours and liberty runs are humorous and reflect on a time before the post-Vietnam social revolution that occurred in the military. His depiction of personalities is superb and poignant. His introspective account of returning to the United States and entering the civilian world is an eye-opener and relevant to our military today.

***The reader gets a good dose of Vietnam-era Marine fighter aviation culture.***

Lentz's writing is well-crafted and authentic, it grabs the reader from the beginning and does not let go. *A Back Seat View* is highly recommended for both serious students of the Vietnam War, military aviation, and military social history as well as the military-history buff.

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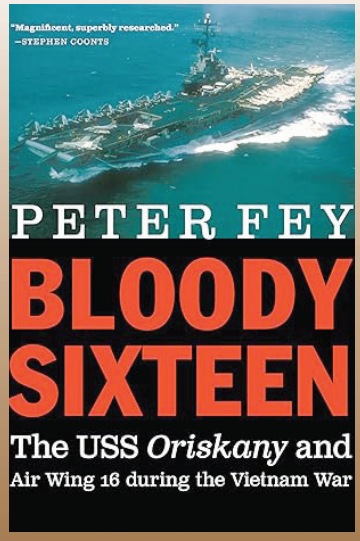
# Bloody Sixteen

reviewed by Mr. Bob Shaw




Bloody Sixteen: The USS Oriskany and Air Wing 16 during the Vietnam War. By Peter Fey. Lincoln, NE: Potomac Books an imprint of the University of Nebraska Press, 2018.
ISBN: 978-1612349794, 393 pp.

The upper Marine Amphibious Unit Camp, Subic Bay, Philippines in the late 1970s created a patchwork of memories for me as a young lieutenant. Nearby was the Cubi Point Officers Club, and I was enthralled by its huge bar display of Vietnam War carrier aviation squadron plaques. How I wanted to hear those pilots' stories!

Thankfully, we now have *Bloody Sixteen: The USS Oriskany and Air Wing 16 During the Vietnam War*, a magnificent chronicle of their adventures. This book sets the stage for the air war over North Vietnam, examined through the lens of carrier aviation, the squadrons, and pilots. Carrier Air Group 16 was embarked aboard USS *Oriskany* for three combat deployments off North Vietnam from April 1965 to January 1968. Each deployment coincided with a significant step up in the massive Rolling Thunder air campaigns which resulted in losses that earned the air wing its nickname: "Bloody Sixteen." Marines should read this story about how *not* to fight an air war and how leadership and innovation mix while caught in a meat grinder with unclear objectives and deadly opponents.

President Johnson directed Tuesday lunch sessions—without the Joint Chiefs present—that targeted the next two weeks of missions. Each mission was assigned to one of five uncoordinated theatre air wars measured by Secretary of Defense McNamara's myopic focus on "sorties." Dysfunctional rules of engagement evolved, and irrational behavior sprouted as targets of opportunity or follow-up strikes were banned and four planes with one bomb apiece—instead of one plane with four bombs—were dispatched to score four sorties. Meanwhile, North Vietnam countered with the world's most robust and lethal anti-air triad of 7700 artillery pieces, 25 surface-to-air missiles (SAMs) SA-2 battalions, and increasingly effective MiG fighter aircraft squadrons. A terrible operations tempo wrecked Air Wing 16; the last deployment from June 1967 to January 1968 lost one-half of embarked aircraft and one-third of its pilots.

***>Mr. Shaw is a Business Executive and the son and brother of Marines. He was an Infantry Officer with Battalion Landing Team 1/3 "Lavadogs" in 1979–1981.***

Naval aviation professional Peter Fey set out to write his master's thesis on the Bloody Sixteen after meeting the survivors at reunions. Fey does a powerful job explaining carrier aviation ballet: aerial refueling, anti-SAM suppression, rescue, and electronic warfare amid an evolving mix of aircraft. Best of all, he captures the pilots' personalities, fears, attitudes, and thoughts. You can imagine the pilots narrating while their hands are demonstrating diving at a supersonic SAMs to escape. Or after one particularly grim raid quipping, "we caught them with their pants up." Countless acts of stamina, heroism, and guts occurred: one pilot earned three Silver Stars in three days, two to three alpha strikes a day became normal, and a pilot turned his wings in to go to the riverine forces (gulp!) after three ejections in less than a year. Old equipment such as World War II-era bombs or defective air-to-air missiles with up to 80 percent failure rates bedeviled the pilots. Daily life was overshadowed by weather and monsoons, the ever-present specter of accidents, unknown prison camps, and fire—the worst nightmare of any sailor. USS *Oriskany's* nightmare inferno killed 44 sailors, including the air wing commander, and was caused by an overworked, short-handed, and junior crew.

Initial cost-benefit analysis concluded the damage inflicted was one-tenth the cost of the lost airplanes alone. Yet, the British Counsel in Hanoi said the U.S. air war was on the cusp of impacting the war's balance when the United States eased up after the summer of 1967. Meanwhile, the new constraints cost more pilots.

Fey's gripping story sets a drumbeat of tension while covering a huge spectrum of topics. It provided just enough technical detail not to overwhelm the layman while moving the story along. Better maps to illustrate a typical mission's objectives and sequence would improve understanding. Four appendices of cruise dates, squadron organizations, and key events by day are an excellent reference.

Today those venerable Cubi Point O Club plaques decorate the Pensacola National Naval Aviation Museum restaurant. *Bloody Sixteen* is their perfect salute.

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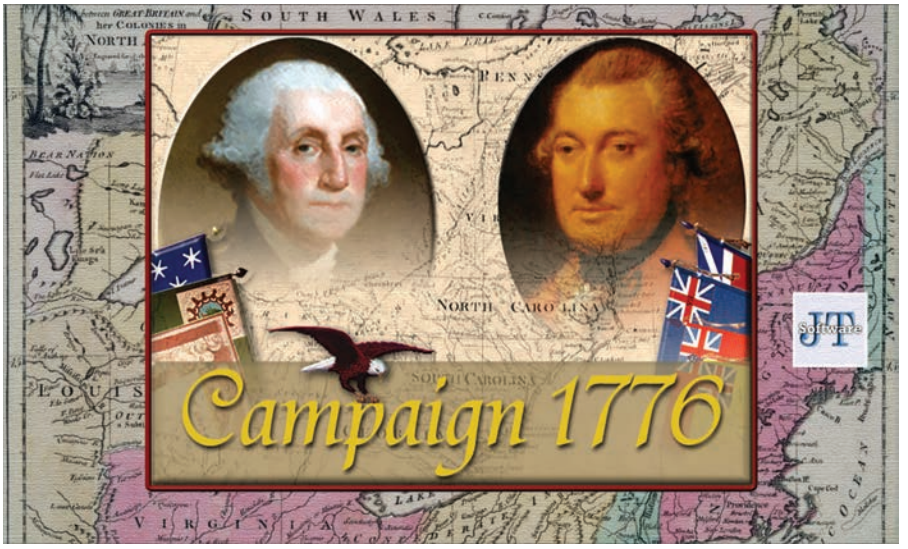
# Campaign 1776

## Wargame review #1 5-24

by Mr. William J. Treuting

Wargame Design Studio's *Campaign 1776* allows players to fight the major battles and skirmishes of the American Revolution from Lexington and Concord to the Siege of Yorktown as well as a wide variety of alternate-history scenarios. Fought throughout the eastern regions of North America, the battles of the American Revolution offer wargamers a unique variety of scenarios that will put them to the test. Many engagements are fought in remote areas of the American wilderness, with limited lines of communication and blocked lines of sight, forcing players to decide early on how to conduct their battles and leaving little room for error. The parity between the British and American forces is quite stark. Generally, the British armies will be of higher quality with superior officers, weapons, and supplies. To compound these advantages, in many scenarios, the British will have numerical superiority over the Americans. Conversely, the American armies are generally smaller and suffer from deficiencies in troop quality, weapons, and supplies; however, their advantage comes from the fact that they are generally fighting on the defensive in many scenarios and usually have greater numbers in their offensive battles. While few and far between, the Americans also have greater access to rifled units—which can offer a tactical edge if applied appropriately. Considering the size and scope of the American Revolution, *Campaign 1776* lends itself to wargamers interested in exercising their skills at the tactical level of war.

For wargamers interested in fighting guerrilla warfare, "Battle Road" pits the British regulars against a disparate band of dozens of American militia companies in a 72-turn brawl on the road between Lexington and Concord. The British force consists of 848 grenadiers and infantrymen who must escort their supply wagons from the outskirts of Concord past Lexington toward Boston. They are well-armed and of superb quality. Opposing them are 1807 American militiamen from a variety of militia companies. They are of exceedingly poor quality and are ill-equipped compared to their British counterpart, but their advantage comes from the numerical advantage of over two to one. In this classic setup of professional military versus local militias, each side will have to play to their advantage to win. To succeed, the British must keep moving while fighting an active rearguard and avoid being bogged down in one location. They must use their superior infantrymen to push aside any roadblock—or else risk being slowed down and surrounded—and make sure to maintain ranks as any unit that gets separated from the main column will likely be swarmed and annihilated. For the Americans, the key to victory will be to stall the British at every turn. Although the Americans outnumber the British, it takes roughly half the scenario before all the American forces arrive on the field, whereas the British start the game with all forces available. By using hit-and-run and swarming tactics, the Americans can offset the qualitative advantage of the British troops by forcing them to fight on ground not of their choosing. After wearing down the enemy over time, the Americans can begin to unravel the British formations and gobble up isolated units. Regardless, this scenario is a challenge for either opponent and




***Wargame Design Studio Campaign 1776.*** *(Photo courtesy of Wargame Design Studio.)*

***>Mr. Treuting is a historian, associate editor for the* Marine Corps Gazette*, cohost of the MCA Scuttlebutt podcast, and Director of MCA Films.***

offers the ability to apply both guerilla and counter-guerilla tactics.

As with any game from Wargame Design Studio, it would benefit wargamers to play through historical scenarios when studying the conflicts; however, the alternate-history scenarios allow players to fight in free-play battles unbounded by the constraints of history. Two scenarios in particular provide great opportunities with relative force-on-force parity: "Independence Day" and "The Battle of Monmouth, June 28th, 1778." The former scenario starts with each army arrayed in column on the map—based on the Battle of Germantown—in full strength, with each side containing roughly 20,000 men. The large map offers a wide variety of geography with multiple lines of communication, allowing for a variety of gameplay options. The latter scenario, "The Battle of Monmouth, June 28th, 1778," is based on the Battle of Monmouth and features two armies of roughly equal parity fighting for 80 turns on a large map with the majority of forces arriving from an off-map position. With roads, forests, and streams dividing the map into roughly three sections, players will have to carefully reconnaissance the area to determine where to best position their supporting and main efforts. Both scenarios allow wargamers to fight a peer enemy on a map that is neither conducive to nor hinders the offense or defense. Victory will be dependent on skill alone.

***The Siege of Yorktown.*** *(Photo courtesy of Wargame Design Studio.)*

Wargamers interested in fighting a free-play siege scenario will enjoy "The Siege of Yorktown, September 29th–October 19th, 1781." Lasting 370 turns, this scenario is the longest of the *Campaign 1776* series and is also one of the largest maps in the game. The length of the scenario is crucial for replicating siege warfare as it puts the onus on the defender to ration their ammunition while the attacker has time to maneuver their forces and launch several coordinated assaults to chip away at the enemy's defenses. The British player will have a total strength of 5557 men compared to 5293 American troops supported by 6578 French soldiers. While the British troops are of excellent quality, they are outnumbered over two to one by the American and French who possess troops of average quality. Beginning on the morning of 31 August 1781, the game starts with Cornwallis' British army arriving off the map to drive off the few militiamen holding Yorktown. With American and French forces not arriving until the next day, the British player has time to array their defenses as they see fit. Should they choose, they can occupy the historical defensive line, construct their own, or even plan an assault to try and defeat the French and American armies in detail. Still, being heavily outnumbered, the British can ill afford to make a critical mistake. Alternately, the American and French forces must contend with fighting offensively against an enemy that holds a significant geographic advantage. To the west, a series of swamps and streams will limit any offensive capabilities while to the east they must traverse over open ground with little cover. To beat the British will require careful probing and scouting to determine the gaps and surfaces of the enemy defenses. Ultimately, this scenario will test both players' patience and resolve when conducting 18th-century siege warfare.

***Campaign 76' is a great series for newer wargamers trying to get in their "reps and sets" ...***

With a focus on smaller, tactical engagements, *Campaign 76'* is a great series for newer wargamers trying to get in their "reps and sets" as well as those looking for a companion game on their studies of the American Revolution. With an array of historical and alternate-history scenarios on reasonably sized maps, wargamers have an opportunity to fight among the most foundational battles in American military history.

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