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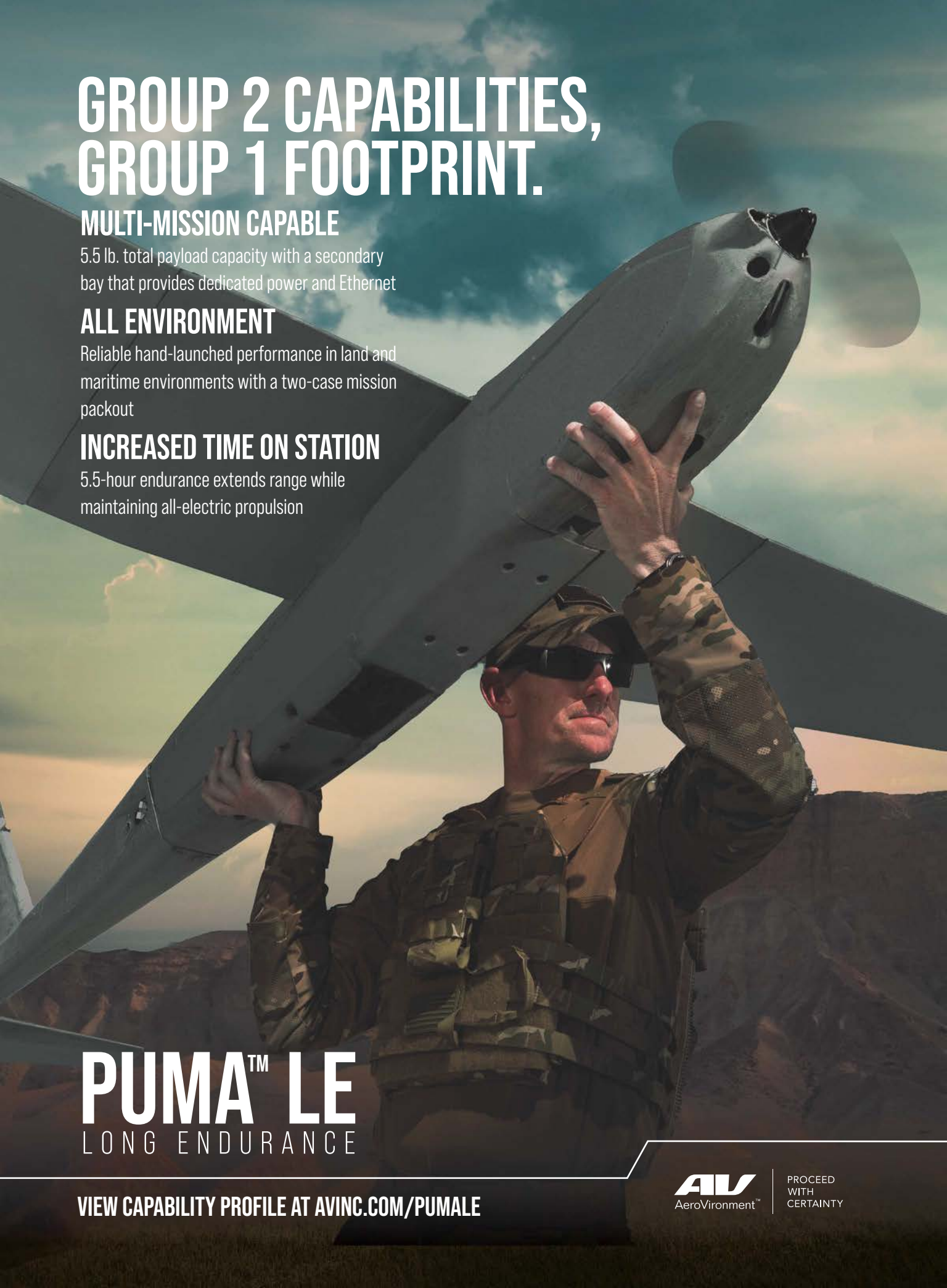
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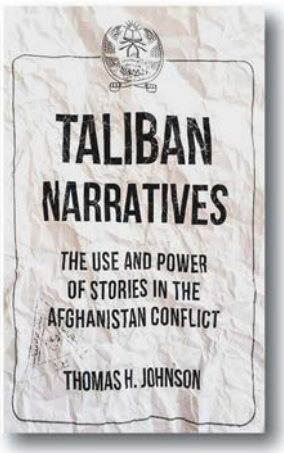
March 2020
Volume 104 Number 3

MARINE CORPS Gazette
Professional Journal of U.S. Marines

47 Cover Article
The Marine Corps tactical air-ground refueling system. *(Marine Corps photo.)*

DEPARTMENTS



84 Book Review

IDEAS AND ISSUES

The *Marine Corps Gazette* (ISSN 0025–3170) is published monthly by the Marine Corps Association & Foundation 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 • MEMBERSHIP INFORMATION: Contact Member Services, 1–866–622–1775. • ADVERTISING QUERIES: Defense Related Industries/Business: Contact LeeAnn Mitchell, Advertising@mca-marines.org 703-640-0174. All other Advertising Contact James G. Elliott Co. Inc., Phone New York: 212-588-9200 Chicago: 312-236-4900 Los Angeles: 213-624-0900. • COPYRIGHT 2020 by the Marine Corps Association & Foundation. All reprint rights reserved. • EDITORIAL/BUSINESS OFFICES: All mail and other queries to Box 1775, Quantico, VA 22134. Phone 703–640–6161. Toll Free 800–336–0291. 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&F except for such products or services clearly offered under the MCA&F's name. The publisher reserves the right to accept or reject any advertising order at his absolute discretion.

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MARINE CORPS Gazette
Professional Journal of U.S. Marines

MARCH 2020

Editorial: Expeditionary Logistics and Naval Integration

As the Corps proceeds with the historic re-design effort to develop the credible capabilities required for "stand-in" forces to support a naval campaign against a peer adversary, the vital importance of sustaining these forces has quickly come to the fore. This month's annual logistics focus edition covers the gamut of logistics, sustainment, and installation functions focusing on the future of supporting forces conducting EABO as part of fleet operations in congested maritime battlespace. Our cover articles highlight over nineteen thoughtful and detailed essays, both in print and online, on many aspects of sustaining forces in the future operating environment.

Establishing the azimuth for the logistics way forward, we begin with a letter on page 6 from DC I&L, LtGen Charles G. Chiarotti, and our lead article "Future Logistics and the Art of the Possible" by the HQMC I&L Futures Branch on page 7. In "Greater Naval Integration through Logistics," on page 10, a group of Navy and Marine Corps authors look at the opportunities for Navy and Marine logisticians to meet the intent of Gen Berger's CPG. Potential future solutions to the challenges of Class I (water) and Class III production and distribution are described in "Pulling Water Out of Thin Air" by CWO4 Sean C. Flores on page 20, on page 37 with "Fuel Distribution" by LtCol Brad Klusmann, and "Admiring the Bulk Fuel Problem" by CWO4 Robert Y. Lee. The Defense Logistic Agency's efforts at the DOD level to develop responsiveness to the materiel needs of Marine warfighters is the subject of "DLA National Account Managers" by Dianne Ryder. The crucial role of medical logistics in saving lives of combat casualties is covered by LCDR Russell P. Wier, et al., in "Prolonged Field Care and Fresh Whole Blood" on page 59.

Outside this month's logistics focus, standout articles address further aspects of naval integration, EABO, and other topics ranging from doctrine to civil military operations. On the *Gazette* webpage you will find "Back to the Future?" by Col Gary Anderson, a direct response to Capt Valerie Cramer's article from the November 2019 edition "A New Maneuver Warfare Handbook." With almost 50 years' worth of experience, Col Anderson ponders whether the Captain's article is satire or not, and if so where is the punchline? On page 69, frequent *Gazette* contributor, Capt Walker D. Mills, asks why the Naval Expeditionary Capabilities Command is absent from most Marine Corps discussions of Naval integration in "Where is the NECC?" Finally, on page 79, LtCol Anthony P. Terlizzi reimagines Marine civil military operations in the future operating environment in "The Civil Affairs Force."

Visit the *Gazette* homepage online at https://mca-marines.org/gazette to access all the features in the print magazine plus exclusive online content and a variety of professional resources. As the Corps' professional journal, we continue to use our webpages to provide resources to all Marines, even non-members, including the Maneuver Warfare and TDG collections as well as our professional reading and leader development references. This support to the wider Marine Corps is made possible through the willingness of you—the members of the MCA&F—to be a part of your professional association. Thank you!

Christopher Woodbridge

U.S. Space Force

In a news release on 20 December 2019, it was announced that the Fiscal Year 2020 National Defenses Authorization Act established the United States Space Force within the Department of the Air Force. This is the single most significant reorganization of the DOD since the Goldwater-Nichols Act of 1986.

The role of space within the national defense takes on a higher meaning and will transform how the DOD organizes, trains, equips, and provides forces to combatant commanders. All of the DOD is expected to support the establishment of Space Force as space forces of all Services are consolidated under the new force.

BGen David W. Maxwell

BGen Michael S. Martin

BGen James F. Glynn

BGen Roger B. Turner, Jr.

BGen Bradford J. Gering

BGen Francis L. Donovan

BGen William H. Seely III

BGen Scott F. Benedict

General Officer Announcements

On 14 January the Secretary of Defense, Mark T. Esper, announced that the President had nominated the following brigadier generals for appointment as major generals:

BGen David W. Maxwell who is currently serving as the Assistant Deputy Commandant (Plans), Department of Installations and Logistics, HQMC.

BGen Michael S. Martin, USMCR, who is currently serving as the CG, 4th MarDiv, MarForRes.

BGen James F. Glynn who is currently serving as the CG, Marine Corps Recruit Depot Parris Island/Eastern Recruiting Region, Parris Island.

BGen Roger B. Turner, Jr., who is currently serving as the CG, MAGTF Training Command/MCAGCC, Twentynine Palms.

BGen Bradford J. Gering who is currently serving as the Deputy Director, J-3 Africa Command, Stuttgart, Germany.

BGen Francis L. Donovan who is currently serving as the Assistant Commander, Operations–Korea, Joint Special Operations Command, Fort Bragg, NC.

BGen William H. Seely III who is currently serving as the Director, Joint Operations Control Center, Baghdad, Iraq.

BGen Scott F. Benedict who is currently serving as the Deputy Director, Politico-Military Affairs (Middle East), J-5, Joint Staff, Washington, DC.

BGen Jason Q. Bohm who is currently serving as the Chief of Staff, Naval Striking and Support Forces, North Atlantic Treaty Organization, Oeiras, Portugal.

The following Reserve officers were nominated for appointment to the rank of brigadier general:

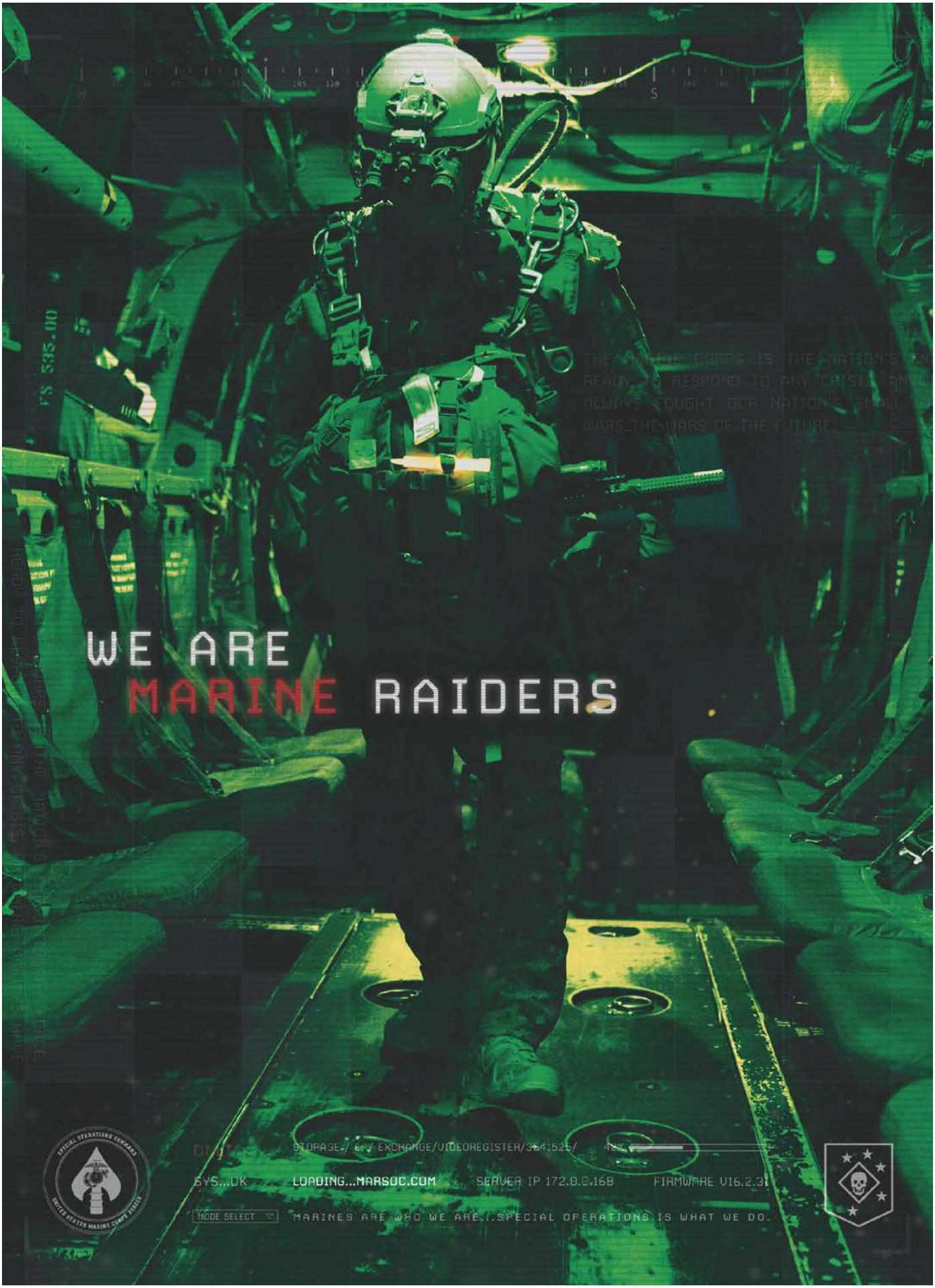
Col John F. Kelliher III, USMCR, who is currently serving as the Assistant Wing Commander, 4th MAW, MarForRes.

Col Douglas K. Clark, USMCR, who is currently serving as the Commander, Marine Detachment, Joint Enabling Capabilities Command, U.S. Transportation Command, Norfolk, VA.

>Photo credit: BGen Bradford J. Gering's photo was taken by LCpl Luis Zamot.

Letters of professional interest on any topic are welcomed by the *Gazette*. They should not exceed 300 words and should be DOUBLE SPACED. Letters may be e-mailed to gazette@mca-marines.org. Written letters are generally published three months after the article appeared.

The entire *Gazette* is now online at www.mca-marines.org/gazette.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March 2020

It is indeed an exciting time to be a Marine—and especially in the logistics community. The urgent and compelling need to rapidly transform the Marine Corps, as outlined by the 38th Commandant in his Commandant's Planning Guidance (CPG), requires our logistics community to review the very fundamentals of how we support the Fleet Marine Force (FMF) across the spectrum of operations, whether forward deployed or in garrison. Many of these transformational efforts are represented in this year's Logistics focus edition of the *Gazette.* These articles present an exciting mix of innovation and ingenuity, identifying new capabilities for supporting distributed operations and introducing a large portion of the logistics community to naval logistics support to the FMF. Accordingly, these articles are shaped by the CPG and fit within the four lines of effort outlined in the Marine Corps' functional concept for logistics: *Sustaining the Force in the 21st Century* (StF).

It has been nearly a year since *Sustaining the Force in the 21st Century (StF)* was signed and published by the Deputy Commandant for Combat Development and Integration (DC CD&I)—just before assuming his post as the 38th Commandant of the Marine Corps. While *StF* articulates a broad vision for how we will sustain the FMF of the future, there still remains a need to refine that vision into specific action and guidance. For that reason, we will soon assemble and publish the first Marine Corps Logistics Plan (LOGPLAN), which applies the *StF* lines of effort to support logistics capability development in pursuit of the Commandant's objectives. Installations and Logistics (I&L) will annually release the LOGPLAN to synthesize the contributions of the I&L staff and the FMF into a single, documented position on future logistics force development and employment.

The success of the LOGPLAN is highly dependent on the subject matter expertise that all of us throughout the Marine Corps and logistics enterprise have developed through a variety of experiences and education. It will also be reinforced by a collective awareness of many new programs and initiatives, a few of which are represented within the pages of this *Gazette.* There is a lot going on and still so much to do. In addition to all you are doing to support day-to-day operations, I invite you to join in the conversation and take part in this transformative, perhaps even revolutionary, period in our history.

Charles G. Chiarotti
Lieutenant General, U.S. Marine Corps
Deputy Commandant for Installations and Logistics

Future Logistics and the Art of the Possible

Supporting naval expeditionary capabilities

by HQMC, I&L Futures Branch

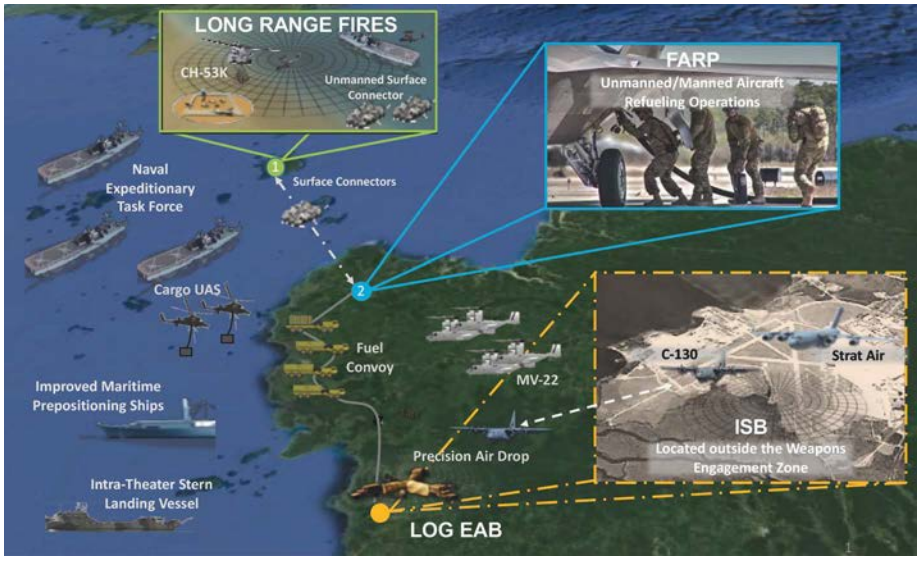
In recent articles and speeches, the Commandant has emphasized the need to divest in certain capabilities purpose-built for traditional sustained operations ashore in order to invest in naval expeditionary capabilities that support fleet operations.[1] Many of the capabilities in both the divestment and investment categories are, or affect, logistics systems. Prior to taking over as our 38th Commandant, General David H. Berger, then-Deputy Commandant Combat Development and Integration, published *Sustaining the Force in the 21st Century*. That functional concept supports future installations and logistics capability development. As the senior logistics subject matter expert, the Deputy Commandant Installations and Logistics has directed the alignment of legacy and future capabilities to four lines of effort: Enable Global Logistics Awareness, Diversify Distribution, Improve Sustainment, and Optimize Installations to Support Sustained Operations. To articulate the changes needed across the logistics enterprise, a vignette provides operational context to operations in 2030. The vignette highlights notional Fleet Marine Forces in a littoral environment in support of a Joint Force campaign. The vignette underscores how future capabilities might support and sustain distributed maritime operations (DMO). The capabilities described are technologically achievable today and available in many commercial industries; all are in line with the CMC's investment goals.

Situation

A task organized expeditionary force deployed in an archipelago is supporting the Joint Force Maritime Component Commander's (JFMCC) mission to provide sea denial and enable assured access for naval operations. An Expeditionary Advance Base MEU (EAB MEU)[2] deploys multiple combat support elements[3] (CSE) across distributed sites to provide logistics capabilities in support of DMO. The distribution of forces compounds the logistics support demand and requires improved organic unit logistics capabilities, improved point-to-point distribution, and reduced reliance on legacy supply chain methodologies.

Execution

CSEs deploy via surface and air connectors to a pair of islands with a mix of organic and leased transportation assets, locally purchased supplies, and prepositioned stocks. CSE Marines prepare or man EABs based on JFMCC requirements. In this case, the EAB MEU provides CSEs to support a long-range fire battery, a forward arming and refueling point (FARP), and a logistics EAB. The units at these sites have the organic capabilities to displace and relocate to new positions at random intervals with minimal physical and electromagnetic signature. CSE personnel are multifunctional logisticians, capable of performing multiple, previously uncombined, logistics tasks and activities.



Fleet Marine Forces supporting DMO in 2030. *(Image provided by author.)*

Notional Employment

CSE Marines receive and transfer all classes of supply from a mix of manned, remotely operated, and autonomous connectors, then they distribute logistics to the point of need.

Predictive maintenance and supply support is augmented by additive manufacturing at the logistics EAB, afloat with the EAB MEU, and at intermediate support bases outside the weapons engagement zone. The equipment outfitted with predictive maintenance capabilities are automated and networked. During operations, condition-based maintenance plus processes implemented in the 2020s allow equipment to autonomously identify potential failures, transmit requirements, and autonomously select the best source of supply. An imminent failure is detected on one of the long-range firing battery vehicles and the information is directly transmitted to the logistics EAB. The needed part is unavailable within the required delivery date to support mission requirements, so requisitioning from the supply network or the original equipment manufacturer is bypassed. The requirement is delivered to a 3D printer collocated with the EAB MEU with the expeditionary naval task force; by using additive manufacturing, the part is locally produced. The EAB MEU maintenance element quality checks the part and the S-4 coordinates delivery to the using unit. The S-4 loads the part on an unmanned air system for delivery along with specialized tools needed to make the repair. The multifunctional logisticians receive the part and realize they are unable to perform the required maintenance. In the past, the unit would have had to wait for a maintenance contact team to arrive; however, virtual enhancement capability links the Marine to a senior maintainer at the intermediate support bases who guides the Marine through the repair using virtual reality technology. With the repair complete, the battery is now able to conduct their displacement, ensuring continuous sea denial mission support to the Navy. Virtual enhancement reduces the number of senior maintainers required across the deployed force while increasing logistics responsiveness, flexibility, and overall unit readiness.

As the long-range firing battery initiates its displacement to an alternate site, the fuel cache located at the midway point is destroyed. Thanks to the fuel management decision support dashboard, the loss of the fuel cache is immediately identified and the EAB MEU S-4 directs a remotely piloted surface connector with fuel bladders to an alternate landing site. The multifunctional logisticians with the long-range firing battery move to the drop site and collect the fuel bladders allowing the battery to refuel and finish establishing the next firing position. The empty bladders are returned to the connector and the connector returns to its loiter position where a stern landing vessel intercepts the craft and refills the bladders for the next on-call mission. While the EAB MEU S-4 is managing fuel distribution at the tactical level, the MEF G-4 sees that fuel status in the area is lower than planned and dynamically retasks fuel stores from the Defense Logistics Agency to the area of operations. This information is updated on the fuel management decision support dashboard and logisticians at the EAB MEU and individual CSEs see new sources of supply for this pacing commodity.

Improving the visibility of all supply commodities and the addition of new sources of supply and foraging techniques were implemented in 2025. Logistics decision support tools coupled with improved operational contracting support improved sustainment of deployed forces. As the CSEs conduct their assignments, Class I resupply is requested by the FARP. The logistics EAB is unable to respond due to network attacks, but the logistics EAB is able to identify Class I availability in a nearby partner-nation unit. Using an existing acquisition cross-service agreement, the FARP draws the rations. Unfortunately, the partner-nation unit can not provide 100 percent of the requirement. The FARPs organic operational contracting support Marine procures local food stuffs to augment the rations drawn from the partner-nation unit. This 21st century foraging process ensures continuous support when the network is contested or denied. When the network is re-established, the logistics EAB resupplies both the partner-nation unit and the FARP with remotely piloted, unmanned ground systems.

The FARP receives a new task from the EAB MEU S-3, the JFMCC requires the FARP to be prepared to support joint aircraft the next day and needs the FARP expanded. In the early part of the 21st century, engineer equipment was too large and heavy to rapidly deploy into an emerging EAB mission. Fortunately, in late 2028, the Marine Corps restore a page from history and replaced several heavy, earthmoving machinery with lighter, unmanned capabilities. Using a small bulldozer modeled after the Clark Airborne (CA)-1 tractor[4] from World War II, FARP engineers expanded the FARP and provided necessary refueling points to meet the JFMCC task. Unmanned rapid expeditionary deployable tractors arrive on unmanned surface craft with additional combat engineers. Augmenting the FARP engineers, the team expands the FARP in time. With the mission complete, the engineer augments from the EAB MEU retrograde with the tractors to the expeditionary task force via a stern landing vessel operating nearby.

Logistics decision support tools coupled with improved operational contracting support improved sustainment of deployed forces.

The scenario outlined in the Fleet Marine Forces supporting DMO in 2030 vignette is just one of many notional situations Marines may find

themselves operating in. The future is full of uncertainty, but what is certain is that resisting the transition necessary to support the change needed to succeed in the future operating environment will surely set the Marine Corps up for failure. Improving capabilities in an incremental manner (capability and capacity) will not suffice to resolve challenges, nor will connecting new platforms to old, with minor changes to our methods: none of those will suffice.[5] To paraphrase our Commandant:

> The Marine Corps is initiating a 10-year evolution. We have two to three years to initiate the changes that are required or we will fall behind. We cannot and will not get this wrong.[6]

Notes

1. Gen David H. Berger, "Notes on Designing the Marine Corps of the Future," *War on the Rocks*, (December 2019), available at https://warontherocks.com.

2. Pending final force design efforts, for the purpose of this article the EAB MEU is a MEU-sized, task organized unit focused on EAB missions.

3. Pending final force design efforts and unit of employment determination, the authors are using the generic term combat support element interchangeably for battalion- and company-sized organizations.

4. In March 1944, 30 gliders carrying CA-1 tractors and other engineer capabilities landed behind Japanese lines in a jungle clearing in Burma. In less than a day, they constructed a 300 by 5,000-foot runway to handle combat forces to reinforce the position. See https://amcmuseum.org.

5. Gen David H. Berger, "Comments at the MCA&F Ground Dinner," (Washington, DC, November 2019).

6. Ibid.

Greater Naval Integration through Logistics

Bring Navy, Marine, and Coast Guard logistics together

by LtCol Roy E. Truba, Jr., USMC(Ret), CDR Christopher Kading, USN & LtCol Randy Hodge, USMC(Ret)

Naval integration is the concerted, proactive effort that includes any action, at any level, to bring the Navy and the Marine Corps together to form a more effective warfighting team. [1]

>LtCol Truba retired from active duty in 1998 and is now the Deputy Head, Logistics Vision and Strategy Section (LPV-1) in the I&L Department (HQMC) leading the naval and MAGTF logistics integration efforts.

>> CDR Kading, Navy Supply Corps, serves on the Deputy Chief of Naval Operations, Fleet Readiness and Logistics (OPNAV N4) staff as the Naval Logistics Integration (NLI) lead within the Logistics–Supply Chain Operations Division (OPNAV N41).

>>> LtCol Hodge retired from active duty in 2005 and is now a consultant for naval and MAGTF logistics integration matters to HQMC and the Fleet Marine Forces.

NLI is a naval Service[2] effort bringing Navy, Marine Corps, and Coast Guard logisticians together to seek and exploit opportunities for integrating capabilities, processes, and technologies that optimize support for naval force operations. NLI is driven by Secretary of the Navy policy[3] and Naval Service Chief guidance[4] and has a long history of success across the logistics spectrum.[5] Since NLI's inception, stakeholders have challenged the status quo in the areas of science and technology, policy and doctrine, and business practices and processes to enhance the readiness and combat capability of naval operating forces.

NLI Guidance for 2020[6] addresses specific initiatives and tasks for executing the *NLI 2017–2021 Strategic Plan*[7] in support of naval Service Chief guidance. *NLI Guidance for 2020* defines three priority efforts: logistics billet integration, integrated logistics training and education, and logistics information technology. This article focuses on greater naval integration through logistics by correlating the NLI 2020 priorities to three lines of effort described in *Sustaining the Force in the 21st Century:*[8] enabling global logistics awareness, diversifying distribution, and improving sustainment.

Billet Integration

A key NLI objective is to increase

We will build capability with our most natural partner, tying more closely with the Marine Corps—at all levels.
—ADM Michael Gilday, USN

Our logisticians exist to enable and sustain the lethality of the Marine air-ground task force across all warfighting functions and within all warfare domains.
—Gen David H. Berger, USMC

integration of naval logisticians on operational staffs to enhance expeditionary logistics support. In doing so, we must also recognize integrated billets as a core competency for naval logisticians. Success in this area is highlighted by the permanent assignment of distribution management Marines at Naval Supply Systems Command Fleet Logistics Centers (NAVSUP FLC) in Bahrain, Sigonella, and Yokosuka. These Marines are embedded in the NAVSUP FLC staffs serving as cargo expeditors supporting regional sustainment of deployed naval forces. Also, Marine Corps Logistics Command has a supply Marine assigned to the Navy's Priority Materiel Office in Bremerton, WA, providing on-site Marine Corps supply chain expertise within the organization dedicated to sourcing and expediting mission essential materiel to forward deployed units. These are just two examples of billet integration that have reaped huge dividends for deployed naval forces by improving sustainment and diversifying distribution.

Currently, there are Marine Corps aviation and ground logistics officers assigned to NAVSUP Headquarters, and Navy Supply Corps officers assigned to Marine Corps Logistics Command and Marine Corps Systems Command. These assignments provide the insight necessary to ensure unity of effort as support plans and acquisition decisions are made in the best interest of the Naval Service. Both Navy and Marine Corps have supply and logistics personnel working within the Defense Logistics Agency (DLA). These logisticians perform sustainment and distribution functions that directly support naval force operations and possess greater global logistics awareness than their peers serving within Service-specific organizations. The knowledge and skillsets Marines and Sailors acquire while serving in DLA strengthen the Naval Service's capability to leverage support from DLA—the Nation's combat logistics support agency that is responsible for managing the global supply chain.

In 2020, we must work to increase billet exchanges between appropriate naval force staffs to further enhance mutual understanding and unity of effort. Knowing the specific logistics capabilities each Service brings to the fight and including those capabilities in our logistics support plans for operational concepts can only be accomplished through billet cross-decking. Specific functional areas and staffs that could benefit from further integrating supply/logistics personnel include:

- *Contracting*. Navy and Marine Corps expeditionary contracting officers adhere to the same regulatory requirements; however, each Service maintains a unique capability aligned to contracting authority held by their respective heads of the contracting activity. NLI stakeholders should explore opportunities to integrate expeditionary contracting among MEF and NAVSUP FLC contracting offices to leverage economies of scale and avoid duplication of effort and market competition.
- *Distribution*. Distribution management and supply Marines can further integrate with Navy's distribution pipeline through assignments with the combat logistics force (CLF) and logistics task forces (CTFs) that execute distribution and sustainment for naval forces.
- *Planning*. Billet integration between naval surface forces, Fleet Marine Forces, numbered fleets, MEFs, CLF/CTFs, Navy Expeditionary Combat Command, and NAVSUP FLC supply and logistics staffs are essential for developing relationships and effective naval operational logistics planning and execution.
- *Sustainment*. Greater billet integration between NAVSUP, MARCORLOGCOM, Military Sealift Command (MSC), and DLA should be explored to improve our collective global logistics awareness and maximize readiness and sustainability through the most effective and efficient use of our global logistics support network.

Marine Corps forces that plan for and use the replenishment capabilities of CLF vessels can reduce their embarkation footprint, and the inventory investment and transportation costs associated with those items available for delivery by CLF ships. *(Photo by MCS3 Danielle A. Baker.)*

Training and Education

Another key NLI objective is to broaden cross-training and educational opportunities for naval logisticians by identifying, developing, and modifying expeditionary logistics courses to support current operations and warfighting concepts. The Marine Corps Logistics Operations Group now provides expeditionary logistics seminars: a collective training event designed to educate and train logisticians who are preparing for deployment on the full array of operational logistics capabilities that may be needed to support the range of military operations. This is done through expe-

ditionary logistics seminars for MEUs and other logistics focused deployable organizations within each MEF. The goal of this program is to increase unit knowledge on MAGTF, naval and joint logistics, intergovernmental and interagency capabilities, as well as theater specific roles, capabilities, and resources that may be necessary for deployment.

The Expeditionary Warfare Training Groups (EWTGs)–Atlantic and Pacific conduct training and instruction in the doctrine, tactics, and techniques of naval expeditionary warfare with a focus on amphibious operations to support operational commanders. The Navy Center for Service Support at Newport, RI, provides Navy logistics personnel the knowledge and skills to support the Fleet's warfighting mission. Center for Service Support Newport is the parent command to the Navy Supply Corps School, which provides a career-length training continuum that develops Navy logisticians. Marine Corps Combat Service Support Schools, aboard Camp Johnson in Jacksonville, NC, provides formal resident school training for logistics and supply Marines.

While each of these training and education commands allow other Service participation, only the EWTGs have integrated Navy–Marine Corps staffs, but their training is largely focused on information warfare, expeditionary operations, and expeditionary fires. Marine Corps Logistics Operations Group uses Navy instructors to facilitate their naval logistics seminars, but that instruction is typically *ad hoc*. So then, the naval logistics enterprise must be capable of providing expeditionary support and sustainment from greater distances imposed by a threat that is broader and deeper than in the past,[9] yet we have no formal training and education program of instruction that adequately prepares naval logisticians to sustain future naval force operations.

Over the next twelve to eighteen months, we must pursue training and education opportunities to support the Chief of Naval Operations' and the Commandant of the Marine Corps' planning guidance as we transition to a more fully integrated naval force to meet the demands of the pacing threat and future operating environment. Specific actions that could be driven by NLI governance oversight to improve sustainment, diversify distribution, and enable global logistics awareness include:

- Explore the EWTGs–Atlantic and Pacific as potential venues for integrated naval logistics training and education focused on operational logistics doctrine. *NWP 4-0M/MCTP 13-10K, Naval Logistics*, subordinate doctrine in the Navy 4-series (logistics), Marine Corps 3-40-series (operational logistics), and 13-10-series (seabasing), provide the foundation for necessary periods of instruction.
- Expand, modify, or integrate expeditionary logistics instruction at formal schools to include both Navy and Marine Corps perspectives ensuring naval logisticians are capable of functioning together and in joint operations. Assess the feasibility of mobile training team courses at or near major military installations and expanding use of distance learning courses.
- Ensure logisticians actively participate in official forums such as NLI, the Maritime Working Group, and the Expeditionary Operational Advisory Group.
- Conduct Marine Corps logistics unit staff rides at various Navy commands within NAVSUP, MSC, naval component commands, numbered fleets, and logistics CTFs to gain an appreciation for Navy capabilities and processes. Include DLA to garner a broader understanding of the global logistics support network. Reciprocate by hosting Navy staff rides at Marine logistics commands.
- Maintain the *NLI Playbook* (*NAVMC 4000.4A*), *NAVSUP Support to Expeditionary Forces Guide*, and *Marine Corps Forces–Logistics for Deployed Forces Handbook*. These publications describe logistics capabilities available to commanders, who are responsible for formulating logistics support plans to achieve mission success.

Marine Corps logistics is not postured to sustain the fight defined by the National Defense Strategy.
—Sustaining the Force in the 21st Century

Information Technology

Logistics information technology remains the long pole in the tent for overcoming many naval logistics obstacles. Much has been done under the NLI umbrella to enable interoperability and system cross-servicing, but we are a far cry from logistics systems integration. At a minimum, Marines can access select Navy systems using Global Combat Support System–Marine Corps (GCSS-MC) and other Navy capabilities using Navy systems. In 2016, NLI stakeholders developed the capability for deployed MAGTFs to pass requisitions from GCSS-MC to Navy's Enterprise Resource Planning and Navy Priority Materiel Office systems of record using pass-through accounts established at MARCORLOGCOM.[10] Although these capabilities eliminated the swivel chair process for requisition processing, problems arose with status and fiscal transactions as well as with system connectivity while underway.

In 2017, MSC established a Navy-funded Marine Corps load list comprised of Marine-specific items available for issue aboard all twelve fleet ordnance and dry cargo ships in the Navy's CLF.[11] The Marine Corps load list is just one of several load lists identified within the Consolidated Afloat Requisitioning Guide Overseas, used by afloat naval forces to order materiel for delivery by CLF ships. Marine Corps forces that plan for and use the replenishment capabilities of CLF vessels can reduce their embarkation footprint, and the inventory investment and transportation costs associated with those items available for delivery by CLF ships.

However, for Marines to access these inventories, they must use local procedures established by each particular logistics CTF. Although offline requisitions are permitted by Marine Corps supply policy in certain circumstances, Marines are reluctant to tap into this capability because of the added workload.

Navy to Marine Corps system interoperability has proven successful in several system tests, whereas rotational naval mobile construction battalions on Okinawa and Guam used Navy's One Touch to interface with GCSS-MC and requisition materiel directly from MEF supply management units. As with Marines using Navy systems, problems arose with status and fiscal transactions making system interoperability a cumbersome process.

Given the renewed emphasis on naval integration from the highest levels of command, the NLI governance is optimistic about exploring opportunities for true logistics systems integration. NLI stakeholders should pursue the following in 2020 to integrate Naval Service logistics systems and technologies to achieve interdependency in the maritime domain, including capabilities for electronically requesting, processing, and tracking materiel over the last tactical mile.

- Map requisition process flows from request to fulfillment within each Service. Process maps can be used to identify gaps and potential systems integration points.
- Develop common naval processes or compatible systems for requisitioning materiel from CLF ships. Ideally, materiel listed in any of the Consolidated Afloat Requisitioning Guide Overseas categories would be accessible using primary Service logistics systems of record.
- Develop the next generation of logistics information technology system(s) to address shortfalls in existing Navy and Marine Corps systems and promote naval logistics, including the command and control of logistics forces. Evaluate integrated system opportunities with the ongoing Naval Operational Business Logistics Enterprise Project.
- Integrate naval request and requisition management systems to enable cross-servicing. If a common logistics system cannot be sourced through the acquisition process, then pursue opportunities for interoperability without status and financial transaction constraints. Leverage the Secretary of the Navy's supply chain modernization forum to promote systems integration.

Integrate naval request and requisition management systems ...

Conclusion

Future operating concepts—*Littoral Operations in a Contested Environment, Expeditionary Advanced Base Operations,* and *Distributed Maritime Operations*—require integrated naval logistics organizations, training and education, and information technology. As logisticians, we must exploit every logistics integration opportunity to enable greater global logistics awareness, diversify our distribution processes, and improve warfighter sustainment. NLI is the official and continuing forum to address and prioritize logistics integration opportunities with a focus toward enabling and sustaining the lethality of naval forces across all other warfighting functions, whether conducting seabased or expeditionary operations ashore.

Notes

1. Department of the Navy, Chief of Naval Operations/Commandant of the Marine Corps Joint Memorandum, *The Path to Greater Naval Integration,* (Washington, DC: May 2019).

2. The *Naval Service* is comprised of the Active and Reserve Components and the civilian personnel of the United States Navy, the United States Marine Corps, and the United States Coast Guard.

3. Office of the Secretary of the Navy Instruction, *Secretary of the Navy Instruction 4000.37B, Naval Logistics Integration*, (Washington, DC: August 2018).

4. Chief of Naval Operations, *A Design for Maintaining Maritime Superiority 2.0,* (Washington, DC: December 2018); Gen David H. Berger, *38th Commandant's Planning Guidance,* (Washington, DC: July 2019); and U.S. Coast Guard, *Coast Guard Strategic Plan 2018–2022,* (Washington, DC: 2018).

5. The NLI Terms of Reference was signed in 2003. NLI stakeholders have repeatedly been recognized for their contributions enhancing the supply readiness and combat capability of Fleet Marine Forces through multiple ADM Stan Arthur Awards for Logistics Excellence, VADM Robert Batchelder Awards, and Defense Logistics Awards.

6. *NLI Guidance for 2020* addresses specific initiatives and tasks for executing the NLI 2017–2021 Strategic Plan. It is a collaborative effort of the NLI Executive Board, whose membership includes flag/general officers and senior executive service leadership representing Marine Corps, Navy, Coast Guard, and Department of Defense interests.

7. The *NLI 2017–2021 Strategic Plan* outlines the mission, vision, goals, and objectives of the NLI concept and serves as a road map to cohesively guide logistics integration initiatives.

8. *Sustaining the Force in the 21st Century* provides an aiming point for logistics development, document priorities, and provides direction for supported and supporting actions in the future.

9. Department of the Navy, *Naval Warfighting Publication 4-0M/Marine Corps Tactical Publication 13-10K, Naval Logistics,* (Washington, DC: 2012).

10. Headquarters Marine Corps, *Announcement of Global Combat Support System-Marine Corps Capability to Pass Requisitions to Naval Supply Systems Command*, (Washington, DC: June 2016); and Headquarters Marine Corps, *Announcement of Global Combat Support System-Marine Corps Capability to Pass Requisitions to the Priority Materiel Office,* (Washington, DC: June 2016).

11. Headquarters Marine Corps, *Marine-Specific Inventory aboard Combat Logistics Force Dry Cargo Ships*, (Washington, DC: February 2017).

Passive Radio Frequency Identification

Enhanced expeditionary logistics, answering the call to modernize for tomorrow's fight

by Maj Christopher M. Gilmore, Antoine Bailey, James A. Jones, Dominique Rhines, Jeffrey Booth, Christopher Cox, Jillian R. McCain & Meloney Wallace

Need for Change

In 2019, Gen David H. Berger, the 38th Commandant, published the *Commandant's Planning Guidance* (CPG) to provide his strategic direction for the Marine Corps in support of the President's 2018 *National Defense Strategy* and the Secretary of Defense's *Defense Planning Guidance.* The CPG serves as an authoritative and strategic roadmap, which details the "Commandant's Intent" for the next four years. Gen Berger concurs with his predecessor's (Gen Robert B. Neller) observation: "The Marine Corps is not organized, trained, equipped, or postured to meet the demands of the rapidly-evolving future operating environment."[1]

Gen Berger intends to effect changes to meet the "demands of the Naval Fleet in executing current and emerging operational naval concepts."[2] One of the changes is developing the Marine Corps' capability to conduct distributed operations (DO). According to the CPG, the Marine Corps must develop DO capabilities to succeed in missions against distant and distributed adversaries, enhance maneuverability to obtain positional advantages during assaults and engagements, protect forces by reducing the effects of enemy fire, inflict battlefield chaos and casualties upon the enemy, and reduce force signature to mitigate or avoid detection.[3]

To support DO, the Marine Corps will need to develop, test, and refine diversified and distributed logistics capabilities. The Marine Corps must leverage available technologies, processes, and systems to enhance the logistics enterprise, especially in the expeditionary environment. These solutions incorporate technologies, which include passive radio frequency identification (pRFID), among others, to modernize logistics in support of the warfighter.

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Headquarters Marine Corps, Logistics Plans, Policy, and Strategic Mobility Division (HQMC/LP), published the final version of *Sustaining the Force in the 21st Century*, which supports the CPG. This functional concept outlines four lines of effort (LOE): Enable Global Logistics Awareness, Diversify Distribution, Improve Sustainment, and Optimize Installations.

The Enable Global Logistics Awareness LOE lays the foundation for leveraging future data-driven operating environments to rapidly gain and maintain situational awareness. We must leverage available joint force resources and those within the area of operations. We need the capability to assess friendly force posture and accurately identify warfighter requirements in all stages of operation. These actions will allow us to develop mature technologies to maximize our responsiveness to force demands.

The Diversify Distribution LOE directs Marine Corps planning and action to capitalize on both legacy and emerging distribution capabilities supporting geographically dispersed forces in multiple warfighting domains. We must support these forces whenever DO are either impractical or inhibited, acknowledging that massed sustainment becomes a vulnerability in DO (e.g., expeditionary advanced base operations: EABO). Improvements within

this LOE should result in distribution methods that maximize the MAGTF speed, agility, and reliability.

Background

For nearly 30 years, the DOD has successfully employed available 20th century technologies to execute complicated global logistics efforts in support of force deployment, redeployment, sustainment, and retrograde operations, from Operations DESERT SHIELD and DESERT STORM to efforts in Iraq and Afghanistan. The DOD invested in rapidly developed logistics technologies with capabilities to enhance the logistics enterprise. However, not all of the technologies aligned to future operational and infrastructure requirements. The DOD introduced cargo and personnel visibility processes, capabilities, and technologies (e.g., automatic identification technology [AIT] and automated information systems) to improve tracking and tracing of military equipment, cargo, and personnel throughout the distribution and supply chains, from unit home stations and industry, to storage in distribution locations, and through the Defense Transportation System to theater-deployed units. Yet, a lack of data standardization, accuracy, and availability continues to affect asset visibility (AV) negatively. Inaccuracies in asset technical data, poor data standardization across several logistics databases, and complex data mining requirements exacerbates the problem of obtaining accurate AV. These issues result in a unit's or commander's inability to locate cargo and supplies in order to close the force effectively and efficiently.

Beyond DOD efforts, Marine Corps logistics communities searched for ways to improve AV throughout the supply chain with mixed results. These communities focused their efforts on capturing key asset attributes and information while in-transit, in-processing, in-maintenance, and in-storage, thus enhancing the capability to provide end-to-end visibility of logistics materiel.

The vehicle is being tracked using a radio frequency identification tag. *(Photo by LCpl Lydia Davey.)*

The Marine Corps developed capabilities in active radio frequency identification (aRFID), in-transit visibility (ITV), and pRFID infrastructure. These capabilities focused on landbased operations and did not adequately support tactical distribution AV during seabased contingencies: multi-nodal ship-to-shore arrival and assembly, shorebased reception and staging, onward movement, and integration operations. With the Navy and Marine Corps incorporating EABO in its "pivot to the Pacific," integrating command and control technology with supply and distribution operations during amphibious and prepositioning operations is critical. The Marine Corps needs a common operational picture to support strategic and tactical AV.

The DOD AIT Implementation Plan for Supply and Distribution Operations (March 2008) targeted supply and DO in its attempt to provide an enhanced AV posture and improve materiel chain of custody throughout the logistics supply and distribution chains. This plan directed the implementation of pRFID tags at the wholesale level (Defense Logistics Agency) and the installation of pRFID readers at distribution nodes (installation Distribution Management Offices). The Marine Corps used pRFID readers (installed at various installations) to track Defense Logistics Agency-shipped materiel, enhance the transportation receiving process, and provide automatic supply receipts. While the plan called for a designed approach using incremental and phased implementation, non-existent unit participation combined with contractor renewal complications and a low return on investment caused the Marine Corps to discontinue Service participation. Therefore, the Marine Corps began to explore other pRFID technologies to produce a better return on investment. Unfortunately, those efforts did not align to the scope of the *DOD AIT pRFID Implementation Plan*.

As part of the Marines Corps' expanded look at pRFID technology, two separate pRFID projects were developed. These projects specifically focused on yard management and AV. From these projects, the reported successes prompted an analysis by the Marine Corps' Transportation and Distribution Operational Advisory Group. The ITV Working Group assessed pRFID-related processes and associated costs. The initial analysis necessitated investigation into the gaps between system-to-system interfaces and functional areas where the pRFID technology employed by the two systems provided a bridge for the entire Marine Corps logistics enterprise. The Marine Corps relies on multiple data systems and manual

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procedures to capture the daily status of assets and on-hand balance records for visibility purposes. These systems and manual procedures are prone to duplicative efforts. Further, there is a risk in degraded AV data quality because of multiple manual processes compared to a single, automated solution.

Many deployment and distribution systems do not interface with GCSS-MC, resulting in a "swivel chair" environment where logisticians attempt to obtain ITV across the supply chain. Ineffective and inefficient data transfers contribute to Service-level AV limitations. Efforts are underway to create data exchanges between deployment and distribution systems that do not automatically share information in order to help the Marine Corps logistics enterprise to keep pace with the speed of operations in EABO environments. Using RFID technologies will bridge this gap, provide enhanced accuracy and integrity into logistics data, and help support force closure during EABO operations.

RFID Technologies and Trade-Offs

How does RFID technology bridge the gap in logistics capabilities? The following provides a quick summary of RFID components and capabilities to enhance logistics processes. RFID transmits encoded tag data via radio waves to readers and associated computer databases. This data provides foundational elements for automated reports and information to assist units with making timely and informed decisions. RFID tags are equipped with antennae for receiving and transmitting signals. These tags also contain microchips for data storage, receipt, and transmission. RFID readers communicate with these tags through sequential and accelerated data transmissions within the range of each reader.

Reading devices contain antennae to send signals to pRFID tags via radio waves. These radio wave pRFID tag antennae provide power to the tag's microchip. Passive RFID tags are typically small, lightweight, and users can apply them to multiple surfaces. The tags are designed to provide precise location information (within centimeters) as well as asset details like temperature, humidity, and pressure. The microchip transmits the asset's unique data identifier to the reader's antenna. Software or applications on computing devices (laptop, tablet, or other device) connected to the reader stores the data locally in servers or databases. Because the pRFID tags do not supply their own power, they are less expensive than aRFID components. In deployed environments, handheld RFID readers make the inexpensive pRFID tags an attractive option because of reduced fixed infrastructure (aRFID) costs.

Many deployment and distribution systems do not interface with GCSS-MC, resulting in a "swivel chair" environment ...

Active RFID tags contain their own power source; they do not require a reader's radio frequency signal to transmit data. Active RFID tags are typically larger and much more expensive than pRFID tags. Active RFID tags can also be "data rich," meaning data can be stored directly on the tag versus relying on databases to determine associated tag data. Additionally, aRFID tags have a longer communication range with a reader, which increases efficiency of gathering data.

There are trade-offs with each type of tag: size, range, cost, and capability. Combining passive and active RFID technologies will create greater efficiencies and data accuracy. Each technology provides advantages and disadvantages; however, combining these capabilities will improve the Marine Corps' ability to deliver the right materiel, at the right place, at the right time, and in the right condition. If used together, AV and ITV capabilities could dramatically improve throughout the Marine Corps logistics chain.

RFID Lessons Learned

Despite the Marine Corps' efforts, significant AV limitations remain. Service-level AV limitations include the following: ineffective and inefficient data capture, lack of AV throughout the supply chain, and the inability to create an enterprise dashboard to display pertinent logistics data. AV data is only shared and contributed from selected functional areas and is not available in actionable formats. Furthermore, antiquated, landbased aRFID enterprise solutions do not support EABO, one of the concepts in support of DO. To improve and enhance AV capabilities, the Marine Corps must modify its current protocols and business processes. Data is required from all functional logistics areas to provide tailorable displays for specific expeditionary requirements.

AV and ITV data significantly contributes to the overall logistics mission. It is critical for the data to reside within an integrated system architecture so that users may access and share it across the logistics spectrum of the MAGTF. The goal of these Marine Corps' RFID efforts is to produce scalable and improved AV/ITV capabilities based on commercial technologies while conforming to DOD-mandated standards.

Looking Ahead: Testing and Employing RFID Capabilities

The Marine Corps seeks to provide the Fleet Marine Forces with fully networked, interoperable, end-to-end AV across strategic, operational, and tactical operations. This goal effectively supports distributed logistics operations on a large scale: distribution and transportation maritime and ashore reception, staging, and onward movement and integration. Active and passive RFID technologies enhance the operational commander's ability to make timely decisions by providing accurate, realtime logistics information to make operational and tactical decisions faster than our adversaries observe-orient-decide-act loop.

To mitigate AV/ITV gaps, the Marine Corps is using a phased approach to implement pRFID across the Marine Corps supply chain. The Marine Corps

will enhance and facilitate the application of these technologies using lessons learned from Blount Island Command's utilization of pRFID for the Maritime Prepositioning Force Program.

To accomplish the Marine Corps' AV/ITV goals, and as a means of closing some of the aforementioned gaps, HQMC/LPD is executing a pRFID Proof of Principle (PoP) at Combat Logistics Regiment 15 (CLR-15) onboard Marine Corps Base Camp Pendleton, CA. The pRFID PoP analysis includes the end-to-end visibility of assets—meaning from acquisition to point of employment, including in-transit, in-processing, in-maintenance, and in-storage information—in order to achieve a seamless and effective MAGTF logistics supply chain. The PoP intends to highlight pRFID capabilities in support of enhanced force closure.

The equipment selected for tagging during the CLR-15 pRFID PoP includes organic vehicles in a local motor pool (to demonstrate speed-to-count and accuracy during inventories), vehicles undergoing maintenance (to track exactly where something is during a sometimes-lengthy maintenance cycle), howitzers, and a few selected repair parts (to demonstrate the physical availability of "fast mover" parts on the shelf). Marines will tag, track, and report the items during the PoP, which continues through this year and into 2020. The Marine Corps expects the pRFID PoP to deliver the following benefits:

- Integrate near-realtime and multi-dimensional view of logistics throughout the battlespace and logistics pipeline.
- Inform the integration of systems to eventually eliminate the "stove-piped" information systems from logistics communities (distribution, maintenance, and supply) and provide worldwide, authorized access to shared data.
- Develop interoperable, portable, and scalable AV/ITV capabilities in expeditionary logistics environments through common hardware suites.
- Encourage standardized processes for pRFID tag creation and placement for identified military equipment with pRFID tags, from acquisition to disposal.
- Create one repository for pRFID tag-to-asset relationship, logistics data interfaces, and system-to-system transactions versus multiple system interfaces.
- Facilitate realtime data analysis and process improvement.
- Reduce costs and mitigate gaps associated with AV over the materiel lifecycles.
- Support automated data quality assurance for tagged items, improve asset accountability, and increase inventory accuracy.
- Improves planning with more accurate and easily accessible equipment inventories.
- Minimize expensive and less reliable AIT options.
- Support joint deployment and distribution enterprise logistics framework transition to pRFID capabilities.

... our integration and modernization efforts will reduce man-hours and costs ...

In addition to the pRFID PoP at CLR-15, the pRFID PoP team and I MEF are in the process of tagging military equipment for tracking and tracing as part of the upcoming NATIVE FURY exercise. The purpose of the exercise is to enable military personnel to move large equipment such as tanks, HMMWVs, other vehicles, and supplies from ship to shore. During the exercise, Marines will test current pRFID capabilities to help inform processes, applications, and technologies used in expeditionary environments and across the Marine Corps logistics enterprise. This will help the Marine Corps improve our ability to deploy forces rapidly across the globe. Furthermore, NATIVE FURY will help to develop trained, interoperable forces for combatant commanders.

In coordination with related efforts, Marines are integrating and testing RFID technologies within the logistics enterprise in order to enhance global logistics awareness and diversify logistics operations to support missions against 21st century adversaries. Previous and current efforts are helping to organize, train, and equip Marine logistics units with upgraded technologies that will keep pace with the speed of EABO and DO. Marine logisticians are acquiring and training with digital and wireless capabilities to help deliver supplies and services to the forward edge of the battlefield.

As the Marine Corps implements strategic guidance outlined in the *National Defense Strategy*, the *Defense Planning Guidance*, the CPG, and the *Sustaining the Force in the 21st Century*, we will leverage pRFID and other technologies to ensure Marines will be trained and equipped to deliver supplies and services across the battlespace. The Marine Corps' logistics communities will reap the benefits by integrating realtime and multi-dimensional logistics data into our planning process. Thus, we will reduce our reliance on more expensive and less reliable AIT/automated information systems options. Ultimately, our integration and modernization efforts will reduce man-hours and costs while enhancing property accountability, informing critical decision making, and improving management of mission essential assets. These enhancements will allow Marines to focus on warfighting tasks rather than waste valuable time on antiquated tracking and tracing processes. With ongoing efforts toward force transformation in support of DO and EABO, we must modernize our current business processes. When successful, our efforts will increase the lethality of our warfighters as they face the formidable logistics challenges posed by any of our 21st century adversaries.

Notes

1. Gen David H. Berger, *38th Commandant's Planning Guidance*, (Washington, DC: July 2019).

2. Ibid.

3. Ibid.

Pulling Water Out of Thin Air

Diversify distribution, improve sustainment

by CWO4 Sean C. Flores

The increasing scarcity of drinkable water is a global concern gaining the attention of industry and military initiatives. Marines are known for scavenging and seemingly pulling things out of thin air, which spawned Maj Matthew Neely's idea to forage water from the air. Atmospheric Water Generation technology is a revolutionary solution that will fundamentally change the Marine Corps' ability to conduct distributed maritime operations against peer competitors. With worldwide applications, Atmospheric Water Generators (AWGs) can support sustainability for distributed operations, provide sustainability in crisis response, and possibly mitigate future conflicts on the horizon.

When the well is dry, we know the worth of water.

—Benjamin Franklin

A Macro Look at the Problem

It is common knowledge that more than 70 percent of our planet is covered in water. However, with more than two-thirds of the earth's surface being covered in saline saltwater, only one percent is accessible and useable for drinking in its current state. According to the World Health Organization, more than 855 million people lack access to safe drinking water, and approximately 3.6 million people die annually with contaminated water being a contributing factor. The growing scarcity of drinkable water has leaders around the world concerned about the preservation of this precious resource.

>CWO4 Flores has deployed in support of Operations Dynamic Response, Iraqi Freedom, and Enduring Freedom and is currently assigned as the Innovation Officer and Force Utilities Officer, III MEF.

In wine there is wisdom, in beer there is freedom, in water there is bacteria.

A common misconception is that water coming out of a spout is safe for drinking. Drinkable water is subjective to location based on the acceptable risk of contaminants of certain concentrations. You do not have to be in a third-world country to be susceptible to contaminated drinking water. Discoveries like the tainted drinking water aboard Camp Lejeune, NC, and the water crisis in the city of Flint, MI are examples of how trusting water sources can be dangerous. Water can be sourced within a host nation, but it presents an additional risk to forces because of the potential for substandard quality.

A Micro Look at the Problem

The luxury of large-scale logistics buildups is unsupportable in a fight with a peer competitor. Currently, Marine

AWGs can support sustainability for distributed operations, provide sustainability in crisis response, and possibly mitigate future conflicts. *(Photo by CWO2 Jerry Jordan.)*

Corps logistics is not postured to sustain the future fight described in the *National Defense Strategy* (Washington, DC: 2018). Leaders, logisticians, and utilities officers around the world share the tyranny of distance as a challenge for distributing safe drinking water to consumers. Sustaining the force is similar to sustaining a village. The answer resides in diversifying distribution.

In accordance with *Joint Publication 4-03 (JP 4-03), Joint Bulk Petroleum and Water Doctrine* (Washington, DC: 2016), "Tactical bulk water-support operations are implemented to purify water as close to the user as possible." As these operations spread, bottled water became an easy button for offsetting bulk water demands fulfilled by tactical water purification equipment. Bottled water and tactical water purification methods still require distribution comprised of robust convoys delivering drinkable water to consumer locations. In addition to the robust fuel demands, these convoys put equipment and service members from all Services at risk. Studies have shown that approximately one service member is killed per twenty convoys.

Searching for a Solution

Maj Neely's initiative resulted in an Industry Innovation Fellowship (I2F) coordinated by the National Security Innovation Network, with a premier manufacturer of AWGs—Watergen USA in Miami, FL. Watergen USA hosted me for a 35-day I2F funded by the DC, Installations and Logistics, Logistics Vision and Strategy Branch-1 (LPV-1). The key to the I2F's success was the establishment of clear objectives from LPV-1 to learn about atmospheric water generation, validate the technology, discover current uses for AWGs, and develop methods to procure equipment for further evaluation and proof of concept for Marine Corps application.

I2Fs are an effective way to keep up with the exponential growth of technology by coupling a subject matter expert from the Fleet Marine Force with a reputable company willing to host, teach, mentor and share applications of capabilities. This pairing should provide strategic outcomes to both parties to ensure the maximization of time and education. Because of an unfortunate accident involving Watergen USA's lead engineer, Ari Woodworth (a former Marine), I was able to take on the lead engineer position and get a better look at the technology through numerous installations. Watergen USA was able to treat and task me like an employee vice an observer, which resulted in the maximization of the I2F.

Villagers in Sierra Leone line up to get water from a Watergen USA. *(Photo by Oren Stevi Photography.)*

> ***... bottled water became an easy button for offsetting bulk water demands ...***

How AWGs Work

A blower draws the air from the atmosphere into the system through air filters, removing dust, dirt, and other particles. The air gets directed into a heat exchange and cooling process, resulting in condensed water. The water travels through various types of filters to remove impurities before transferring to a reservoir. There are variations of this process from start to finish that separate and distinguish AWG competitors from one another through various categories. The process is scalable, resulting in variations in power requirements and amounts of product water generated per hour and per day. However, an effective stand-alone AWG will generate, purify, store, and distribute safe drinking water efficiently.

AWG Advantages

- Currently, the Marine Corps lacks the ability to *generate* water. Current purification systems require the establishment of tactical water points near lakes, rivers, streams, oceans, and other water sources to draw water into the purification process.
- These fixed positions become distribution nodes for logistics convoys transporting product water to remote locations. AWGs provide an organic capability to generate water in remote and austere locations away from known water sources, reducing and potentially mitigating additional convoy/distribution support.
- AWGs provide the ability to diversify distribution by staging units across a non-linear battlespace, which reduces delivery requirements and supports the unpredictably of locations required for expeditionary advanced base operations (EABO).
- AWGs are cost-efficient systems that are easy to use and maintain.

Current purification systems require technical expertise for both operation and maintenance. AWGs could be operated through an expedient incidental licensing process including user-friendly preventive maintenance to contribute to smaller footprints. Corrective maintenance would be conducted by MOS 1171 (water support technicians), which would be a zero sum gain for the occupational field.

- AWGs can operate indoors, reducing visual signature. They also have the ability to operate continuously for months at a time, providing a reliable organic source of drinking water.
- Purifying water from the air reduces the number of potential contaminants. Additionally, AWGs typically do not require additional chemicals, reducing hazardous material requirements, to include reclaiming waste water, also known as grey water, created during the water purification process.
- AWGs provide consumers a trusted water source that they control. They can also provide a more comfortable environment in tents and structures, serving as dehumidifiers.

Generating water from the air takes longer than current purification systems. *(Photo by CWO2 Jerry Jordan.)*

AWG Limitations

Generating water from the air takes longer than current purification systems, which limits capabilities when expedient bulk water is required. AWGs should be used to offset and complement tactical water purification system bulk water demands.

An AWG's performance is relative to climate. The abilities of AWGs vary but typically operate in a minimum of 45 degrees fahrenheit ambient temperature with relative humidity above 30 percent. However, environments such as the U.S. Indo-Pacific Command area of responsibility are exceptional locations for AWG employment because of the consistent climate conditions comprised of higher ambient temperatures and relative humidity which accelerate AWG capabilities. Additionally, environments can be created to meet these conditions with tents or structures coupled with environmental control units if required.

Deployed with EABO teams, AWGs can serve as a constant source of organic water. *(Photo by CWO2 Jerry Jordan.)*

Potential AWG Applications

- AWGs generate, purify, store, and distribute clean drinking water in one system that can be employed almost anywhere in the world. They are a materiel solution with applications from garrison to combat.
- AWGs can be employed in embassies, consulates, and various permanent structures, significantly reducing the cost of bottled water while providing a trusted and controlled source of safe drinking water.
- AWGs can be employed with various EABO teams and scenarios because of the alleviated technical expertise requirements and user-friendly maintenance. Deployed with EABO teams, AWGs can serve as a constant source of organic water, mitigating visual signature and scheduled resupplies.
- AWGs can replace burdensome bottled water transportation requirements by providing a forward capability in caches and various locations to create

water on demand for packaging and prepositioning.

- AWGs can offset municipal water system requirements for consumption in garrison, where local infrastructure is compromised, undeveloped, or destroyed. One of Watergen USA's AWGs is installed aboard Tyndall Air Force Base in Panama City, FL, which was decimated by a category five hurricane. This application provides cold and ambient-temperature drinking water on demand to a remote location that will take years to refurbish.
- AWGs can greatly reduce the competition of resources between providers and consumers during humanitarian assistance, disaster relief, and crises response missions. Additionally, AWGs can reduce transportation costs while providing a sustainable solution to locations suffering from disaster. Strategically prepositioning AWGs could fundamentally change joint missions with non-governmental organizations by providing safe drinking water distribution points. Non-governmental organizations and military support could provide additional support with portable reusable storage solutions.
- AWGs can increase access to locations when conventional military partnering strategies no longer work. Incorporating AWGs in humanitarian civic actions and joint civil military operations task forces provides opportunities for partnering military exchange programs used for diplomacy. Similar to civil military operations projects involving mine deactivation, countries are compelled to take action to keep their people safe by providing clean drinking water.
- AWGs can be implemented in multilateral capability developments and strategic mobility projects. Engineers can incorporate AWGs into planed engineer related construction projects to increase structure independency and reduce the costs of tapping into local and often unreliable municipal water systems.
- Chef Jose Andres, founder of World Central Kitchen, an organization that responds to crises around the world by providing disaster relief with food, recently purchased AWGs to be self-supportive and reduce competition for resources. This introduced the application of AWGs with expeditionary field kitchens. Food service requires water for cooking, hygiene, sanitation, and cleaning utensils and cookware. Providing food service with organic AWGs and expeditionary field kitchens would offer a constant source of drinking water.
- AWGs have numerous applications in the medical field. Shock trauma platoons require medical-grade water for patients, sterilization, cleaning instruments, and consumption. AWGs can provide medical-grade water while creating a more comfortable environment in dehumidifying the air for patients and medical personnel.
- There are several joint applications, to include capabilities with special operations forces. Joint Special Operations Command transported an AWG around the world with exceptional results. Special operations forces often operate in a clandestine manner in austere environments where host-nation drinking water is unreliable. Prepositioned AWGs can provide a low signature capability requiring little to no resupply for drinkable water resulting in significant decreases in dependency of bottled water.

Current AWG Application and Sustaining the Force (StF) Alignment

Combat Logistics Battalion 31, in support of the 31st MEU, conducted the first proof of concept in the Marine Corps with an AWG in support of EABO concept of logistics support. The battalion purchased a system which generates, purifies, stores, and distributes 238 gallons of ambient- and cold-temperature drinking water per day (according to manufacturer specifications). The AWG was trailer mounted and inserted via C-130 on the island of Tinian and displaced every eighteen hours supporting a company minus size element with water at the point of need. The AWG exceeded expectations producing at a rate of more than 400 gallons per day in support of water caches and organic support. The AWG contributed to the increased speed and velocity of operations. Data collected by the battalion was used to enhance potential acquisition by the Marine Corps.

AWG technology will directly impact the Marine Corps' ability to *Diversify Distribution* (StF Line of Effort 2) and *Improve Sustainment* (StF Line of Effort 3). This technology and capability is *resilient, scalable, and unpredictable* (StF Line of Effort 2). It is most definitely an alternative source of supply and falls under non-traditional 21st century foraging capable of supplying units forward (StF Line of Effort 3). AWG will improve lethality of the Marine Corps by maximizing the ability of commanders to employ tactical units across the depth and breadth of a nonlinear battlespace (StF Line of Effort 2), enabling the logistics enterprise to meet the demands of distributed operations and rapid displacement (StF Line of Effort 3).

Conclusion

Distributing drinkable water has been considered a wicked problem by world leaders and military commanders alike. Everyone is a stakeholder in the consumption of drinkable water. Providing drinkable water to everyone requires numerous solutions to work in concert with each other. There is no one-size-fits-all solution to this equation.

The time to act is now—by expanding upon current resources with AWGs. The global scarcity of drinkable water continues to grow. Distributed maritime operations against peer competitors require innovative thinking and disruptive technologies. Atmospheric water generation technology can support sustainability in a range of military operations from garrison to combat. The applications and benefits of AWGs remain undiscovered and await innovative employment. If implemented at the tactical level, AWGs can contribute to winning the next fight. If implemented at the strategic level, AWGs can contribute to mitigating the next fight.

On Target and On Time

Global logistics awareness through conditions based maintenance +

by Maj Michael Whitaker & Capt Elle Ekman

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To successfully support the *Commandant's Planning Guidance* and *Sustaining the Force*, maintenance, supply, and operational data should be leveraged to inform decision making, support the warfighter, and influence enterprise sustainment. Conditions based maintenance plus (CBM+) is a proven process that can be used to accomplish all these tasks. CBM+ is

> the application and integration of appropriate processes, technologies, and knowledge-based capabilities to achieve target availability, reliability, and operation and support costs of Marine Corps' systems and components across their lifecycle.[1]

How often do Marines wait on deployment? A convoy carrying ammunition, chow, and fuel halts because of an improvised explosive device or because a vehicle breaks down, and Marines wait hours for information, recovery, repairs, or mission critical supplies. Operations get delayed, and while they may get back on target, they will never get back on time. This wait for information, repairs, or supplies gets longer and becomes riskier as operating environments become more contested and distributed. As Gen David H. Berger pointed out in 2018 while still the Deputy Commandant for Combat Development and Integration, logistics becomes the pacing function for the Fleet Marine Force because every broken truck or failed resupply decreases combat power, impedes agility, and minimizes lethality.

In an alternate reality, instead of waiting, a commander has visibility across their vehicle fleet and can see issues as they occur, the parts and knowledge to conduct repairs are already positioned, and a new convoy is readied with minimal disruption. The commander understands the status of their forces, can assess combat power, and makes realtime decisions; commanders can save manpower, maximize lethality, and move on to the next problem. This alternate reality includes garrison maintenance efforts that ensure the success of artillery shoots or engineers conducting vertical construction. It would enable planning efforts and predictability in sustainment costs on a monthly and yearly basis.

The alternate reality of increased global logistics awareness and improved sustainment is possible with present

Every downed vehicle impacts the effectiveness of combat forces. *(Photo by LCpl Carla O.)*

technology and historically proven processes. Hardware, software, data, and algorithms combine to enable a concept known as CBM+. CBM+ is a system that changes how Marines act in response to equipment data that is collected, transmitted, stored, and analyzed. This data comes from original manufacturer manuals, historic maintenance and supply data, and sensors feeding realtime information. Instead of focusing on arbitrary time-driven maintenance actions, CBM+ "ensures maintenance is performed when needed rather than on a strict schedule."[2] CBM+ allows Marines to predict when something will fail and, because they know about the failure in advance, arrange to have parts on hand to quickly fix equipment. Maintenance becomes less reactive, and Marines will instead be able to effectively plan how to support the force.

Currently, commercial entities and other DOD organizations are using CBM+ to predict equipment failures, plan operations, and complete their missions more efficiently. Caterpillar (CAT), the world's largest construction equipment manufacturer, is a leader in the practice of conditions monitoring, which it integrates into everything from offshore oil rigs to heavy equipment. Conditions monitoring helps CAT to "make informed decisions based on real-world data" in order to control costs, improve performance, reduce risks, and manage people.[3] In one case, CAT used condition monitoring tools, oil analysis, and inspections to track diesel generators on oil rigs, ultimately extending the life of the generator, ensuring the success of the oil rig, and saving $60,000 per generator.[4] In other cases, CAT uses their fleet monitoring systems to ensure that operators are trained to operate equipment correctly; owners proactively rebuild engines to prevent unscheduled failures; and managers are constantly improving their operating procedures.[5] CBM+ is not, however, just for companies like CAT that monitor huge fleets of equipment; smaller companies have also taken advantage of CBM+. FIXD is a company whose mobile application and sensor leverage data feeds from personal vehicles.[6] Instead of going to a mechanic, drivers have a personal and mobile vehicle diagnostic tool on their phone.

Other Services have also used CBM+ to improve fleet readiness. In 2018, the Air Force included the B-1 bomber in its CBM+ program that already included the C-5.[7] The Army also has efforts dedicated to their CBM+ program. They have spent over ten years collecting and analyzing CBM data to inform maintenance, supply, and operator activities. The Marine Corps has much to gain from adopting CBM+ for its own logistical needs. For example, a lance corporal working in the supply management unit will no longer have to guess what parts they should include in the Class IX–supply block for a deployment. Because CBM+ focuses on predicting the likelihood of a parts failure, the lance corporal will only need to include the parts that are most likely to fail. This minimizes the operational footprint and maximizes the ability to repair equipment in a contested environment with limited reach-back support or transportation options. While this would change how Class IX blocks are built on a small scale for individual units, CBM+ would also enable precise planning on a large scale in support of prepositioning for expeditionary advanced base operations. Minimizing footprints and maximizing equipment availability is necessary for expeditionary advanced base operations, and CBM+ would become a critical enabler.

A corporal responsible for fixing equipment is told to prepare to conduct maintenance on an MTVR that has seen recent fluctuations in its sensor readings. The sensor data allows the corporal to begin troubleshooting the most likely causes and develop a plan for preventive maintenance when the MTVR finally gets back to the shop. In addition to saving time, the corporal is able to minimize future catastrophic failures.

From an enterprise perspective, equipment data can be transmitted, consolidated, and analyzed to improve fleet sustainment based on accurate cost projections. CBM+ will also save sustainment costs over the lifetime of the equipment. For example, a study completed in 2015 showed that if a predictive sensor, the Expeditionary Fluid Analysis System, was installed across the medium and heavy motor transport fleet, the Marine Corps would save approximately $6.5 million and approximately 60,000 labor hours over the course of two years.[8] This particular sensor focuses on monitoring the fluids that are closely related to vehicle health and whose changes are often a precursor to equipment failure.

Currently, commercial entities and other DOD organizations are using CBM+ to predict equipment failures, plan operations, and complete their missions more efficiently.

CBM+ has become a newfound priority for Marine Corps leadership and the DOD. Gen Berger stated in his *Commandant's Planning Guidance* that investments should focus on "data science, machine learning, and artificial intelligence" and "challenges we are confronting in … predictive maintenance, logistics, intelligence, and training"; that "we have significant data ripe for the application of these tool sets"; and that "it is not acceptable to waste resources because we lack the investments in infrastructure, processes, and personnel."[9] The Commandant's guidance makes clear that the use of data to analyze and influence decision making is paramount. CBM+ is a clear cut example that uses maintenance, supply, and operational data to predict and then influence maintenance actions and concepts of support.

Before the *Commandant's Planning Guidance* was released, Gen Berger,

while still the Deputy Commandant of Combat Development and Integration, published *Sustaining the Force, a functional concept for Future Installations and Logistics Development.* This document "describes the steps the Marine Corps will take to design, develop, and field a logistics enterprise for the 21st century in support of the future fight as defined in the National Defense Strategy."[10] One of the document's lines of effort is enhancing "Global Logistics Awareness." This focuses the Marine Corps' efforts to successfully "identify warfighter requirements," assess "where and when" those requirements are needed, and then adapt to changes in plans and requirements.[11] CBM+ is the process that will allow the Marine Corps to take advantage of the sensor-based, data-driven, and networked environment to ensure Global Logistics Awareness. Using sensors on equipment and historic data, Marines can plan for and adapt to changing operational requirements.

Even the former Secretary of Defense, James N. Mattis, turned his focus to readiness when he mandated in 2018 that fighter aircraft readiness needed to be raised to 80 percent.[12] This is what prompted the Air Force to pull data feeds from the Joint Strike Fighter so that they could predict when parts are likely to fail or when inspections are due. Recently, even Congress questioned what the services are doing in regard to predictive maintenance.[13]

This holistic focus on readiness, maintenance, and data analysis has found a foothold within the Marine Corps logistics enterprise. LtGen Charles G. Chiarotti, the Deputy Commandant for Installations and Logistics (DC I&L), reenergized predictive maintenance and CBM+ by forming a cell to focus Marine Corps CBM+ efforts. He recently reiterated his priorities by speaking at the National Defense Industrial Association's Expeditionary Warfare Conference on 23 October 2019, where he talked about requirements for "precise sustainment".[14] He said that Marines need "the ability to look at a platform and understand its health; to make decisions far removed from the battlefield and deliver for sustainment is critical for us."[15] While prioritized by DC I&L, the effort to make CBM+ maintenance processes a reality involves stakeholders from across the Corps (to include Marine Corps Systems Command and Combat Development and Integration) and is supported by entities like the Penn State Applied Research Lab and joint military agencies. Currently, CBM+ efforts focus on technology, processes, manpower, and policy. A CBM+ Marine Corps order was recently approved, and a Marine Corps CBM+ Roadmap will soon follow. Existing efforts include pilots that focus on weapons systems health through round-counting sensors, improving maintenance processes for legacy equipment, and wireless data transmission.

Operationalizing CBM+ in the Marine Corps will require changes to technology infrastructure, analytic capabilities, policy, and culture. Many of the roadblocks to CBM+, however, are roadblocks that exist systemically throughout the Marine Corps; many of these challenges revolve around the collection of data, data storage and cleaning, access to required systems and tools, having Marines who can perform detailed analysis, cyber security, and unwillingness to change from "how it's always been done."

For CBM+, data must be collected from disparate data streams to then be stored, cleaned, and analyzed before Marines can begin to predict how equipment can fail, how critical that failure is to the equipment, and what maintenance steps should happen. Tools based on that data can be used from the operator level to the enterprise level. Once there is an infrastructure to store and aggregate data, new tools like machine learning or artificial intelligence algorithms can drive even greater insights that can return value to Marines and increase their lethality in our increasingly contested and distributed environments.

All of these issues are worth overcoming if it means that gear will not break when it is most needed, and the Corps can use saved sustainment dollars to reinvest in modernization. Most importantly, CBM+ is the only way to be precise in fights where the Marine Corps has to be on target and on time.

Notes

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15. Ibid.

Moving Military Operations Forward

The railroad is as critical today as it was in the "days of old"

by MSgt Patrick Grabowski

Since 1869, when the last spike of the Transcontinental Railroad was driven, rail has played a vital role in America, linking the Atlantic to the Pacific. Moving goods to market, the railroad provides the infrastructure necessary for our Nation to compete globally as an economic and industrial powerhouse. As technology continues its meteoric advance, particularly on the battlefield, amateur logisticians may errantly dismiss the value of rail today. At home and abroad, its strategic worth continues to provide our military with the agility to move massive amounts of materiel during times of war; to subconsciously relegate rail to archaic practice is to forfeit the strategic advantage it avails.[1]

Rail was first leveraged for military advantage during the Civil War. It was the Union's superior rail infrastructure which gave it the logistical edge and, in some cases, the ability to even outmaneuver the Confederacy. As World War I and II unfolded, the strategic use of railroads became refined; the transport of millions of troops for forward deployment became common practice. Rail lines hauling coal, iron ore, and the steel needed to produce military supplies became indispensable, particularly when moving finished products to strategic bases, installations, and seaports.

At the onset of World War II, Joseph Stalin quickly recognized the USSR's inability to out-maneuver the Nazis without a robust railroad infrastructure. Over the vast swaths of land in Russia, Ukraine, and the Baltic States, construction began. Nearly 75 years later, Vladimir Putin effectively utilized the same Soviet era infrastructure to invade the Crimea in 2015. Not to be outdone that same year, the People's Liberation Army of China utilized its high-speed rail system to move an entire brigade over 300 miles in just under 4 hours. Satisfied with the proof of concept, in 2018 China spent $112 billion of its annual budget to continue modernizing its high-speed rail infrastructure. A testament to its rapid mobilization capability, the People's Liberation Army can now successfully move a division (minus) over 600 miles in under 5 hours.

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With the increasing capabilities of our global competitors and potential adversaries, it is imperative that the U.S. military lean forward in understanding opposing forces' rail innovations and effectively leverage the rail transportation industry for ourselves. Properly controlled, railroad is as critical to the modern U.S. military as it was in "days of old." With in-transit visibility (ITV) advancements and state of the art command and control, rail is still the king of overland movement.

Enabling Global Logistics Awareness

One of the key characteristics of the rail transportation industry is its global logistics awareness system. This system integrates ITV sensors which provide accurate enterprise-wide visibility and accountability of equipment. Currently within the rail transportation industry, redundant levels of ITV sensors exist. Each railcar is equipped with the radio frequency identification tag system, referred to within the industry as an automatic equipment identification tag, which provides real-world updates on the location, speed, destination, and current status of every railcar. The advantage of this system when applied to rail is that sending or receiving units can track very large amounts of equipment with a single search vice interrogating enumerable trucks from multiple carriers.

Through systems such as Railinc, the rail industry already has systems in place which provide continual data on all military movements. This can be utilized during the initial planning phase of a movement as it provides detailed, fact-based information on the movement timeline and capabilities of specific units. Similar to the MAGTF Deployment Support System or Sea Service Deployment Module, Railinc can provide granularity down to the lowest unit levels or collect and measure data for large-scale movements—such as the recent 2d MarDiv's movement from the East Coast to the latest MAGTF Warfighting Exercise in Southern California.

A recent shipment of M1 Main Battle Tanks from Marine Corps Logistics Base (MCLB) Albany to MCLB Barstow tested a new ITV sensor, which provides even greater detail. With the use of the telemetry tracker application attached to a specific vehicle, the shipping installation was able to track equipment via this web-based system. During this single shipment, the trackers provided over 25,000 updates both in motion and at rest. Through the use of the telemetry website, the shipping unit was able to provide detailed reports to higher headquarters on the location

and movement of the tank. In realtime, telemetry captured every change in action or location with a time stamp. The details show the arrival of various items, including shipments, assets, and sensors to the final delivery location.[2]

Diversify Distribution

The concept of diversifying distribution is characterized by resiliency, scalability, and unpredictable movements. Rail transportation provides a level of resiliency by identifying any threat level against a specific line or movement and then diverting shipments to alternate routes. Resiliency minimizes potential threats which might exist against any movement. Additionally, because rail requires a minimal number of personnel to move large amounts of equipment, the potential for loss of life is extremely limited.

With established longstanding routes and infrastructure, any form of sabotage taken against rail infrastructure can easily be detected prior to movement on the tracks. Through the use of inspectors and pre-run movements, any defects or attempts at sabotage can be easily identified and remedied in short order. Recent advancements in maintenance of the way technology, track maintenance, repair, and sensors have significantly improved the resiliency of track infrastructure.

Rail movement can be extremely scalable. When departing a port of embarkation, specific pieces of equipment may be loaded in such a manner that each specific "package," or set of equipment, can be loaded for each disaggregated unit. Through precision loading and load planning, much smaller movements can be dispatched via different routes to ensure successful delivery without incident. Use of telemetry trackers provide shipments realtime ITV offering situational awareness of all distribution movements to higher headquarters. This realtime visibility of movement allows commanders the information necessary to shift shipments on-the-fly as the mission dictates.

Moving large amounts of equipment into a specific region will likely start with ocean movement into a large port of entry. Throughout the world, major seaports are serviced by one form or another of rail infrastructure. The ability to plan and move equipment along unpredictable routes from a port is always an option. Europe, for example, has over 230,000 kilometers (143,000 miles) of rail infrastructure. Diversifying the movement of cargo at the point of embarkation allows the logistics planners to avoid utilizing the same routes and routines, which could be exploited by potential adversaries. The decision on which mode of transportation to utilize at the seaport would be based on the urgency of need and quantity of equipment to be moved.

Rail transportation is a global endeavor. *(Photo by Cpl Immanuel Johnson.)*

Improving Sustainment

At an operational level, the utilization of rail transportation in a contested environment would be ill-advised. This said, the importance of rail transportation during the War on Terrorism in Afghanistan cannot be overstated. The Northern Distribution Network, in which U.S. Transportation Command was the lead, turned to rail transportation as a vital supply line for operations in support of Operation ENDURING FREEDOM. With shipments departing German-based Defense Logistics Agency depots, these trains traversed Poland, Ukraine, Russia, Kazakhstan, and then continue by rail to Uzbekistan. The equipment and materials were then trucked or flown into the contested environment.

The utilization of rail to support large-scale movement helped speed the resupply and availability of equipment close enough to the battlefield so that other modes could be used to distribute materials and equipment to disaggregated units in a timely manner. Utilizing rail transport in this manner reduced transportation costs and transit times to more effectively support the warfighter.

Restaging of equipment within reach of battlefield commanders is another advantage of rail transportation. By preloading and staging equipment close to the front lines, commanders can better regulate and manage the war reserve equipment, materials, and supplies with positive inventory control methods in place.

For CONUS prepositioning and movement, installations such as MCLB Albany and MCLB Barstow provide power projection platforms for war reserve materials and equipment. MCLB Barstow is strategically located within 48 hours by rail of five separate seaports, which can be utilized for rapid deployment. Additionally, the base features multiple LZs, is located at the apex of two major interstates, and is within ten minutes from Daggett Airfield, which is capable of supporting C-130 and C-17 aircraft. Within a 45-min-

ute drive, Southern California Logistics Airport has two 9,000-plus foot runways. MCLB Barstow possess multiple capabilities and avenues in which to support the movement of large quantities of equipment to ports and Fleet Marine Forces rapidly and efficiently.

Optimizing Installations to Support Sustained Operations

As the Marine Corps continues to optimize installations in support of sustained operations, priorities must be established which focus on critical support functions such as readiness, training, deployment, employment, force protection, and sustainment. For the past several years, MCLB Barstow, which operates the DOD's largest throughput railhead, has been making sweeping changes in their rail operations as well as base operations to support such initiatives.

In order to leverage the advantages of rail in support of the Fleet Marine Forces, both CONUS and OCONUS, the primary focus must be on training. Prior to Operation IRAQI FREEDOM, Marines from across the enterprise were trained and practiced at conducting rail operations, oftentimes in support of training such as CAX. During the IRAQI FREEDOM and ENDURING FREEDOM missions, utilizing "green suiters" on the railheads became less a priority and the utilization of civilians and contractors became the norm. This provided additional downtime for Marines when not deployed and prevented unnecessary injuries. As well, the availability of other contingency operations (OCO) and global war on terror (GWOT) funds led to the use of more costly motor carriers during that time.

In 2013, with the dissolution of the OCO and GWOT funds, Marines became more judicious and frugal with their transportation funds. We reverted back to rail operations and quickly discovered the vast majority of the enterprise expertise was lost; we lacked the organic capability to properly conduct rail operations. In 2014, the Railhead Operations Group Training School was established at MCLB Barstow to teach Marines the skills necessary to leverage rail as an effective and efficient mode of transportation. Within three years, the course was recognized by HQMC Deputy Commandant Installations and Logistics as the Center for Excellence for Rail Operations training. Today, this course is the only intermediate or advanced training available in rail operations and conducts dozens of classes per year across CONUS and OCONUS locations. Railhead Operations Group Training School Classes for 04XX and 3112 Marines offered by MCLB Barstow include:

- 14-day rail operations subject matter expert certification.
- 90-day rail operations instructor certification.
- SOF-rail interdiction course was developed with U.S. Army Special Operations Command and U.S. Special Operations Command to train special operations force personnel DOD wide.

In 2014, the Railhead Operations Group Training School was established ...

Through training, advisory assistance, and installation analysis, instructors from the school have been able to incorporate more efficient processes at a variety of DOD installations, making rail operations a more effective mode of transportation. Recent major cost and time saving initiatives include a $6 million dollar savings for a unit destined to Alaska for annual training, a new location for operations to support weapons and tactics instruction movements in and out of MCAS Yuma, AZ, and a joint initiative with Surface Deployment and Distribution Command for west coast deployments to specific regions, cutting down sail times by nearly a month.

As the only training facility capable of certifying individual active duty personnel in rail operations, MCLB Barstow courses are also available to certify units in the mission essential tasks and mission essential task lists for rail operations. With creation of the new 90-day instructor development course, the school is now able to train and certify personnel to return to their home station as a certified rail instructor. This empowers units with an organic capability to train in-house. Courses are available in European Command, NATO, and Pacific Command operations and may even be tailored to the need of the specific students and units.

As the home to the West Coast War Reserve, MCLB Barstow is continually improving its position and ability to support the sustainment requirements of the Fleet Marine Forces. With an influx of trained, certified personnel, MCLB Barstow will continue its legacy of supporting the Marine Corps' logistical requirements.[3]

Conclusion

As written in the *Sustaining the Force in the 21st Century*, the end state identifies the need for "allowing commanders to outpace the enemies' decision cycle by being able to allow our logistics enterprise to deliver the right resources, to the right place, at the right time, for the right reasons."[4] Marine Corps logisticians would do well to view rail transportation as an effective and timely mode of movement for personnel and equipment in the 21st century. When it comes to large-scale movements of equipment, rail remains the prime mode to successfully accomplish this.

Notes

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Optimize Installations

Our need to support sustained operations

by Capt Brandon Barnes, John Holloway,
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Marine Corps Recruit Depot (MCRD) Parris Island is teaming up with other Marine Corps installations on the East Coast and collaborating with the University of North Carolina's Institutes for the Environment and Marine Science, Duke University Marine Lab, Attollo LLC, and Clemson's Center for Geospatial Technologies UAV and LiDAR (light detection and ranging) Program in an effort to integrate unmanned aerial systems (UAS) into natural resource management efforts. Funded by the Environmental Security Technology Certification Program, the collaborative project will provide an operational framework for Marine Corps Installations East to integrate UAS technology into present and future civilian-led management of natural resources. This effort will develop and validate UAS protocols and provide a training pathway to professional remote pilot certification for installation personnel; create and disseminate standardized UAS mission kits consisting of a quadcopter and fixed-wing drone; and integrate UAS technology through demonstrations that represent an array of applications for DOD natural resource management that exist across a broad range of installations. Aligned with the Commandant's line of effort to optimize installations to support sustained operations,[1] this project will ensure MCRD Parris Island continues to produce the finest quality Marines by providing modern, realistic training. This project will also provide commanders with a uniform, safe, and effective starting point for UAS employment in natural resources monitoring that can be readily expanded to other areas.

MCRD Parris Island boundary. *(Map provided by Capt Brandon Barnes.)*

Low Country Adaptation and Resilience

Changes in the environment affect personnel, resources, and facilities. The use of UAS support to management of natural resources aboard MCRD Parris Island will enhance overall Force Protection, through earlier detection of vulnerabilities and threats.[2] MCRD Parris Island is a collection of several islands, located about halfway between Savannah, GA, and Charleston, SC. The entire property is approximately 8,000 acres, half of which are salt marshes and tidal creeks that are inundated by tides twice daily. The land elevations on MCRD Parris Island range from mean sea level to only 22 feet above mean sea level.[3] The DOD manages 128 coastal installations with significant mission assets, and those along the

Horse Island boat ramp at high and low tide. *(Photo by Capt Brandon Barnes.)*

Atlantic Coast exhibit high vulnerability to sea level rise (SLR) and extreme storm events.[4] Catastrophic events occur against a backdrop of higher frequency and chronic effects from SLR .[5] While a full spectrum of solutions will be required to address the scale of threats across coastal installations, using natural coastal marshes can be a pivotal part of that strategy. Considering the extent of marshes surrounding MCRD Parris Island and the surrounding broader landscape, it is important to maximize the natural ability of marshes to provide a thriving ecosystem able to adapt to SLR. Although salt marsh loss because of inundation or erosion at the shoreline can be offset by transgression toward uplands, MCRD Parris Island already has limited upland space for facilities and training areas. Better understanding of wetlands delineation, especially over time, will help the Depot properly manage these natural resources. UASs provide reliable and sustainable platforms from which to monitor shorelines and wetland-upland boundaries, both in realtime and through long-term data collection.

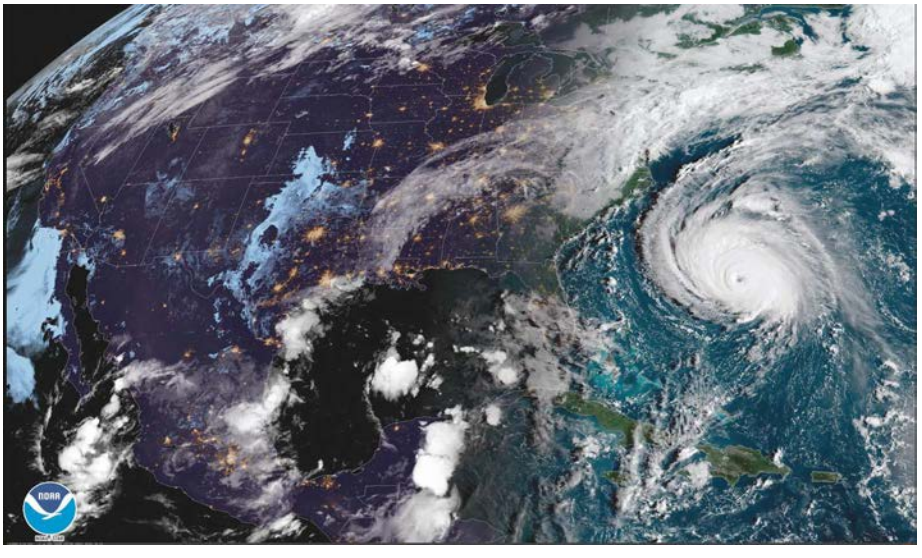
With sufficient sediment, coastal marshes have the ability to increase their surface elevation. By trapping sediment during tidal events, and increasing belowground root production, marshes are able keep pace with SLR over millennia.[6] This resilience provides a low maintenance and self-sustaining natural buffer that can protect both coastlines and infrastructure. Fringing coastal salt marshes provide many benefits to coastal installations and communities including erosion control, water purification, fish and wildlife habitat, recreation, and carbon sequestration.[7] Although salt marshes have some capacity to grow vertically and keep up with SLR, erosion at the salt marsh shoreline because man-made and natural forces tends to reduce salt marsh area. Furthermore, reducing salt marsh width decreases wave dampening and the capacity of a salt marsh to buffer a military installation from erosive wave and storm energy. Even during extreme events when water levels are at a maximum and waves are highest, experiments show that salt marsh vegetation accounts for up to 60 percent wave reduction.[8]

Paving the Way

As a cost effective and efficient platform to collect a wide variety of data, UASs can be used to more effectively monitor and manage natural resources. The benefits of integrating UASs into DOD natural resource management are numerous and transformative. Employment of UAS can improve the quality and efficiency of data collection and

SenseFly eBee fixed-wing. *(Photo by Susan Cohen.)*

MCRD Parris Island yellow footprints. *(Photo by Capt Brandon Barnes.)*



NOAA 2018, Hurricane Florence. *(Found at https://www.star.nesdis.noaa.gov/GOES/index.php.)*

open doors to new capabilities to help understand challenging environments. For large organizations with unique sets of management drivers and requirements such as the DOD, UASs can be a transformative tool for natural resource managers as well as other installation staff. Demonstrations of comprehensive, non-intrusive wetland monitoring focused on marsh migration, coastal erosion, and storm impacts are well-suited to the low-gradient topography of MCRD Parris Island. Use of UASs for environmental applications also provides unique, career-enhancing opportunities for DOD civilian employees, opportunities for collaboration with research institutions, and—most importantly—can be integrated into existing geospatial information systems, such as GEOFidelis, to help inform decisions at all levels.

By teaming up with other Marine Corps installations and collaborating with outside scientists, MCRD Parris Island is taking a deliberate approach to integrating UASs into their natural resource management efforts. Using the non-prescriptive Climate-Smart Conservation Guide developed by the National Wildlife Federation,[9] MCRD Parris Island is currently updating its Integrated Natural Resource Management Plan and incorporating UASs. By doing so, MCRD Parris Island will be able to more efficiently manage its natural resources while sustaining its mission of making Marines.

We Make Marines

MCRD Parris Island is one of the three Service-level training installations in the Marine Corps and has the critical mission of making Marines. It is the second oldest facility in the Marine Corps and has been the home for recruit training since 1915. Generations of men and women have stepped onto the yellow footprints to hear:

> You are now aboard Marine Corps Recruit Depot Parris Island South Carolina, and you have just taken the first step toward becoming a member of the world's finest fighting force, the United States Marine Corps.

However, extreme events like hurricanes and tropical storms continue to chal-

Malecon Drive during and after Tropical Storm Irma. *(Photo by John Stroud.)*

lenge MCRD Parris Island's ability to perform its mission.

Parris Island has seen its share of near misses. Hurricane Hugo in 1989 and Hurricane Floyd in 1999 both had tremendously destructive impacts to the coast of South Carolina but ultimately spared MCRD Parris Island the worst of the destruction seen in nearby counties and states. By the time Hurricane Florence reached MCRD Parris Island in September 2018, the winds, rain, and storm surge had mostly diminished, but it served as a stark reminder of the precarious situation of coastal military installations. If Hurricane Florence had made landfall in Savannah, GA, instead of near Wilmington, NC, MCRD Parris Island would likely have sustained catastrophic damage. In 2016, Hurricane Matthew was downgraded to a category one hurricane when it hit the coast just south of Charleston, and yet caused significant damage aboard MCRD Parris Island. Even tropical storm Irma, in 2017, caused significant impacts from storm surge, with flooding roads and debris hindering road movement.

It is not just the extreme weather events that challenge the ability of MCRD Parris Island to meet its mission. Localized flooding from heavy rain combined with high tides, in and around training areas, is a common challenge that impedes training. The problems associated with flooding are compounded by a high-water table, low topography, poorly drained soils, and an aging stormwater infrastructure. The Depot continues to wrestle with the inherent challenges associated with maintaining the facilities over time in this dynamic environment. The planning and execution of facilities development, whether for infrastructure or training needs, must consider the future environment and sustainability. For example, MCRD Parris Island recently finished construction at Inchon Range—the first of a four-phase range improvements and modernization effort. Although a major

Localized flooding around 4th Battalion obstacle course. *(Photo by Capt Brandon Barnes.)*

Inchon Range drainage basins. *(Photo by Capt Brandon Barnes.)*

part of the range improvement effort was raising the firing lines an additional nine feet to ensure continuous operation during high tide events, it is possible for the new drainage basins to convert to salt marsh as wetlands migrate inland—decreasing the amount of upland terrain around the ranges. However, as wetlands migrate inland, it is possible for the new drainage basins to convert to salt marsh. As long as recruit training takes place in the lowcountry, MCRD Parris Island will need to adapt to this dynamic environment.

Natural Resource Management

With a staff of fifteen civilians and one Marine officer, the Environmental Office at MCRD Parris Island is tasked with maintaining the critical balance of natural resource management while sustaining realistic military training for future generations of Marines. The three natural resource professionals in the environmental office include the natural resource manager, a wildlife biologist, and the conservation law enforcement officer. To meet their objectives, this team must develop innovative solutions and approaches to monitoring and managing natural resources aboard the Depot. The impacts of SLR can be seen today at MCRD Parris Island with more frequent flooding, especially during spring high tides and signs of salt water intrusion. Using the DOD database, regionalized sea level change scenarios, and extreme water level statistics, sea-level rise is predicted to be 3.4 feet above current mean sea level in 2065. A notable quantifiable impact of such a rise in sea level is a loss of approximately 40 percent of the training area. Over time, these impacts will be felt across the Depot. The ability of MCRD Parris Island to continue its legacy and mission into the future will depend on the resilience of the landscape and infrastructure.

Examining changes in salt marsh areas advances our understanding of salt marsh resilience and improves best management practices by providing high resolution metrics of spatial and biological change. The salt marsh-upland boundary is difficult to map using aerial photography collected from a

The problems associated with flooding are compounded by a high-water table, low topography, poorly drained soils, and an aging stormwater infrastructure. The Depot continues to wrestle with the inherent challenges associated with maintaining the facilities over time in this dynamic environment.

Jericho Island salt marsh. *(Photo by Capt Brandon Barnes.)*

fixed-wing aircraft because this interface is commonly obscured or hidden by tree cover. In addition, aerial photographs are seldom available at both inter- and intra- annual time scales, a requirement for examining storm impacts to both upland and shoreline boundaries. UAS surveys can address broad wetland dynamics including marsh die-off and recovery as well as shoreline changes. Understanding changes in wetland extent and condition will give natural resource managers the information to take proactive management steps to delay or even reverse negative trends. Using UAS technology expands the role of the manager in planning and collecting data on limited, finite land resources at MCRD Parris Island.

... human-snake interactions are almost always problematic.

Eastern Diamondback rattlesnake. *(Photo by by Emily Mausteller.)*

Eagle nest in 3rd Battalion pond. *(Photo by John Holloway.)*

Changes in finite land resources can also have an impact on wildlife that currently inhabit areas potentially, directly or indirectly, impacted by SLR and a changing climate. For example, the Eastern Diamondback rattlesnake on MCRD Parris Island spends a large portion of its life on the marsh edge, which is inundated daily. With more frequent flooding events, they adapt by heading to slightly higher ground that, in some cases, is in training and other areas where interactions with people become more likely. Coupled with potentially being listed under the Endangered Species Act, human-snake interactions are almost always problematic. However, this behavior is not limited to eastern diamondback rattlesnakes. Other wildlife, such as osprey and bald eagles, share a similar story. These species nest on the edge of the terrestrial-salt water environment. Bald eagles nest in live pine trees; however, if these trees are continually inundated by salt water, they will not survive, pushing the birds to adapt by moving into more upland areas, and possibly closer to humans. This relocation may affect both nest success and utilization of training areas. Nest monitoring is difficult from the ground, and UASs offer additional methods to collect data for nest monitoring across the Depot, including small islands only accessible by boat. Forestry is another area that will benefit greatly from UAS applications. UAS will be used to monitor and record timber stands, controlled burning, canopy coverage, timber value, and even tree mortality.

MCRD Parris Island is committed to sustaining the forces in the 21st century. As a Service-level training installation, MCRD Parris Island supports the entire Marine Corps. Changes in the environment may pose a threat to making Marines, but this project will greatly increase MCRD Parris Island's ability to adapt and respond accordingly. The use

of UASs will not only improve current natural resource management practices by enabling data collection and analysis in order to support these practices but will assist with understanding impacts because of SLR. It is difficult to assess the magnitude, speed, and acceleration of impacts because of constant tidal inundation, extreme high tides, and storm events on the death of vegetation at the fringe without this ability to collect data and subsequently analyze it. This in turn can help MCRD Parris Island manage land resources and training requirements into the future, aligning to critical overall support functions of providing readiness, training, deployment, employment, force protection, and sustainment.[10] MCRD Parris Island may be one of the first Marine Corps installations to deal with significant impacts because of SLR. This project will help optimize MCRD Parris Island to support sustained operations.

Notes

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10. *Sustaining the Force in the 21st Century.*

Fuel Distribution

Today's plan to use yesterday's technology tomorrow

by LtCol Brad Klusmann

The *Commandant's Planning Guidance* frames the Marine Corps as a legacy force both inhibited and unable to move past 20th century technology, doctrine, and organization. It demands that the Service assess how it organizes, trains, and equips to execute its core competencies. The resultant formations must enable self-sufficient units that can operate in and seamlessly transition between the contact, blunt, and surge layers to increase the lethality, protection, and operational reach of the MAGTF while retaining the ability to mass.[1]

This statement from the *Marine Corps Functional Concept for MAGTF Engineering* captures the spirit of *combat credibility* and is explicit in the fundamental transformation required of capabilities spanning the range of military operations to achieve alignment to the 2018 *National Defense Strategy* and *Defense Planning Guidance*.

In its current configuration, the joint force and Marine Corps' bulk fuel distribution capability will not enable the naval force to achieve combat credibility because of the combined effects of the ever-increasing speed of conflict and the five drivers-for-change that define the future operating environment: complex terrain, technology proliferation, information as a weapon, battle of signatures, and an increasingly contested maritime domain.[2] These factors will negatively impact the deployment, employment, and redeployment cycles of bulk fuel delivery networks within contested environments against peer competitors. In this article, the doctrine of bulk petroleum operations—*providing the right fuel, in the right place, and at the right time*[3]—will be presented through historical context and current application so gaps can be identified. This approach links institutional reliance on historical precedence for perspective to validation through commercial industry metrics for efficacy.

Hose reel system (HRS) employment, Operation IRAQI FREEDOM I (OIF I). *(Photo courtesy of CW05 Luc Brennan.)*

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Velocity, agility, and *accuracy* are the three measures of effectiveness (MOE) that will be utilized to analyze the application of bulk petroleum operations spanning 75 years—we will first review the past, then address contemporary utilization, and finally address the future. Petroleum industry companies like XRI Holdings, LLC, utilize these MOEs (or what they refer to as key performance indicators) to adjust plans, resource allocations, and influence advancement toward defined end states.[4] While it is recognized that commercial sector standards of competition are market forces, not enemies attempting to destroy them, the MOE definitions are flexible enough to reveal the glaring capability gaps with bulk fuel distribution and detect opportunities to inform gaps' solutions. Ultimately, filling the bulk fuel distribution capability gap must become an institutional objective to enable naval force combat credibility. To make this happen, the Service will need to divest from efficiency, invest into resilience, or combine solutions where it makes sense.

MOE

Velocity is efficiency, capacity, and speed moving toward an objective (or objectives) within a system. Velocity works best in linear, relatively static, and predictable environments associated to phase IV and V operations in the joint operations phasing model. Achieving velocity implies an ability for the force

to sufficiently control interior lines. Velocity's correlative effectiveness will diminish as relative compounding effects of the five drivers-for-change appear within an operating environment, as unpredictability and friction intensify during contact to blunt layer transitions and phase II and III operations, and where resilience is not a constraint.

Agility is resilience of a distribution network and can be applied to models of responsiveness, modularity, and adaptability. Agility is best associated to a distribution network's ability to rapidly deploy, employ, respond, and adjust to its operating environment to achieve maximum effectiveness. Agility implies continuous and timely delivery—regardless of environment—and not just a single rapid transfer that degrades over time. It is a desirable metric in operating environments characterized by uncertainty and where control of interior lines cannot be assured.

The final MOE, accuracy, is the precise delivery of wholesale, retail, or kiosk capabilities and capacities to an organization at a specified time and place. Accuracy must always be achieved to ensure tempo is maintained relative to the speed of conflict. For a capability to be effective, accuracy must be combined with velocity or agility.

The Past

World War II marked the beginning of modern theater bulk fuel distribution as it developed as a critical requirement to maintain tempo. Emerging technologies spanning the domains of land, air, and sea created a tremendous demand for fuel in both the Asiatic-Pacific and African-European theaters. As such, bulk fuel accounted for over half of the tonnage delivered during the war.[5]

World War II marked the beginning of modern theater bulk fuel distribution as it developed as a critical requirement to maintain tempo.

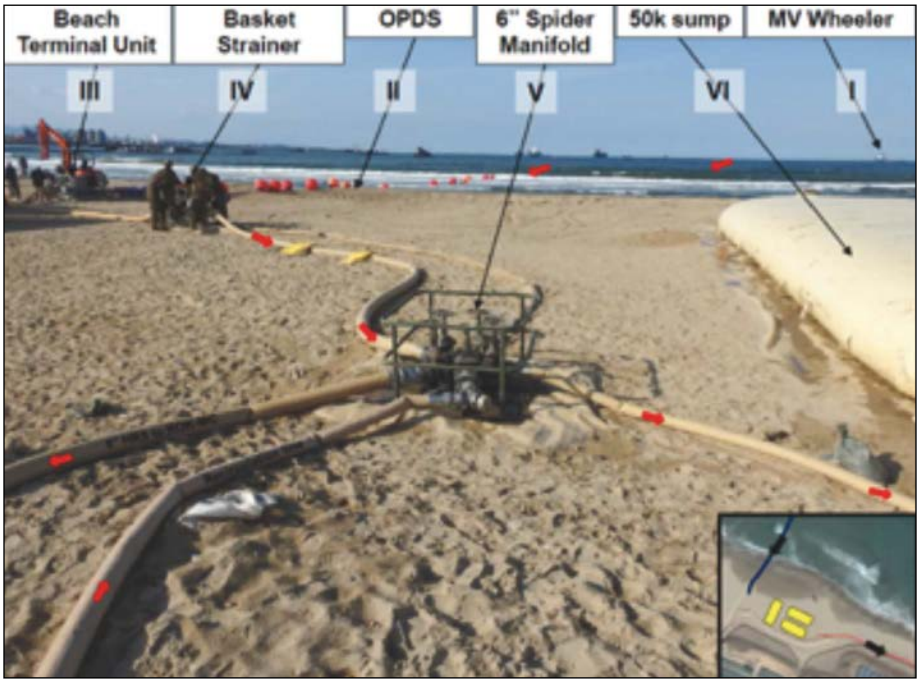
Military and industrial partnerships filled both theaters' capability gaps through the creation of a pipeline distribution solution called the invasion-weight pipe, which was later designated lightweight steel tubing (LWST).[6] This solution combined the capabilities of ship-to-shore and inland-from-shore technologies to achieve both accuracy and velocity in the distribution of bulk fuel. Slow system deployment, employment, and long decision cycle timelines contributed to the system's failure to achieve overall agility. Within the African-European Theater, fuel distribution networks, which spanned from ports to refineries to airfields, were prevalent. Combined fuel distribution network distances aggregated from short-, medium-, and long-range pipeline construction were well over 1,000 miles.[7] While this system was revolutionary for the time, its linearity, signature, and multiple single points of failure created an exploitable culmination mechanism because of its inherent lack of redundancy. In both the Asiatic-Pacific and African-European theaters, distribution networks achieved velocity and accuracy, and they were largely successful because of allied controlled interior lines and absence of the five drivers, which effectually averted the need for agility.

During the Vietnam War, the employment of fuel distribution networks initially befuddled engineer planners because of the *complex terrain* in which it was employed. Bulk fuel distribution started off as a complicated network of tanker ships, barges, and aircraft wholesale delivering 55-gallon drums of fuel for retail distribution by both military and host-nation commercial trucking.[8] This distribution method achieved accuracy and moderate levels of agility but lacked velocity. The system struggled to maintain the tempo of a force, and agility was irrelevant because of the relatively static nature of phase IV and V operations. Ultimately, the complex terrain—both human and environmental—undermined the resilience of the network. Eventually, commanders were no longer willing to expose the force to risk for negligible gains in agility. Consequently, they adjusted their bulk fuel distribution network to resemble a capability comparable to solutions utilized during World War II. Predictably, this solution was able to meet demand at

MV* Wheeler *Offshore Petroleum Distribution System (OPDS) connection to the Beach Terminal Unit (MV* Wheeler *in the background). *(Photo by 3D MEB COMSTRAT.)*

both wholesale and retail levels and reduced reliance on trucking and aircraft resupply. The solution "utilized legacy LWST pipelines for both ship-to-shore and inland-from-shore methods of delivery, and distributed fuel directly to areas of high demand."[9] These pipelines ran through semi-permissive environments to airfields in spans of 25 miles or less, and "losses due to spills, pilferage, and contamination were estimated at 2.5 million gallons a month."[10] Regardless, the refined solution was able to achieve accuracy and velocity but unsurprisingly lost agility. While strategic victory was not achieved during Vietnam, operational- and tactical-level objectives were attained with consistent regularity, due in part because of the velocity and accuracy of the bulk fuel distribution solutions.

Following the Vietnam War and prior to the Persian Gulf War, the LWST was no longer a viable solution for both ship-to-shore and inland-from-shore wholesale distribution. The system was not functional, as remaining components were not mission capable.[11] A capability gap formed based on concerns about its enormous signature, which led to the development of the Army's Inland Petroleum Distribution System (IPDS) and the Navy's OPDS. Both systems were improved solutions over the LWST and were interoperable in the transportation of wholesale bulk fuel from ships to the high-water mark, then from the high-water mark to inland distribution points. The Persian Gulf War marked the first time that IPDS was employed within a combat theater.[12] The utilization of the system proved to be a challenge for engineers, as the system's enormous logistical footprint delayed its deployment and subsequent employment. Alternative methods for fuel distribution had to be identified and executed to support the Coalition Joint Task Force Commander's main effort—advancing combat power forward. Delays in employment were caused by complex terrain and the inherent friction and uncertainty associated with phase III operations. While the pipeline was deployed in a permissive environment, host-nation governments stalled the employment of the IPDS over concerns regarding impacts to both the environment and pattern of life of its citizens. At the conclusion of the war, 260 miles of pipeline had been employed, but they were never utilized.[13] While this system increased velocity relative to its predecessor's capabilities, its drawback was that the concept of employment remained the same. Exacerbating its diminishing relevance was its adaptability to complex terrain and employment in support of phase II and III operations. This system's linearity, enormous signature, and long decision



Bulk Fuel Company, 9th Engineer Support Battalion, 3D MLG Beach Terminal Unit, from the OPDS MV* Wheeler *to the amphibious assault fuel system, beach unloading assembly, in the Republic of Korea during Exercise SSang Yong 16. *(Photo by 3D MEB COMSTRAT, identification graphics by CWO2 Kyle Babka.)*

Marines employ the Hose Reel System during OIF I, somewhere in Iraq. *(Photo courtesy of CWO5 Luc Brennan.)*

HRS emplacement during OIF I, Iraq. *(Photo courtesy of CWO5 Luc Brennan.)*

cycle never achieved agility, and its ability to influence the outcome of the war never came to fruition.

The War in Iraq was supported with the same bulk fuel capability solutions as previous wars; the Army and Marine Corps ran parallel bulk distribution systems but at longer ranges. The Army employed the IPDS, and the Marine Corps employed the HRS.[14] The Marine Corps' HRS was doctrinally intended to be employed as a retail system but was utilized in wholesale distribution. The relatively static operating environment determined by phase IV and V operations facilitated the concept of employment of both systems. Both the Army and Marine Corps were able to achieve velocity and accuracy. At the conclusion of the war, the Army had employed and utilized 182 miles of the IPDS, and the Marine Corps had employed and utilized 90 miles of the HRS.[15] Relative to the irregular threat, both bulk fuel distribution systems were able to maintain tempo but did so within the context of relatively static phase IV and V operations. The Army registered significant fuel losses from the employment of the IPDS because of pilferage.[16] This fuel loss was largely indicative of the longer distance between pumping stations with the IPDS as compared to the HRS. Complex terrain, coupled with the moderate control of interior lines, created a semipermissive environment that ultimately impacted the IPDS's velocity. While the solution that filled this capability gap was sufficient to maintain the tempo, it was largely enabled through the static precepts of phase IV and V operations. Similar concepts of employment utilizing these solutions, because of their inherent lack of agility, would become increasingly ineffective as operating environments became more fluid.

The United States is still using mid-20th century capability solutions to distribute fuel in the current operating environment.

Current

The United States is still using mid-20th century capability solutions to distribute fuel in the current operating environment. Bulk fuel distribution systems remain linear and adhere to wholesale and retail distribution models, which are adequate in the static predictability of post-phase III operations or when the control of interior lines can be assured. These systems, the organizations that employ them, and their associated doctrine were never fully adapted for fluid operating environments. Under the current approach, the compounding effects of increasing speed of conflict and the drivers-for-change will continue to degrade the effectiveness of legacy bulk fuel distribution. This observation is built on the belief that current capability solutions will continue to be employed in fluid uncertainty—because there is no alternative.

As the Marine Corps endeavors to become an adaptive force designed to seamlessly transition between the contact, blunt, and surge layers, bulk fuel distribution capability gaps will require solutions optimized to provision forces across range of military operations. The divergent MOEs of agility and velocity will always be necessary to support accuracy, but these metrics need to be balanced by risk against a peer competitor. As previously demonstrated, and throughout history, agility was never consistently achieved above the tactical level and still does not appear to be an institutional objective. Precedence shows agility is not only a gap but a constraint to attain combat credibility. In order to address solutions, a quick look at the historical examples reveal the current distribution capability has

Dracone attached to hydraulic pump, Bishop's Point, Hickam Field, HI (April 2015). *(Photo by CWO5 Michael Neill, USMC[Ret].)*

an enormous signature, is linear, and has long associated decision cycles. This establishes that correlative solutions influenced by deception, economy of scale, and global logistics awareness will be required to inform and modernize capability solutions.

Future

The *fait accompli* of a fluid operational environment controlled by the five drivers, multi-domain transitions, and an institutional aversion to change has forced the Marine Corps into an inextricable dilemma: evolve or be dominated by peer competition. Over the past 75 years, the lack of operational need to achieve agility has generated institutional apathy, which led to the obsolescence of bulk fuel distribution solutions. To achieve agility in bulk fuel transfer and gain combat credibility in the future operating environment, the following three opportunities—derived from historic deficiencies—must inform gap solutions: deception, economy of scale, and global logistics awareness. Solutions informed by these opportunities, coupled with legacy bulk fuel distribution solutions, could evolve the capability into a hybrid bulk fuel distribution solution optimized to support an adaptive force. In other words, hybrid solutions would maintain velocity and accuracy through legacy bulk fuel distribution solutions in static operational environments and attain agility and accuracy with innovative fuel distribution solutions amidst fluid unpredictability.

The first opportunity, economy of scale, creates the virtues of mass without the vulnerabilities of concentration.[17] In this context, solutions that support the agility gap would be focused on the employment and control of multiple mobile fuel delivery systems that operate dispersed and provide risk-worthy platforms that enhance the mobility and transportability of bulk fuel. Instead of concentrated stocks of wholesale bulk fuel within ship stores and fuel farms ashore, low-cost mobile platforms—able to receive transferred fuel stocks—would move to and reside in shallow water harbors, rivers, deltas, and coastal waters.[18] These solutions would support maneuver units

One million–gallon fuel farm, 9th Engineer Support Battalion, Bulk Fuel Co, Central Training Area, Okinawa, Japan (January 2017). *(Photo by LCpl Roland James.)*

that possess limited abilities to receive and distribute fuel. Standards informing these solutions would be inexpensive, mobile, remote, and autonomous systems capable of multiple domain transitions and massing and disaggregating based on operational demand. The utility this provides would enable naval force lethality through responsive flexibility in multiple domains and reduce the need for secured interior lines. The non-linearity of the system would remove the legacy systems' exploitable culmination mechanism and amplify resilience.

The second opportunity, deception, informs standards of signature obscuration and the utilization of decoys. Specific solutions to the agility gap would include construction scale additive manufacturing, which creates decoy refueling points; user-defined signature amplification and masking capabilities, which create minimal or increased optical, infrared, and electromagnetic signatures; hide in plain sight platforms, which saturate an operational environment that have the same visual and electromagnetic signature as commercial vessels;[19] and subterranean or subsurface employment to reduce signature. Deception is dependent on original concepts of deployment and tactical-level innovation informed by operational-level guidance. Certain aspects of deception, like decoys, reduce efficiency, but the resilience attained would be through the uncertainty achieved.

… hybrid solutions would maintain velocity and accuracy through legacy bulk fuel distribution solutions in static operational environments and attain agility and accuracy with innovative fuel distribution solutions amidst fluid unpredictability.

The third and final opportunity, global logistics awareness, informs reduction in decision cycles, enables network degraded environment operations, and facilitates responsive delivery

across multiple domains. Possible solutions would be decision support tools to generate predictive demands based on minimal information from the joint integrated data network; enhanced information management processes; and user-defined situational awareness tools that enable faster decision timelines and ensure responsive air, land, and surface delivered supplies from wholesale distributed fuel warehouses to kiosk-level end-users.[20] These solutions would achieve resilience by outcycling a competitor's decision cycle, reducing the joint force and Marine Corps' decision cycle, and eliminating the petroleum lake ashore by removing the middleman.

Bulk fuel distribution solutions informed by the stated opportunities would achieve the compounding effects of agility and accuracy in the future operating environment. More importantly, solutions informed by these opportunities, and combined with legacy fuel distribution solutions, would be employed as a hybrid capability to give the naval force both the resilience and efficiency necessary to support accuracy—and enable it to achieve combat credibility.

Conclusion

In order to be able to compete in the future operating environment, the Marine Corps must move past its obsession with 20th century technology, doctrine, and organization and must align to the 2018 *National Defense Strategy* and *Defense Planning Guidance*. This fact is clear as bulk fuel distribution has not changed much over the past 75 years and has not been forced to change by operational need. Throughout the historical examples, no precedence was ever established of velocity and agility existing concurrently to support accuracy within the same operating environment. More importantly, agility was never achieved in any of the examples above the tactical level for any measurable amount of time. This highlights a capability gap that detracts from force resilience.

As the Marine Corps endeavors to adapt to the changing character of war, the increasing speed of conflict, and the five drivers-for-change, a hybrid bulk fuel distribution capability that is flexible enough to achieve all three MOEs will become necessary to enable the naval force to gain and maintain combat credibility through contact, blunt, and surge layer transitions. If nothing is done, legacy bulk fuel distribution solutions will culminate early or be dominated by peer competitors due to systemic inflexibility. As demonstrated through historical context, a hybrid bulk fuel distribution solution with legacy systems continuing to support in static operational environments to gain efficiency and modernized solutions—informed by the opportunities of deception, economy of scale, and global logistics awareness—and continuing to be employed in fluid operating environments to gain resilience will fundamentally transform this capability and enable an adaptive force. Ultimately, bulk fuel distribution will enable naval force combat credibility—but only if filling the gap of agility becomes an institutional objective.

If nothing is done, legacy bulk fuel distribution solutions will culminate early or be dominated by peer competitors because of systemic inflexibility.

Notes

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Admiring the Bulk Fuel Problem

Providing fuel and energy sustainment

by CWO4 Robert Y. Lee

The Navy and Marine Corps remain stuck in a perpetual cycle of bureaucratic, uninformed, and costly organizational factions that hinder the progress of providing the most optimal fuel and energy sustainment to enable flexible, agile, and mobile combat operations against a peer adversary. Immediate changes are needed in organizational structure and joint fuel policies by the Department of Navy (DON) and DOD to address the bulk fuel problem. Many of these changes can be made internal to the DON with a small investment of personnel and reshaping of existing bulk fuel billets.

While this article is not intended to delve into the technical aspects of the different Service regulations or policy, it is intended to spur discourse into the increasing need for the uniformity of fuel doctrine, regulations, and policy across the Services. This need is based on our current military posture and the adversary's projected military advancements and global financial status in the next ten to twenty years. Our recent *National Defense Strategy* highlighted several areas of imminent concern around the world with a strong focus on the Pacific operating environment. While the DOD has begun several innovative and important energy initiatives in recent years, the military's dependence on diesel and kerosene-based fuels still presents a true vulnerability to our posture in the region.

Current Navy and Marine Corps bulk fuel capabilities are credible and capable in conventional land-based and afloat operations. This means that if the DON remains committed to winning the littoral fight as described in the concepts of *Littoral Operations in a Contested Environment* (LOCE [Washington, DC: HQMC, 2017]), *Expeditionary Advanced Base Operations* (EABO [Washington, DC: HQMC, 2018]), and *the 38th Commandant of the Marine Corps Planning Guidance* (38th CMC CPG [Washington, DC: HQMC, 2019]) the Navy and Marine Corps must divest itself of legacy policies, doctrine, and outdated operating concepts.

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In 1942, Fleet Admiral Ernest King, the Chief of Naval Operations, made a statement, "I don't know what the … this 'logistics' is that Marshall is always talking about, but I want some of it." ADM King was referring to GEN George Marshall, who served under both Presidents Franklin D. Roosevelt and Harry S. Truman and is credited with organizing the Allied victory in World War II. This quote and many others on the importance of logistics exist and modern leaders often revel in the thought of prioritizing logistics' initiatives under their watch. These moments of senior leadership motivation are often short lived and often give way to other "easier" fixes and agenda items once it is revealed how large the task at hand will be.

Many witnessed or were a part of the "operational pause" echoed throughout

Medium tank comes ashore with a rush. Fuel in the foreground will keep tank in operation. Marines worked tirelessly to keep the atoll supplied with fuel. Samoa-October 1942. *(Photo from historylink101.com.)*

I MEF LCpl Sebastion, a Bulk Fuel Specialist with Marine Wing Support Squadron 371, pulls a fuel nozzle to a Lockheed Martin F-35 Lightning II during jump forward arming and refueling point operations at advanced Naval Base San Clemente Island, CA, during Exercise Pacific Blitz 19. *(Photo by LCpl Tia Carr.)*

the battlefield during the March Up to Baghdad. The joint force witnessed an entire U.S. Army Corps come to a halt because their vital fuel supplies were struggling to meet the enormous demand of the 3d Infantry and 1st Armored Divisions. Over 15 years after the operational pause of "Old Ironsides" and the "Marne Division," and almost 76 years since ADM Fletcher and Gen A.A. Vandergrift's orchestrated offensive into Guadalcanal during Operation WATCHTOWER, we have yet to realize a fuel supply chain and an equipment acquisition process that operates with a single fuel for both aviation and ground capabilities, that is available worldwide, and in sufficient quantities to meet our ever increasing demands.

While uniformity across the Services in all logistics activities and processes may not be beneficial, the benefits to the Services across DOD would be noteworthy were we to adhere to a uniform bulk fuel doctrine, regulation, and policy. To this end, military aircraft could share a single policy for the type(s) of fuel that may be utilized; ground and aviation platforms would have interchangeable fuel; and global coalition strategies could then amplify the need to align supply chain strategies, increasing our survivability and ultimately resulting in our resiliency and superiority. If we stay the current course, the DON will continue to face outdated fuel supply chain policies, fuel operations doctrine, regulations, and accountability measures that will only stymie progress and increase the gap between ourselves and our adversaries.

Obsolete fuel management business practices are further exacerbated by not investing in the placement of the right fuel subject matter experts in the right commands throughout the MAGTF and joint world. The Marine Corps remains reliant on the Navy to do our bidding for aviation fuels and on the Army to solve our ground fuel policy challenges for the MAGTF. In order to present and advocate for the unique challenges of employing Marine Corps capabilities, appropriate subject matter experts must be given increased authority and placed in equal positions within the fuel staffs in joint organizations.

In general terms, our Navy remains reliant on Jet Propellant-5, Diesel Fuel Marine, and Marine Gas Oil to conduct "at sea" operations. The Marine Corps and Army can operate solely on Jet Propellant-8 for all MAGTF and Army operations. The Air Force is moving toward utilization of commercial aviation fuels such as Jet A-1 and diesel (DF2/DF1) to support their programs. This is the crux of the problem, a lack of uniform fuel requirements limits the resiliency of the joint force and further stretches the capacity of the fuel supply chain. The joint fuels community remains disjointed and the stove-piped conversations within each Service to modernize and innovate often conflicts with the need for the Services and the DOD writ large to have a uniform approach toward the fuel problem.

In 2016, the Joint Access and Maneuver in the Global Commons provided the joint operational concept for the DOD to counter adversary advancements and to energize the discussion for the DON to take action in becoming a more relevant and lethal naval force by revisiting our operational roots, much of which was lost in the previous decade and a half spent supporting the ground fight. In 2017, the Commandant of the Marine Corps and Chief of Naval Operations signed a concept called the LOCE:

> This concept provides a framework for naval integration, placing renewed emphasis on gaining sea-control, to include employing sea-based and land-based Marine Corps capabilities to support the sea-control fight.

Key to the concept are naval maneuvers and action to maintain access and preserve the ability to maneuver through the global commons. Our naval force will remain poised to respond to and defeat any adversary who attempts to deny freedom of action to U.S. and allied forces.

Since the end of World War II, the United States has generally enjoyed the ability to posture itself with pockets of prepositioned military fuel stocks in hardened storage tanks throughout vast areas in the Pacific. With technological military advancements from potential adversaries, the bulk fuel playing field has been leveled, and the United States now finds itself contemplating the best approach in posturing fuel requirements where their availability can be guaranteed when needed.

Previous fuel studies projected the increase in fuel consumption based on

future military acquisitions plans. The 2017 MAGTF Fuel Study (released in the summer 2018 by Combat Development and Integration Division) further revealed that the consumption trend line will continue growing beyond Force 2025 based on our current military acquisition programs, future combat formations, and employment strategies. For example, as the MAGTF further explores advancements in areas of cyber warfare and the space domain, it can be assumed that fuel consumption will continue to grow based on the need to power increasing numbers of computer systems, satellite communications, and smart weapons systems. All the while our adversaries are projected to pursue similar technologies, so that the race to secure and exploit finite global energy stocks becomes even more critical to our responsiveness, resiliency, and survivability.

The former Secretary of Defense and 1st Marine Division Commander, General Mattis, realized first-hand how the tether of fuel negatively impacted the MAGTF's ability to maneuver north toward Baghdad in 2003. Since then, we have not changed as a force in terms of how we posture, procure, utilize, and account for fuel. Acquisition programs continue to procure military equipment that consumes fuel at increased rates. While some may argue that these procurements are more efficient, operating for longer periods before needing to refuel, or that increased capability in weaponry and technology at the expense of fuel efficiency is a necessary trade-off, it is these bureaucratic conundrums that continue to constrain our operational reach, leading us down a disastrous path where our failure to implement lessons learned will result in relinquishing our top position in the global order to one or more of our peer competitors. As a senior mentor once mentioned, our commercial sector regulates the research and development of motorized equipment by directing industry standards to attain benchmark gains over time. Why can't the DOD provide benchmark fuel efficiency standards to drive commercial industry and military acquisition?

Our most senior leaders in both the Navy and Marine Corps recognize the need for change and have charged their staffs to develop solutions and execute change. The 37th Commandant of the Marine Corps stated that the very discussion of implementing the *Marine Corps Operating Concept* (Washington, DC: HQMC, 2016) should make some feel very uneasy. In fact, previous discussions to implement the *Marine Corps Operating Concept* had stimulated "spirited" debates within numerous naval circles, certainly at the action officer levels. As we pursue more calibrated discussions focused on EABO and tenets of the 38th CMC CPG, we find ourselves continuing to admire the problem in front of us as the challenges in executing the EABO concept requires the DON to fundamentally change in terms of manpower, task-organization, and employment doctrine to successfully support the new operating environment.

Marines and Airmen participating in a fuel additization capability operation. *(Photo by DLA.)*

As the Marine Corps began implementation of elements of Force 2025, it became evident the Marine Corps future force was not operationally tied to current joint and naval concepts (Joint Access and Maneuver in the Global Commons, LOCE, and EABO) nor was it aligned with the *National Defense Strategy*. With the renewed focus on Force Design and tailoring the MAGTF to be adversary-focused, we cannot continue to execute combat formations for fueling operations solely under a conventional mindset of emplacing large, immobile, and embarkation intensive bladders resident within the LCE and ACE. Additionally, the way our fuel organizations deploy do not entirely support EABO and requires modification to equipment and personnel so as to deploy only those capabilities required for the mission and minimize the footprint. There is a fallacy of thought if we believe there will not be any "mountains of supply" or "liquid lakes" when sustaining the force in the future operating environment. Logisticians quickly realize that this statement, while appreciated, does not support the military and commercial logistics enterprises upon which the Navy and Marine Corps are reliant in an operational environment. In the Pacific, there just simply are not enough fuel stocks of the right military specifications to sustain the ambitions of our interests. One more F-35B or CH-53K in the fight equates to more fuel required in more locations. Compounding the daily demand for fuel is the potential addition of joint and coalition aircraft into the demand calculation.

A cursory look at joint and coalition tactical fuel capabilities will quickly reveal why the Marine Corps bulk fuel capability remains the choice enabler when tasked with an expeditionary mission by the joint commander. Our

A U.S. Coast Guard C-130 participates in forward arming and refueling point operations during Arctic Expeditionary Capabilities Exercise in Adak, AK, on 18 September 2019. *(Photo by LCpl Tia Carr.)*

unique ability to expeditiously aggregate into a refueling capability to support a combined arms endeavor from humanitarian assistance/disaster relief operations to full-scale combat operations makes the Marine Corps fuel capability the top expeditionary choice to deploy first across the range of military operations.

While the MAGTF has always been known to be able to composite units tailored for specific missions, there was a time where formations such as combat service support detachments and brigade service support groups were regularly rehearsed and better poised in aggregating logistics capability to address multiple mission sets. As the MAGTF fuels community further assumes a naval posture, perhaps the timing is right for experimentation in designing a bulk fuel organization that encompasses both naval and joint doctrine rather than just Marine Corps doctrine. The interoperability of such an organization has the potential to serve as a force multiplier in the most restrictive campaigns.

The Marine Corps bulk fuel organizational structure consists of warrant officers and enlisted personnel that are interspersed throughout the MAGTF. The sheer low population of senior warrant officers with limited joint experience negatively affects the future success of our bulk fuel community. The only means to correct current deficiencies is for the Marine Corps to grade shape and selectively assign bulk fuel senior enlisted personnel and warrant officers to better support current operational concepts (e.g., LOCE, EABO), service and joint war games, and posturing efforts throughout the joint logistics enterprise. The current manpower design is inefficient; the fuels community must ensure commanders have the best and brightest on their respective staffs if we are to move out smartly in support of current initiatives. In a perfect world, bulk fuel senior enlisted personnel and warrant officers would reside at the Headquarters, Marine Corps, Combat Development and Integration Division and Headquarters, Marine Corps, Installations & Logistics, Engineer and EOD Advocacy Branch to provide synergy in pursuit of combat capabilities and concepts that minimize our reliance of energy and build upon innovations across industry. Each Combatant Commander Joint Petroleum Office, Numbered and Regional Fleets, and Fleet Logistics Center regional offices should have a Marine Corps subject matter expert on staff with the aim of synchronizing joint and naval fuel requirements across the supported Combatant Commander, Joint Task Force Commander or the Joint Force Maritime Component Commander. Multiple opportunities to advance Marine Corps and naval concepts arise from interactions in joint billets and within the component staffs, in these joint forums we often fail to be represented, resulting in our priorities to be debated by fuels planners from adjacent Services.

Several military occupational fields possess a cadre of limited duty officers to offer mix of rank and experience when the need for protocol arises with coalition and adjacent service counterparts, most of which are majors and lieutenant colonels; in order to gain and retain a competitive edge with these bulk fuel peers, it is necessary to invest in a small population of bulk fuel limited duty officers to fight for Marine Corps priorities at events in which executive fuel policies are made.

In summary, the Commandant of the Marine Corps and Chief of Naval Operations have stated that we must recognize the challenges of the future and develop an operational approach to fight and win; the profession of arms is unforgiving; mistakes are paid for in blood and incompetence can lead to catastrophic defeat. We are far from incompetent, in fact, the ingenuity of our naval leadership has allowed us to remain the most lethal and capable blue/green force, even when operating at less than ideal manpower levels. What has changed are the capabilities of our adversaries and our current position to remain a global leader in offensive military power projection is not guaranteed. An article by Donald Sull published in the *Harvard Business Review* (July 1999) titled, "Why Good Companies Go Bad," highlights that the problem is not that organizations don't take action, but that organizations are not taking the appropriate actions through a condition called "active inertia." Active inertia is an organization's tendency to follow established patterns of behavior—even in response to dramatic environmental shifts. Stuck in the mode of thinking and working that brought success in the past, leaders simply accelerate their tried-and-true activities. In trying to

The Marine Corps tactical air ground refueling system. *(Marine Corps photo.)*

dig themselves out of a hole, they just deepen it. The Navy and Marine Corps may be facing a period of active inertia where legacy bureaucratic policies and methodologies come at a cost to operational reach allowing adversaries to capitalize on our inertia and turning it into their lucrative military successes.

The Marine Corps does not have the depth of senior fuels personnel nor the appropriate grades to present and defend the Marine Corps' agenda within the joint continuum of managing the military's most precious resource, second only to our great people: fuel.

USMC

USS* Kawishiwi *(AO-140) fleet order conducting underway fuel replenishment. *(Photo from navymemoriesships.com.)*

DLA National Account Managers

Building trust while connecting the Corps

by Dianne Ryder

Marines have historically worked in austere environments and virtual isolation. Self-sufficient, they have learned to solve problems on their own.

Relying on anyone outside their immediate sphere is contrary to Marine Corps ethos, said Marine Corps Col Steve de Lazaro, Marine Corps National Account Manager (NAM) for Defense Logistics Agency (DLA). But he and his team ensure the Service understands what DLA can offer it as an expeditionary force that supports naval and joint operations.

"The art of that comes in when you can marry up the Service's needs with the capabilities DLA has," said de Lazaro.

Nurturing relationships with subject matter experts at DLA's headquarters and major subordinate commands (MSC) is key to getting the right data to Marine Corps partners.

> Having all the NAM teams next door to one another is a great way to bounce ideas off each other and find out what one Service might be doing

de Lazaro said, adding that they might borrow others' good ideas:

> That's why they pull us into DLA, to bring that operational experience and see how we can apply those DLA capabilities to some of the problems and challenges we've seen as operators.

The NAM team gets daily calls from Marines who need help developing solutions for operational logistics problems and clarifying how DLA processes can help them.

"We do a fair bit of trouble shooting as we focus on operational and strategic programs," de Lazaro said,

Marines with 11th MEU pass boxes during an at sea resupply. DLA's Marine Corps NAM team ensures the Service knows what DLA can provide to the expeditionary forces.
(Photo by Cpl Adam Dublinske)

>Ms. Ryder is assigned to the Public Affairs Office, DLA.

We give them a good answer or we direct them to the folks they need to be speaking with. That's another facet of the NAMs' job—not necessarily solving everybody's problems but getting them connected to the right people.

Like most of the Marine Corps NAM team members, Senior Logistics Specialist Tom Adissi is a former career Marine who served for 23 years.

According to Adissi,

> Helping the Marine Corps get tied in from a Service perspective and understand how the industrial base keeps that going—that's the big motivation."

A priority for the Marine Corps and DLA is increasing the use of additive manufacturing. Manufacturing parts with a 3D printer reduces time and cost compared to ordering specialized parts that may not be readily available. The Service hopes to have DOD guidance on the certification and testing of 3D parts in the coming months. Until then, DLA will continue pursuing additive manufacturing opportunities with Marines.

The NAM team is also working with Marines to get involved earlier in the Service's acquisition process for vehicles and parts, such as with the joint light tactical vehicle being fielded to Marine

A Marine with Combat Engineer Battalion-6 provides security during a course at MCAGCC.
(Photo by PFC Skylar M. Harris.)

A bulk fuel specialist extracts fuel using an aviation test kit. DLA-provided fuel is one of the Service's high demand items. *(Photo by LCpl Juan Anaya.)*

Corps units in the next few months. The agency already has the majority of the parts catalogued and provisioned, which allows supply planning for as many as 10,000 parts. This also eliminates the need for extended contracted support. Adissi added,

> Early inclusion of DLA in the acquisition process eliminates the two- to three-year process of establishing cataloging data for the parts and appropriate industrial base support after the weapons system is fielded,

Customer support representatives like Dean Cassel are also a valuable part of the NAM team and regularly interact with Fleet Marine Forces and supporting commands. Cassel has been a customer service representative to the Marine Corps for eleven years and is collocated with the Program Executive Officer Land Systems (PEOLS) and Marine Corps System Command in Quantico, VA. He answers requests for assistance, trains customers to use DLA ordering and self-help tools, and helps solve emerging issues. Because of his military and civilian experience, his customers know him and continually seek his help. He said:

> To build trust, you show up; and when I say that, I mean you show up to their meetings when you get invited. You show up and talk to them on a daily basis ... I don't sit at my desk all day. I walk around, I talk to these people and I ask them what's going on.

Errors in the Service's stock control system and distribution standard system recently sent Marine Corps stock to DLA Disposition Services for disposal. The stock, worth more than $1 million, included items needed to complete an upgrade of the Marine Corps' medium tactical vehicle fleet. According to Cassel,

> They needed immediate assistance to get this stuff back. I made the phone calls and connected all the dots, discovered what actually happened and was able to explain that to the different commands.

Col de Lazaro said NAM team members rely on customer service representatives to identify, engage, and resolve issues for the Marine Corps commands they support, keeping the team informed as they work various issues.

"There are times when resolution requires a more holistic response from the agency," de Lazaro said, adding that the NAM team may be able to anticipate obstacles and request resources from DLA directorates or MSCs. This was the case with the Marine Corps stock scheduled for disposal. He said,

> We assisted Dean by enlisting the support of various subject matter experts across DLA Logistics Operations, DLA Finance, DLA Distribution and DLA Disposition Services.

Tom Stevenson, assistant program executive officer for acquisition, logistics, and product support at PEOLS, can testify to Cassel's commitment to the Service. Stevenson has spent the past ten years at PEOLS arranging acquisition support for the Marine Corps' transportation equipment. Cassel recently helped him resolve thousands of discrepancies between Marine Corps data systems and DLA's weapons systems support database.

"His expertise has allowed for orders to flow smoothly between our Marines and DLA," Stevenson said,

> A lot of work was done by my folks, but Dean helped make sure we were getting the right information so we knew what to go fix in terms of the data.

Stevenson recounted a 2017 incident in which the Marine Corps noticed the cost of parts for its medium tactical vehicle replacement trailer had skyrocketed. Because DLA had made no purchases within the last couple of years, the production line had gone cold.

> I researched the technical data and found that the drawing they provided had errors, causing the DLA supply chain to try and procure the parts from the trailer's original manufacturer

Cassel said, "These items had a cold production line that had to be restarted, raising the costs by 1,000 percent."

Working with DLA's Logistics Information Services and DLA Land and Maritime, Cassel helped Marines correct technical data and drawings, which enabled DLA to competitively procure the parts and return costs to normal.

Problems and issues like this are not easily resolved without the NAM team helping the Marine Corps.

> We should be their focal point. All their questions should come to us; we have the expertise to fan it out to the enterprise as opposed to them going to all the MSCs

Adissi said, "The front door for them is us."

USMC

Concrete Printing

Less is more

by Capt Eric F. Satterthwaite

As the Marine Corps embraces the concept of expeditionary advance base operations (EABO) as a methodology for enhanced maneuver and battlespace control, it also inherits the problem of solving the engineering challenges of EABO. For consideration, a problem statement for EABO engineering is: How does the Marine Corps ensure mobility, countermobility, survivability, and general engineering (Marine Corps engineering functions) across a widely distributed expeditionary environment while reducing logistical requirements? Future Marine Corps engineers will be called upon to create increasingly complex projects with smaller teams and less access to raw materials; they will be asked to create more with less. Therefore, future Marine Corps engineers will need equipment comparable to the challenges they must overcome.

Considering the problem statement, the equipment of the future engineer must provide certain capabilities. It must be versatile, enabling innovation to solve problem sets since the future engineer will not have access to a warehouse of specialized tools. It must require few inputs, since the future engineer will have reduced access to refined materials and be more reliant on those locally available. It must reduce the number of Marines needed to complete complex projects, since the future engineer will deploy in smaller teams. Finally, it should have a design aspect, because the future engineer will need to be able develop and implement solutions to unique problems.

One equipment solution that incorporates the equipment characteristics previously described is the employment of 3D concrete printing. The Marine Corps, in coordination with the United States Army Corps of Engineers (USACE), is currently experimenting with this technology and has successfully completed two significant projects of note. The first project was a barracks hut, and the second was a concrete footbridge. The barracks hut was completed in approximately 72 hours, constructed with a team of 12 Marines and 4 additional USACE engineers. Construction used six inputs: sand, gravel, cement, water, dry admixture (admix), and wet admix. Admixes are chemical or material components that are added to the base concrete to achieve specific material characteristics. The rippled wall designs make the walls self-supporting, and the hut boasts an approximate floor space of 30 feet by 16 feet. This is an example of using 3D concrete printing technology for general engineering and survivability purposes. The footbridge was completed in six days, which included construction, curing, transportation, and emplacement. The construction team was comprised of seven Marines, four USACE engineers, and eight Seabees, and the bridge was preliminarily designed by Marines and then reviewed by USACE engineers for safety. It used eight inputs: sand, gravel, cement, water, dry admix, wet admix, fiber reinforcement, and rebar. The bridge spans a 32-foot-wide

>Capt Satterthwaite is a former Training Officer, 7th Engineer Support Battalion. He is currently working as a Field Engineer for Fluor on a commuter rail project outside of Washington, DC.

7th Engineer Support Battalion constructed a concrete bunker during a 3D concrete printing exercise in 2019. *(Photo by Maj Kenneth Kunze.)*

gap and has a calculated load capacity of 3,500 pounds, or a military load capacity (MLC) of two. After testing, it was determined that the bridge could bear a dynamic load of approximately 38,000 pounds, which translates to being able to safely bear the weight of an up-armored HMMWV, a joint light tactical vehicle, or an unloaded Mk23 MTVR. The footbridge is an example of using 3D concrete printing technology for mobility purposes.

These two projects illustrate how 3D concrete printing technology accomplishes each of the requirements for future engineer equipment outlined earlier. First, versatility: without any modification, the same piece of equipment was able to construct two completely different projects across various functions of Marine Corps engineering. Second, both projects were completed without the use of forms, the current leading technique for large-scale concrete construction. In doing so, these projects removed the need for wood, nails, screws, form designs, and time associated with making forms. With both projects using less than ten inputs, and with sand, gravel, cement, and water being widely available raw materials around the world, 3D concrete printing effectively reduces the amount of required inputs over traditional concrete construction methods. Third, these projects produced items that would normally be assigned at minimum to a squad (thirteen Marines). Because of the experimental nature of these projects, additional personnel were utilized (USACE engineers and Seabees); however, both projects used less than a squad of Marines. With further development, this technology could easily be operated by seven or eight Marines. Finally, the concrete footbridge illustrated that by using 3D concrete printing, Marines can custom design operationally relevant structures without having to rely upon assistance from Army or Air Force units.

Acknowledging the argument that 3D concrete printing seems like a viable candidate for future employment by Marine Corps engineers, it is necessary to highlight what a fleet-ready version of this technology would look like. In its current state, the printer is undergoing research and development to further improve the technology. First, the fleet-ready version of this technology should come with a control computer preloaded with structurally approved designs. For example, the control computer could come with designs and instructions for an MLC70 vehicle bridge. Because of the complex nature of an MLC 70 bridge and implications of the end use of said bridge, Marine engineers should not attempt to design a bridge of that magnitude in the field. Instead, preapproved designs (bridges, culverts, runways, fighting positions, barracks huts, obstacles, etc.) would come preloaded to alleviate the burden on operators and ensure that those designs perform as intended. Second, less than a squad of Marines should be able to operate the fleet-ready version of this technology. Third, it should be able to process unrefined raw materials with as few additives as possible. Fourth, it should be able to utilize widely accepted design programs (computer-aided design, (CAD) CAD drawings) for custom projects. Finally, it must be transportable via standard military equipment (palletized, quadcons, ISO containers, etc.).

Once a fleet-ready version is available, how would it be employed? Because of the versatility of the technology, employment considerations may be different for combat operations versus humanitarian aid and disaster relief operations. Combat employment of the technology would leverage EABO concepts to enable a mission-specific production capability within the battlespace. By distributing 3D concrete printers throughout the battlespace, each expeditionary advanced base could produce mission-specific construction projects while logistical support focuses on providing the same raw materials. In essence, this expands the local commander's capability while also reducing and simplifying logistical requirements. (See Figure 1 for a depiction of this employment technique.)

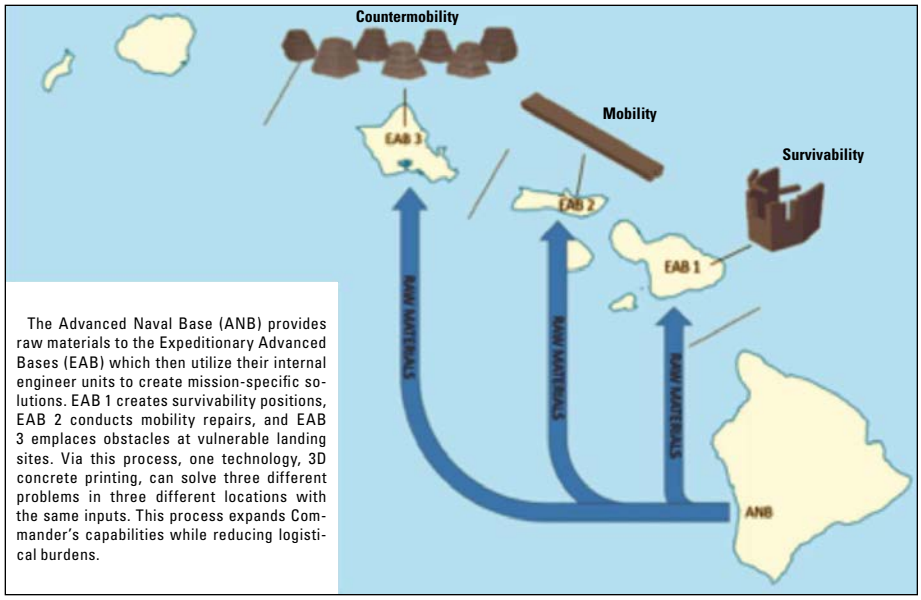


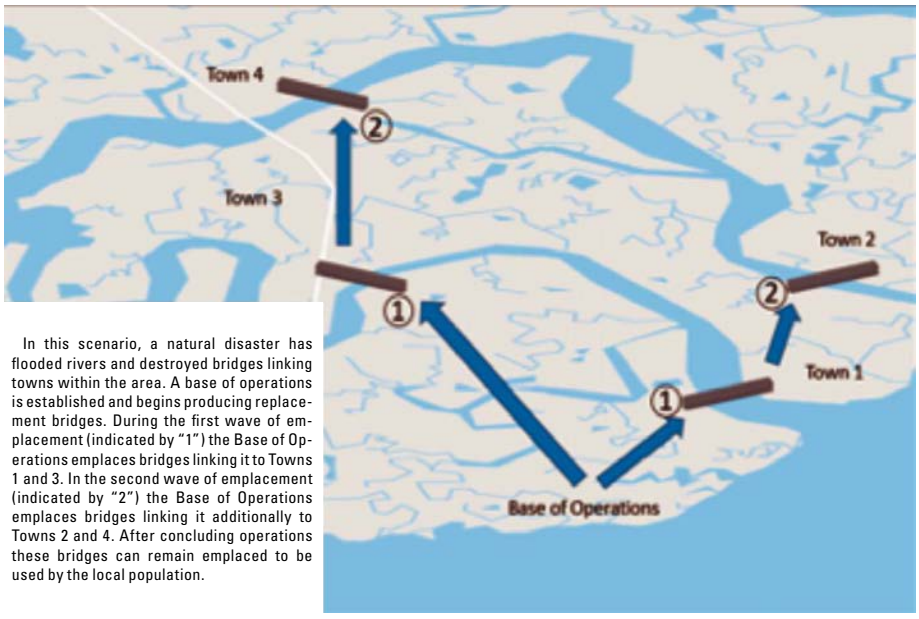
Figure 1. Combat employment of 3D concrete. *(Figure provided by author.)*

Conversely, humanitarian assistance and disaster relief employment of this technology would likely work differently. The employment concept would be mass production at a singular, controlled site and then moving finished projects into place, allowing for tighter control of limited resources and a progressive approach to relief operations. Finished projects could remain emplaced after Marine forces retrograde for future use by local populations. (See Figure 2 on next page for a depiction of this employment technique.)

Now, with an understanding of the employment techniques for this technology, how does 3D concrete printing compete with or outperform our current construction methods? The first distinct benefit is an iterative design process that leverages the capabilities associated with CAD. As an example, see Table 1 on the next page for the design processes utilizing existing methods versus 3D printing CAD.

Using Table 1 as an example, the iterative design process inherent to 3D concrete printing has a distinct time advantage over traditional means. By removing the need to design, create, and remove forms from each step, Marines will be able to rapidly improve designs to rectify identified deficiencies. Also, removing the need to design forms is key in streamlining the process since form design is a highly detailed and technical process. By comparison, 1361 Engineer Assistant Marines are proficient in CAD design work and can produce geometrically complex designs rapidly.

The second distinct benefit is a productivity advantage. By leveraging 3D printing technology, Marines would be able to create more outputs with less inputs, thereby increasing productivity by freeing up resources for other tasks. As an example, Table 2 (see page 55) is a conceptual equipment and material comparison between traditional construction methods and 3D printing. The resource estimates are based on the construction required to create the concrete bridge that was produced in December 2018.



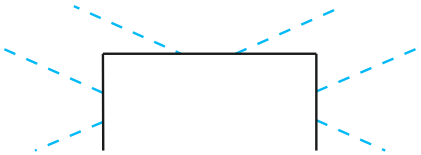
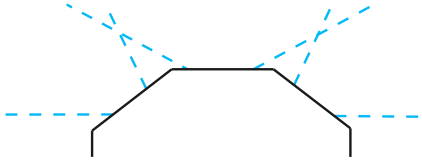
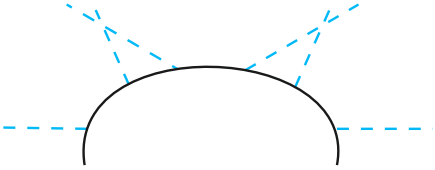
In this scenario, a natural disaster has flooded rivers and destroyed bridges linking towns within the area. A base of operations is established and begins producing replacement bridges. During the first wave of emplacement (indicated by "1") the Base of Operations emplaces bridges linking it to Towns 1 and 3. In the second wave of emplacement (indicated by "2") the Base of Operations emplaces bridges linking it additionally to Towns 2 and 4. After concluding operations these bridges can remain emplaced to be used by the local population.

Figure 2. Humanitarian employment of 3D concrete. *(Figure provided by author.)*

In addition to the above resource advantages, productivity is enhanced via the removal of forms—a point discussed in previous paragraphs. When utilizing 3D printing, the remaining resources—the fireteam of Marines, carpentry tools, and Class IV (construction) materials—could be allocated to another project, thereby increasing the productivity of the Marines, equipment, and materials.

Third, 3D printing has a cost advantage over traditional means. For this example, 3D-printed wall sections are being compared to MIL 1 HESCO barriers. MIL 1 barriers are approximately 4 feet tall, 3 feet wide, have a core filled with dirt or sand, and cost an estimated $240 per every 15 feet. To construct the same object out of 3D printed concrete, using a uniform wall thickness of 4 inches would use approximately 2 cubic yards of concrete, which is estimated to cost $200—a cost reduction of 16.6 percent. However, the true cost advantage of 3D concrete printing is the ability to maximize a design for cost while still retaining required properties of the end design. If the wall thickness could be reduced to 2 inches instead of 4, and still provide the same ballistic protection, the cost-maximized design would use approximately 1.33 cubic yards of concrete, which is estimated to cost $130: a cost reduction of 46.8 percent. By combining ballistic testing, structural load testing, geometric advantages, and material characteristics, designs could be maximized for cost purposes while still providing the required protection, strength, and size.

Marines, Sailors, and Soldiers work together to make concrete. *(Photo by LCpl Betzabeth Galvan.)*

Step	TRADITIONAL
1	Identify need: fighting position with firing ports in front and sides
2	Design fighting position 1 
3	Design forms
4	Build forms
5	Pour forms
6	Remove forms
7	Fighting position 1 - COMPLETE
8	Identify deficiencies: dead space within fields of fire
9	Redesign fighting position 1.a 
10	Design forms
11	Build forms
12	Pour forms
13	Remove forms
14	Fighting position 1.a - COMPLETE
15	Identify deficiencies: Curved edges provide better blast protection than angled edges
16	Redesign fighting position 1.b 
17	Design forms
18	Build forms
19	Pour forms
20	Remove forms
21	Fighting position 1.b - COMPLETE

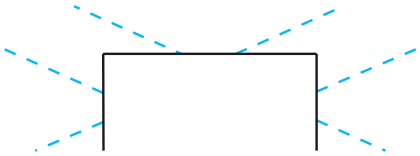
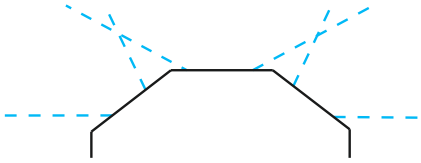
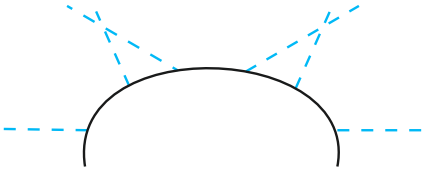
Step	CAD (3D PRINTING)
1	Identify need: fighting position with firing ports in front and sides
2	Design fighting position 1 
3	Render fighting position 1 in CAD
4	Print fighting position 1 - COMPLETE
5	Identify deficiencies: dead space within fields of fire
6	Redesign fighting position 1.a 
7	Render fighting position 1.a in CAD
8	Print fighting position 1.a - COMPLETE
9	Identify deficiencies: Curved edges provide better blast protection than angled edges
10	Redesign fighting position 1.b 
11	Render fighting position 1.b in CAD
12	Print fighting position 1.b - COMPLETE

Table 1.

Item	TRADITIONAL	Item	3D PRINTING
1	(13) 1371s	1	(8) 1371s
2	Hammer(s)	2	Concrete printer
3	Nail(s)	3	Fine aggregate
4	Saw(s)	4	Coarse aggregate
5	2″x 4″ x 8′	5	Water
6	3/4 inch plywood	6	Dry Admix
7	2″ x 6″ x 8′	7	Wet Admix
8	Fine aggregate	8	Rebar
9	Coarse aggregate	9	Wire Mesh
10	Water	10	Rebar cutter
11	Dry Admix		
12	Wet Admix		
13	Rebar		
14	Wire Mesh		
15	Rebar cutter		
16	Concrete mixer		

Table 2.

Finally, 3D concrete printing technology provides a production capability advantage that has been previously unattainable. The important concept to understand is that 3D concrete printing is not a technology to build a better bridge, bunker, or obstacle. It is a technology to build whatever the commander needs to enable his desired effect within the battlespace. Instead of pigeonholing this technology to specific tasks or construction efforts, it is essential from the onset to understand that this technology is a production capability limited by the imagination of the user. Bridges, bunkers, billeting spaces, obstacles, road repair, runway construction, and force protection are all achievable efforts when paired with 3D concrete printing. Additionally, all these efforts would require the same inputs (Marines, materials, power, etc.) regardless of the differences in the project. With the proper development and focus, this technology is a multi-tool on the structural scale, a singular machine able to fix a vast range of problems.

In closing, 3D concrete printing is an emerging technology with valid application by future Marine Corps engineers. Its versatility, reduction of logistical requirements, ability to reduce personnel requirements, and potential to enable custom solutions to individual problems uniquely position this technology for strong consideration as equipment of the future Marine engineer. Its applicability in both combat and humanitarian operations makes this technology relevant regardless of mission set. By expanding a commander's capabilities while simultaneously reducing logistical needs, 3D concrete printing fits well into the greater EABO concept. Considering the wide range and scope of projects across all functions of Marine Corps engineering that a single printer could enable, coupled with the few raw materials and ingredients required to use it, 3D concrete printing is a technology where less truly is more.

7th Engineer Support Battalion Marines and Naval Mobile Construction Battalion 5 used the automated construction of an expeditionary structure printer to conduct 3D printing. *(Photo by LCpl Betzabeth Galvan.)*

Additive Manufacturing

The strategic implications

by 2ndLt Matthew Suarez

[Additive manufacturing], if harnessed and employed correctly, would enable the Marine Corps and Navy not only to get to the battle faster, but also to arrive there with the capabilities and weapons to dominate. The Marines will be equipped to "innovate-in-place" and build mission-specific equipment to suit whichever "clime and place" in which they find themselves … The faster we build and replace broken weapons of war, the faster we win.

—Capt Matthew Friedell [1]

It is well known that additive manufacturing, better known as 3D printing, will help segue the military and modern technology into the future. The potential for the expedited manufacturing of materials will revolutionize how the global economy and supply chains operate. Goods normally manufactured across the world can now be printed in one's backyard, supplying necessary materials in a faster and cheaper manner than the current trading system. It immediately provides users with a strategic ability. The faster production of supplies locally resupplies units in need of materiel quicker—expediting supply chain capabilities, refurbishing and outfitting units faster, ultimately increasing their sustainability and lethality.

Many articles and reports focus on the implications of this technology printing other tools, machines, or objects right on the spot, failing to focus on the major, strategic consequences inherent of this capability. The broad focus of articles dictating the potential capabilities of additive manufacturing is on the tactical and operational benefits that accompany this production. 3D printing is more than just a convenient printer; it is a technology that will provide the U.S. military a strategic advantage.

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T.X. Hammes' article regarding the strategic implications of 3D printing briefly mentions the military aspect,[2] but his expansion on the subject a year later[3] further details the potential effects that localized production could have on the global trading system. He argues that 3D printing—in conjunction with artificial intelligence and autonomous robotic systems—would streamline production locally, potentially rendering the current global economy obsolete. The strategic significance of the reduced costs and streamlined production by these systems can have serious effects not only on the global economy but also on the finances for the military.

Furthermore, Dr. Aaron Martin and Ben FitzGerald published a report[4] focusing on streamlining the production of unmanned aerial systems through 3D printing supported by robotic systems and artificial intelligence to surge the battlefield with more assets at faster rates. They focus on the growing expenses associated with technological development and the procurement of newer weapons systems and provide a framework to reduce the costs and increase efficiency in producing aircraft—starting with unmanned aerial systems. The increased efficiency of reducing production costs and increasing production speeds outputs more aircraft to the operational forces, ultimately giving them strategic advantages. Martin, FitzGerald, and Hammes all illustrate

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SPMAGTF-Southern Command Marine is measuring a water nozzle as part of the training he received on 3D printing during a course conducted at Camp Lejeune, NC. The course provides hands-on experience with 3D printing, computer-aided design, files creation, and manufacturing. *(Photo by Sgt Ian Leones.)*

the significance of this capability in financial and economic terms, which is imperative to a military-industrial complex with rising expenditures.

Additive manufacturing has long been part of the Marine Corps' discussion. Former Commandant Gen Robert B. Neller understood the potential that it provides and has inculcated an attitude to expand on this technology.[5] Additionally, Sean Walsh published a fantastic article in the *Gazette* in 2015 detailing the potential for 3D printing in the Marine Corps. It is one of the few articles dedicated to taking a deep look into the future and provides a framework for the Marine Corps to follow.[6] However, it falls short of emphasizing the strategic implications associated with 3D printing for military forces. He understands that 3D printing will revolutionize the logistic capacity for the military, but the scope of the article focuses too deeply on the tactical and operational aspects therein. He fails to explain the true significance that 3D printing establishes: it will affect all organizational levels, revolutionizing logistic capabilities.

The application of 3D printing in forward deployed forces has significant strategic implications for the supply and logistical support for forward combat units. The famous aphorism "amateurs talk about tactics, but professionals study logistics" is integral in this situation. History shows that leveraging current technologies for combat support rather than warfare oftentimes provides the advantage to the victor. For instance, Napoleon revolutionized the way he organized his armies to reduce the logistical footprint.[7] Patton's "Red Ball Express" during World War II provided constant logistic support to forward units, facilitating greater sustainability for American and allied combat troops. Additionally, America's unprecedented mass production of Liberty ships during the same war increased the sustainability of Allied forces in both Europe and the Pacific; the German U-boat campaign could not sink enough ships to hinder continued supply. The U.S. submarine campaign in the Pacific initially experienced many difficulties yet resulted in the destruction of nearly 60 percent of the Japanese merchant marine capacity, effectively rendering the Japanese ability to sustain combat troops logistically impossible.[8] It remains imperative today, as it did in the past, that our logistics capability remain secure and intuitive.

It is apparent that 3D printing can revolutionize the logistic capabilities of the military. Streamlined production, reduced costs, and local manufacturing provide enhanced sustainability. Sustaining combat forces over longer periods of time is the key component that efficient logistic capabilities provide to the military, ultimately increasing the lethality of those forces. Localizing the production of key materials and stream-

These items were printed for the communications section, Combat Logistics Battalion 11, 11th MEU during deployment. *(Photo by Sgt Adam Dublinske.)*

Sgt Willis explains the functions of a 3D printer on board the USS* Wasp *while underway in the Pacific Ocean. *(Photo by Cpl Stormy Mendez.)*

lining repair allows the warfighters at the tactical level to be outfitted for sustained combat at faster rates and for longer periods of time at significantly lower costs, affording a long-term advantage logistically. As Walsh wrote, "3D printing has the potential to redefine military logistics support to operations,"[9] but it does not do so without true strategic significance. The longer forward troops are supplied with necessary materiel, the longer they are sustained and the longer they may remain lethal. 3D printing not only improves sustainability but, more importantly, lethality through means of supply.

The Marine Corps and the other Services are developing ways to integrate this new technology, but it is integral to understand the true implications and capabilities that additive manufacturing provides. The next conflict will be more complex than the last one, so achieving an edge over the next adversary is integral to achieving success. Additive manufacturing is fundamentally strategic in nature. While it can quickly provide tactical and operational forces manufactured logistic support and supply, it ultimately provides the sustainability of combat forces, increasing their lethality and effectivity. These inexpensive machines can produce critical parts in a matter of hours at significantly faster and more efficient speeds. The cost and speed of resupply materials will drop significantly and increase the sustainability of forces more cheaply. Cheaper resupply for forces allows those funds to be utilized in similarly creative ways to support achieving advantages over one's adversary. The economic and financial potential that additive manufacturing affords is so significant, one would be remiss to not attain and implement that capability sooner. Additive manufacturing is the future of logistics, but it is absolutely critical to recognize that the economic and logistical significance of additive manufacturing is fundamentally strategic in nature.

The Marine Corps and the other Services are developing ways to integrate this new technology, but it is integral to understand the true implications and capabilities that additive manufacturing provides.

Notes

1. Matthew Friedell, "3D Printing is a Game-Changer," *Proceedings*, (Annapolis, MD: October 2016).

2. T.X. Hammes, "3-D Printing Will Disrupt the World in Ways We Can Barely Imagine," *War on the Rocks*, (December 2015), available at https://warontherocks.com.

3. T.X. Hammes, "Will Technological Convergence Reverse Globalization?" Institute for National Strategic Studies, (Washington, DC: National Defense University, July 2016).

4. Ben FitzGerald and Aaron Martin, "Process over Platforms: A Paradigm Shift in Acquisition Through Advanced Manufacturing," Center for a New American Strategy, (September 2016), available at https://www.cnas.org/.

5. Sydney J. Freedberg Jr., "Marines' Love Affair With 3D Printing: Small Is Cheap and Beautiful," *Breaking Defense*, (March 2018), available at https://breakingdefense.com.

6. S.R. Walsh, "3D Printing," *Marine Corps Gazette*, (Quantico, VA: March 2015).

7. William H. McNeill, *The Pursuit of Power: Technology, Armed Force, and Society since A.D. 1000*, (Chicago, IL: The University of Chicago Press, 1982).

8. United States Strategic Bombing Survey, *The War against Japanese Transportation 1941–1945*, (Washington, DC: United States Strategic Bombing Survey, Transportation Division, 1947).

9. "3D Printing."

Prolonged Field Care and Fresh Whole Blood

A required capability in the future operating environment

by LCDR Russell P. Wier, USN; LtCol Benjamin Middendorf, USMC; & COL Andrew Cap, USA

20XX: Islands off the coast of the fictional country of Sembatu. You are the battalion commander tasked with seizing and retaining islands in support of Operation LITTORAL RESOLVE II. These islands are critical to setting conditions for follow-on actions in the naval campaign. Seizing the islands has been rough; however, the Navy's ability to create seams in the enemy's anti-access/area denial system facilitated multiple vertical and small boat assaults, which allowed the battalion to accomplish its mission.

What was not foreseen was the fog of war. The enemy launched a massive counterattack on amphibious shipping using advanced anti-ship cruise missiles after creating gaps in the electromagnetic spectrum. The Navy took damages, including the loss of two destroyers, forcing it to egress the amphibious objective area.

As your operations officer issues orders, your early-warning radar detects incoming missiles. Forty seconds later, they impact, and Echo Company reports five killed in action (and eight wounded in action, four of which are urgent.) You send medevac nine-lines to the landing force operations center. The commander landing force calls and explains that the Navy believes it will take 48 hours to set conditions for an electronic attack corridor for casualty evacuation (casevac).

Your medical officer informs you that with the amount of hemorrhaging these Marines have sustained, they have little chance of survival with only the saline solution that is presently available. Whole blood replenishment is required; unfortunately, the nearest blood is located at the blood bank at the hospital ward aboard the USS Essex.

You know these wounded Marines are likely to die. You instruct your medical officer to do all he can. You order Marines to dig in and prepare for the next attack, knowing that you have one heck of a fight ahead of you.

>LCDR Wier is the Assistant Division Surgeon, 1st Marine Division.

>LtCol Middendorf is the Operations Officer, 5th Marine Regiment.

>COL Cap is the Chairman of Blood Research at the U.S. Army Institute of Surgical Research.

Prolonged Field Care in the Future Operating Environment

What the above scenario described is but one example of the type of battlefield in which the Marine Corps may find itself in the future operating environment and is one where the so called "golden hour" just does not exist. The fictional battalion commander has little recourse at this point and must accept the casualties. It is simply not worth the risk to the air crews to attempt a tactical evacuation, and any unmanned aerial vehicles designated for casevac (yet to be developed) are also likely to be destroyed if they operate in the weapons engagement zone.

Prolonged field care is a contingency model of tactical medical care for extending survival timelines of critically injured patients in austere environments when tactical evacuation is delayed beyond doctrinal timelines. Plainly stated, it is how you keep a wounded Marine alive when you need to get him to a higher level of care as quickly as possible but cannot do so.

Prolonged field care is not just a nice-to-have; in the future operating environment, it will become a requirement. Expeditionary advanced basing operations (EABO) are predicted to pose complex challenges to casevac timelines that contrast starkly with the wars in Iraq and Afghanistan, including disputed air superiority, advanced enemy threat systems complicating air and ground mobility, the encumbrances of cyberwarfare, and the scale of operations throughout isolated or arduous terrain. The MAGTF or the naval task force commander will to have balance operational priorities with casevac and

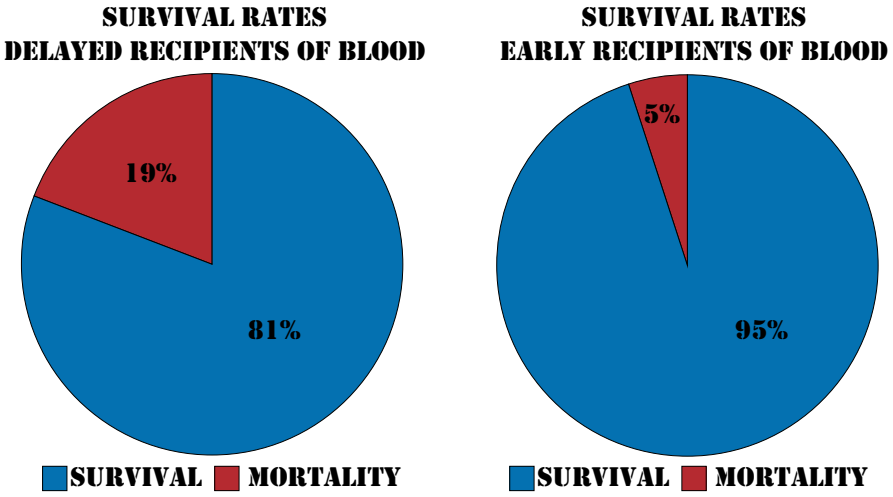

Figure 1. Difference in survival of delayed versus early recipients of FWB. *(Figure provided by author.)*

may be unable to reduce the risk of evacuation to an acceptable level in many situations.

A Marine infantry battalion must have the capability to conduct prolonged field care in the future operating environment, as the golden hour is not a safe assumption. What follows is an explanation of why the Marine Corps needs this capability and why it is not present already, as well as a description of a proof of concept that has demonstrated the feasibility of attaining it.

The Need for an Emergency Fresh Whole Blood Transfusion Capability

Prolonged field care requires multiple skill sets; however, the most critical to the company corpsman is the ability to resuscitate a patient with fresh whole blood (FWB). FWB is drawn from a prescreened donor and transfused immediately to the patient. This is in contrast to "stored whole blood" and components of blood (i.e., red blood cells, platelets, or plasma), which require a larger logistical footprint such as refrigeration, laboratory equipment for processing, and storage under tightly regulated conditions. An emergency FWB transfusion program prescreens suitable donors ahead of time for safe characteristics of their blood (i.e., Group O with low levels of reactive antibodies and screening for absence of transmittable infections). These donors are clearly identified and then called upon in an emergency to give blood in the pre-hospital environment, which may be safely transfused regardless of the patient's blood type.

The #1 Cause of Preventable Death

From the wars in Iraq and Afghanistan (2001–2011), 91 percent of preventable deaths were caused by hemorrhages.[1] This equates to 888 lives lost to potentially survivable wounds, or approximately one infantry battalion. When treating for hemorrhage, the most important first step is to stop the bleeding, and then the patient must receive replacement for the lost blood as soon as possible.

When treating for hemorrhage, the most important first step is to stop the bleeding ...

A Time-Critical Intervention

An important retrospective study that compared mortality rates between hemorrhagic shock patients in Afghanistan was recently published. The study compared the outcomes of those patients who received blood while en route to hospital care to those who received blood upon arriving at the hospital or not at all. Those who received blood within the *first 36 minutes of injury* had dramatically reduced mortality rates. Within 24 hours, 19 percent of those unable to receive immediate blood replenishment succumbed to their injuries. Conversely, those who did receive blood within that 36-minute window experienced a mortality rate of only 5 percent.[2] Stated differently, the odds of death from hemorrhagic shock were nearly 1 in 5 without timely FWB replenishment, yet when the patient received FWB in the first 36 minutes, the odds of death dropped to 1 in 20. The speed with which hemorrhaging patients receive FWB unquestionably correlates directly to their survival rate.

The golden hour was the guiding milestone throughout the wars in Iraq and Afghanistan. However, this study illuminates another important milestone: a 36-minute window in which a critical life-saving intervention must be made, without which the patient is nearly four times more likely to succumb to his injuries. Given the complexities of EABO and the future operating environment, casevac to a higher-level facility within this 36-minute window is not an assumption that future commanders should make. Further demonstrating the unforgiving imperative of time, a different study shows that the *mortality rate rises five percent for each minute that transfusion is delayed.*[3]

Historical Context

Field blood transfusions were common in World War II and to a lesser extent in the Korean War. Based on blood type identification by dog tags, blood could be transfused to wounded personnel near the front lines. However, the process was imperfect, and concerns about lethal transfusion reactions and transfusion-transmittable infections led to a decline of this process in the field. Blood transfusions gravitated to Role Two facilities, where more extensive laboratory testing and controlled environments mitigated those risks. By the Vietnam conflict, corpsmen and medics were primarily carrying crystalloid fluids (e.g., normal saline), which were helpful in treating the vast number of heat casualties experienced in that

theater. However, the efficacy of these crystalloid fluids in the treatment of hemorrhagic shock patients would not be widely challenged for decades.

The medical community has since become increasingly aware that crystalloid fluids are actually harmful to the hemorrhaging patient. These fluids contribute to hypothermia, coagulopathy, and acidosis—three components of the "lethal triad," a self-reinforcing condition that worsens shock and often leads to death. The lethal triad is best countered by whole blood, which is now recommended by the Committee on Tactical Combat Casualty Care as the best fluid for the hemorrhagic patient.[4] Unfortunately for the conventional Marine infantryman, crystalloid fluids remain the mainstay of battalion aid stations and company corpsmen who are not trained in emergency blood transfusion.

Proven Solutions from the Special Operations Force Community

The special operations force (SOF) community has actively addressed this issue through a variety of initiatives. However, perhaps the most notable and relevant to the Marine Corps GCE is the U.S. Army 75th Ranger Regiment's "ROLO," or Ranger O Low Titer program.[5] The Rangers have trained their medics to successfully and safely transfuse a patient with FWB that is donated from a fellow Ranger near the point of injury. Every Ranger is now trained to safely collect blood from prescreened Group O Ranger donors. Every Ranger medic is trained to conduct the transfusion to the patient. The Rangers have reported the ability to initiate blood transfusion near the point of injury in as little as twelve minutes. This successful program has been replicated throughout every branch within the SOF community and within many allied nation SOF units.

Every Ranger medic is trained to conduct the transfusion to the patient.

The SOF medic has a baseline level of training that far exceeds that of the general duty line corpsman serving within a Marine infantry battalion. Yet, only the line corpsman bears the potential capability of initiating a blood transfusion within the tight time constraints demanded by a hemorrhaging patient in conventional Marine units.

All of this begs the question: Can this program be successfully replicated within the Marine division and executed safely by general duty corpsmen?

Marines and Sailors donate blood to the ASBP. *(Photo by Cpl Leynard Kyle Plazo.)*

The 2d Battalion, 5th Marines Proof of Concept

2/5 set out to demonstrate this capability as a proof of concept for a Marine infantry battalion in November 2017. Achieving this end state required four major milestones:

Establishing a donor pool. Through coordination with the Armed Services Blood Program (ASBP) at Navy Medical Center San Diego and Naval Hospital Okinawa, our medical team organized a series of blood drives targeting a list of potential Group O low titer blood donors within the battalion. The battalion provided blood donations to the ASBP, which in turn provided the requisite laboratory testing of our donors to ensure strict compliance with established protocols.[6] The goal was to establish no less than ten percent of each company as donors.

Over two months, three major blood drives yielded 159 satisfactory blood donors (17 percent of the battalion) who could subsequently be used for emergency collection. Among the three rifle companies, twenty percent were eligible donors.

This data translates directly into a medical asset that is gained at minimal expense and weighs next to nothing in the ruck sack. The company commander can now step off with roughly 36 units of organically available blood that can be drawn upon to save a Marine's life in an emergency.

Equipment acquisition. Equipment was open-purchased with unit funds and includes two types of medical equipment sets. A "collection kit" is issued to each successfully screened donor to be carried in his individual first aid kit. The collection kit enables the collection of one unit of whole blood (about one-half liter). Each corpsman who has been trained in emergency whole blood transfusion is issued one or more "transfusion kits." The transfusion kit contains all the items required for the corpsman to administer that collected blood to a patient.

As an initial purchase, 80 collection kits and 75 transfusion kits were pur-

A Valkyrie instructor (far right) assists the students in troubleshooting a blood line during a training scenario at Camp Pendleton, CA. *(Photo by Cory Wier.)*

chased for the purposes of initial training and demonstration of capability. The open purchase request was made for under $5,000.[7]

Program development. Our program and protocols were modeled after the well-established ROLO program with assistance from the Ranger regiment medical staff. Additionally, blood banking specialists from I MEF, II MEF, and the ASBP in San Diego and Okinawa contributed from their experiences to enrich the program.

The Valkyrie Training Program. The 2/5 medical team created a comprehensive training program designed to develop the knowledge base and refine the preexisting skill sets of our corpsmen. Furthermore, it ensured that corpsmen understood the critical elements and contingency responses associated with emergency FWB transfusion. The Valkyrie Training Program is named after the mythological Norse angels of war who soared over the ancient battlefields with the ability to determine whom among the fallen would be carried to Valhalla and who would be restored to life.

The Valkyrie Training Program is structured in a training and readiness (T&R) format and consists of the complete range of topics necessary to safely and efficiently perform field blood transfusions. In its initial form, the syllabus included eight academic modules, six practical-application scenarios, self-study assignments, oral and written examinations, and a final capstone evaluation.

Fourteen corpsmen commenced the initial training in July 2017, and over the following weeks, twelve would complete the training satisfactorily.

Testing during 31st MEU Amphibious Integration Training

Aboard the USS *Wasp*, our first prefield rehearsal was conducted, and I underwent a live autologous transfusion to demonstrate corpsman capability. Autologous transfusion, or auto-transfusion, permits whole blood collection and transfusion to be practiced safely. Collected blood from a donor is immediately transfused back to the same person who transitions to role-playing a patient. Subsequent field demonstration was conducted as part of a tiltrotor-borne raid during Amphibous Integration Training. During the 90-minute raid, a four-person foot-mobile battalion aid station forward element was inserted with Fox Company. Two cherry pickers (one of which included the battalion commander) underwent live auto-transfusion. Collection and transfusion for both casualties were completed in the field within the 36-minute window.

Counter Points

This capability is already present at the shock trauma platoon (STP) and forward resuscitative surgical suite (FRSS). The STP and the FRSS are able to perform transfusions of FWB and component therapies. However, given the likely need for dispersion vice concentration, this capability will simply become over-

Demonstration of the 2/5 FWB proof of concept during AIT with the 31st MEU. *(Photo by LCpl Alexis Betances.)*

stretched, and there is a high probability that neither the FRSS nor the STP will be able to support all the separate nodes required in an EABO scenario. In the best of circumstances, casevac to these facilities will exceed the aforementioned 36-minute window. Providing blood closer to the point of injury will improve survival rates.

In a large-scale conventional conflict, the demand for readily available FWB will likely jeopardize existing Class VIIIB (medical) supply. A forward-capable Low Titer O Whole Blood program stands to reduce the demand experienced at the STP/FRSS (and, by extension, existing Class VIIIB supply chains) by reducing the units required by at least an equal number of units provided before arrival. The severity of the pathology of trauma worsens with time, and to reverse it requires even more blood. By providing blood closer to the time of injury, the patient is evacuated in better condition and is likely to require less total blood.

Requiring a donation from an infantryman in combat will reduce his combat effectiveness. The notion of reduced combat effectiveness by a blood donor who is an athletic individual is not supported by research. In a 2012 study, soldiers were tested by a treadmill stress test, pushups, and pull-ups; a 50-round rapid pistol–shooting test; and an uphill hiking exercise carrying a 20 kilogram backpack. After baseline testing, the soldiers performed the tests again, two to six minutes after donating 450 milliliters of blood. Researchers did not find any significant decrease in physical performance or shooting performance after donating the blood.[8] Repeating similar testing on civilians and staff officers was also demonstrated to have little to no effect on performance.

The L03A line corpsman (formerly 8404) is insufficiently skilled or trained to perform FWB transfusion. This is inconsistent with the proof of concept demonstrated by 2/5. All of the foundational skill sets required for the task lie squarely within the scope of the line corpsman's training. In my experience, corpsmen are generally eager to exercise these skill sets, which are too often underutilized.

The knowledge base required to safely conduct FWB transfusion requires additional training. The Valkyrie Training Program has been developed specifically for the general duty corpsman or medic.

Recommendations for Moving Forward

1. Medical officers must demand evidence-based solutions and make appropriate risk decisions for combat operations. Despite incontrovertible evidence supporting the use of emergency FWB, institutionally entrenched resistance and skepticism to implementation within the medical corps is common. General medical officers attached to infantry battalions must remain abreast of the current medical literature regarding remote damage control resuscitation and advise their ground commanders accordingly.[9] Informed ground commanders can create a strong demand signal, which will be noticed by senior leadership in policy-making positions.

2. Emergency FWB training should be codified and integrated into respective T&R manuals. Specifically, the Health Service Support T&R should be amended to include FWB training. An example framework is included in the Valkyrie Training Program's materials. Infantry T&R should be amended to include prolonged field care incorporated into 7000- and 8000-level codes for processing casualties.

3. Headquarters Marine Corps and the Navy Bureau of Medicine should consider adopting a formal course to ensure standardization and a quality of instruction that is vetted by the Committee on Tactical Combat Casualty Care. This course may serve as the initial training certification for medical providers attached to infantry battalions.

4. The development of a supporting structure must be established to ensure that medical providers maintain currency and proficiency in accordance with the T&R standards. The proposed model of initial training at a formal school and the subsequent enforcement of refresher training by regimental/division-level evaluators is suitable.[10]

5. The Inspector General of the Marine Corps should incorporate unit FWB program inspections into the Health Service Support functional area checklist to ensure compliance with donor safety programs. The Armed Services Blood Program should vet the checklist for compliance with governing regulations.

6. FWB transfusion is only the first of many steps that are required to adequately conduct prolonged field care appropriately. The further refinement and development of a prolonged field care syllabus is recommended.

Researchers did not find any significant decrease in physical performance or shooting performance after donating the blood. Repeating similar testing on civilians and staff officers was also demonstrated to have little to no effect on performance.

Conclusion

The next fight will require prolonged field care.[11] Time-critical emergency FWB transfusion in the field can stop the most common cause of preventable death on the battlefield.

If the Marine Corps is going to innovate for the future, it cannot assume that the way it fought the last war will be the same way it fights the next. Innovation does not have to come through a new, costly technological advancement. In this case, the future can be seen in the past—blood transfusing on the shores of Omaha Beach. The development of

FRSS-STP train with simulated patients to ensure personnel can perform component therapies and transfusions. *(Photo by SSgt Rebekka Heite.)*

FWB training toward the goal of developing a prolonged field care capability is a step that the Marine Corps and Navy would be foolish not to take.

Returning now to our scenario on the island off the coast of the fictional country of Sembatu:

The medical officer recommends drawing upon the list of 150-plus prescreened and approved blood donors. Two donors at a time are pulled from their tasks to contribute a unit of blood to save their fellow Marines' lives and then return to the defensive effort. The corpsmen collect the blood and immediately transfuse it to the wounded Marines. The wounded still require surgical care to save their lives, but the unit's preparation bought them some time. The Navy is working suppressing enemy air defense missions to get an MV-22 from the Essex ashore. Now, with these measures, these guys just might make it home.

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10. The proposed model is similar to the current model of Joint Terminal Attack Controller training and progression, by which initial certification is completed at a formal school taught by Joint Terminal Attack Controller instructors and refresher training and advanced codes are supervised at the regimental/MEU level by Joint Terminal Attack Controller evaluators.

11. The Joint Trauma System Clinical Practice Guidelines are essentially medical doctrine for U.S. Forces. They are specifically designed for prolonged field care, emphasize this need, and illuminate a path for training our medical corps. These guidelines are viewable at https://jts.amedd.army.mil.

>Author's Note: The Valkyrie Training Program has subsequently been used to train more than 80 physicians and corpsmen operating across the MAGTF. The program materials may be downloaded at https://www.milsuite.mil/book/groups/valkyrie-emergency-blood-transfusion-training. Instruction sanctioned by the author is presently provided primarily at the Combat Trauma Management Course hosted by First Marine Division at Camp Pendleton, CA. For further inquiries, please contact the author via e-mail at russell.p.wier.mil@mail.mil or russell.wier@usmc.mil.

Across an Angry Divide

The myths of power projection

by LtCol Robert W. Lamont, USMC(Ret)

As the United States surveys the strategic landscape ahead, our eyes are cast across the Pacific divide once again amid stronger geopolitical challenges and increasing uncertainty. The rise of strong anti-access/area denial (A2/AD) systems will require the country to refine the role a forcible entry capability serves the national strategy. The purpose of this article is to highlight the vision, commitment, and leadership inherent in the sustainment of a robust power projection capability based on the tenets of *Operation Maneuver From the Sea,* (OMFTS [Washington, DC: HQMC, 1996], and *Ship To Objective Maneuver*, (STOM [Washington, DC: HQMC, 2011]), able to challenge a true peer-competitor.

The approach used here reviews some of the myths from the Second World War to baseline the historical level of effort needed to bring power projection concepts into fruition. An assessment of the origins of OMFTS follows to explore the underlying concepts and requirements inherent in this warfighting approach. The current A2/AD threat is then contrasted with this concept to better understand the obstacles that this approach will have to overcome. Next, the current and planned maritime lift structure is evaluated to see the extent to which our capital investment strategy aligns with our operational concepts. Finally, the demands of this path ahead are detailed as we explore how this operational paradigm can be championed going forward.

Perhaps one of the more enduring myths from the Second World War is that America was an unengaged observer of world events until the "day of infamy" brought the struggle to Pearl Harbor. Then the United States opened the valves of industry and ships, planes, and the tools of war rolled triumphantly down the lunch ramps of ships yards and production plants. This view does not align with the events of the 1930s or the capital and labor intensive nature of shipbuilding.

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It is ironic that because President Franklin D. Roosevelt is best remembered for his New Deal and the social engineering side of his agenda, this understates his strategic vision. Having served as Assistant Secretary of the Navy, the President knew the emerging Japanese threat and issued an executive order in 1933 to use public works funds to add 32 ships to the Navy in the next 3 years. His leadership was instrumental in rallying support for the Vinson-Trammel Naval Act of 1934, which added an additional 102 warships over the next 8 years and codified this naval expansion.[1] In fact, the keel for every major capital ship that would decide the issue up to the turning point at the Battle of Midway was laid before the first bombs fell on Pearl Harbor. America's war in the Pacific began almost a full decade before the first blows were exchanged. It is a cornerstone of this dialog that the capital defense investment decisions we make today will have far reaching ramifications well into the middle of this century and, as such, must be approached within an overarching operational concept.

This prewar period of seaborne expansion was not limited to the Navy's ships of the line. The Merchant Marine Act of 1936 sought to support the shipping industry, which was suffering the effects of worldwide economic depression and stiff foreign competition. The act provided construction and operating subsidies for vessels carrying cargos on essential trade routes. This bill established the foundation in terms of ship yards, merchant seamen, and operational knowledge that would allow for expansion of the cargo fleet by 5,777 vessels, half of them "Liberty Ships," during the Second World War.[2] This was the strategic lift that would carry three generations of American fighting men across the Pacific during conflicts against Japan, North Korea, and North Vietnam. In the Cold War, these ships provided the means to carry the goods required to rebuild a worldwide economy under the charter of the Marshall Plan. So, as we prepare to explore our operational concepts the issue is: Does the Nation have the resident lift to carry relevant forces?

From 29 November to 4 December 1992, the Marine Corps Combat Development Command conducted a war game to explore the concepts of OMFTS. The players for this event were drawn from Fleet Marine Forces and Navy commands. This effort led to the development of the following key operational capabilities demanded to support this new warfighting approach: command, control, and surveillance; battlespace dominance; power projection; and force sustainment. This article focuses on the implications of the middle two and how the threat has evolved since the inception of this approach.

Battlespace dominance was seen as retaining friendly freedom of action while simultaneously denying it to the enemy. The battlespace was divided into space, air, land, surface, subsurface, and the electromagnetic spectrum. Space, air, and electromagnetic spectrum superiority were assumed as achievable and important prerequisites to the development of the concept. On the surface, only anti-ship missiles were viewed as a serious threat to contesting that arena. In a similar vein, only mines were considered to have the capability to challenge the subsurface domain. Only on land did the game identify an area that friendly forces would begin with numerical inferiority. It was recognized that sophisticated command and control, coupled with superior fire support assets, could readdress lack of troops ashore. It was shown that dominance in the other key areas of the battlespace could off-set this shortfall, establish local superiority at selected points, and gain sufficient advantage to enable power projection. Once local battlespace dominance was achieved, the stage would be set for power projection.

During the game, power projection was seen as the heart of the OMFTS concept. The strengths and weakness of launching the initial wave from over-the-horizon (OTH) were explored in detail. Strengths of the OTH approach included: tactical surprise, maneuver room, and increased survivability against anti-ship missiles. On the negative side, increased time needed to build-up combat power, greater exposure of landing assets to enemy action, and challenges to coordinated action were all highlighted as areas that demanded additional capability development. The ability to exploit OTH allowed the task force to use dispersion and deception as vehicles to secure tactical surprise.

An operational analysis of OMFTS, published in the December 1994 edition of *Phalanx* magazine, further explored the key operational capabilities of this emerging concept. Through the use of combat modeling and historical analogy, it was shown how a smaller landing force could exploit partitioning of the defender to win out-numbered even given technology parity between the two forces. This approach demanded the force ashore have superior tactical mobility over their opponents in order to retain and exploit initial strategic advantages gained by selecting the point of entry. Finally, it oriented this maneuver ashore within a threat focused approach in lieu of a more inward orientation on the force beach-head line.[3] The use of partitioning as a ground campaign construct allowed the land component commander to present his opponent with an expanding array of tactical threats beyond the defender's ability to respond.

The anti-ship missile threat during this period drove the task force to the survivability advantages of an OTH approach. A survey of these systems at the time indicated that while the average range of threat systems was over 80 nautical miles, well in access of the horizon, they all required radar targeting at some point in the engagement chain.[4] During the game, avoiding radar detection placed the radar horizon at around twenty nautical miles. STOM concepts published in 2011 placed the standoff distance needed to execute the concept at twelve nautical miles. It can be shown that predicted radar range, based on line-of-sight requirements, in nautical miles is the square-root of twice the height of the target plus the same for the radiating system.[5] Given a traditional amphibious ship with approximately 40 feet of freeboard closing on radar with a sensor height of 35 feet, the theatrical detection range would be over 17 nautical miles, which seems to validate the assumption underlying the OMFTS war game. How has the threat evolved since these concepts were first discussed on the banks of the Potomac River?

In March 2010, ADM Robert Willard, the head of U.S. Pacific Command, noted that China was testing a conventional anti-ship ballistic missile capable of targeting aircraft carriers. This effort demonstrated the ability of the Chinese industrial complex to bring an advanced military system from concept to design in less than a decade. Strongly motivated by the intervention of U.S. carrier strike groups in the Taiwan Straits in 1995, the Middle Kingdom has led the world in the development of A2/AD capabilities. The Dong-Feng 21 (DF-21), or "East Wind," has the ability to reach out 1,700 kilometers, use GPS guidance, and execute precision-strike missions against ships underway and over the horizon.[6] The question now becomes where is OTH? The advent of increased range, precision guidance, smart end-game targeting, coupled with real-time mid-course updates, means twenty nautical miles does not buy you the stand-off defeat mechanisms once inherent in the OMFTS concept. Before you can penetrate a robust A2/AD system, you have to achieve the level battlespace dominance detailed in the original OMFTS war game.

Recall dominance of space, air, and the electromagnetic spectrum were assumed during the OMFTS war game. The required level of superiority within these areas demanded as power projection prerequisites is beyond the capabilities of the Navy-Marine Corps Team to unilaterally achieve when facing a peer military antagonist. No longer can the amphibious task force commander establish an amphibious operating area within a joint battlespace and operate within an independent maneuver construct. Power projection demands local surface superiority to set the conditions and tempo of the engagement both afloat and ashore. Blinding enemy acquisition systems requires control of the ultimate "high ground" in the upper atmosphere and space. Dominating the electromagnetic spectrum can isolate his sensor array from the launch platforms they support. When this level of dominance coupled with local command of the air is achieved, a joint task force (JTF) can select landward penetration points that optimize maneuver ashore and further erode the continuity of opposing A2/AD structure. Only through the close combination of all JTF assets can power projection reach its full potential since "shaping the battlefield" ashore will largely fall to fighting forces beyond the land component commander's domain.

It is important to note that the best chance to reach favorable conflict resolution is not likely to occur until ground forces can operate in a manner that allows the JTF commander to impose his

will on the enemy. This requires the landing force to exploit the strategic advantage gained by selecting a penetration point that places the enemy in a dilemma on how to respond. If he remains in place, he can avoid detection and indirect fires but is now subject to piecemeal engagement by the landing force and defeat through partitioning. Conversely, if he aggressively closes on the landing site, he places his forces on road networks subject to combined interdiction and strong landward defenses. However, getting the landing force ashore to execute these defeat mechanisms requires sufficient lift for both combat forces and sustainment.

In the decade before the OMFTS war game, the average amount of the Navy's ship building budget dedicated to amphibious shipping was eight percent. In the twenty years since this event, this amount almost doubled to an average of fifteen percent. In the decade ahead, the planned path forward calls for a reduction of this investment to five percent. The 30-year ship building budget estimate calls for increased investment in submarines and the refueling of nuclear ships. The Navy does not plan to expand its commitment to amphibious shipping, and it is incumbent on Marine Corps planners to fully account for this capital investment strategy as we refine and develop our operational concepts and warfighting techniques.[7] For the Marine Corps, it may well be time to fade from gray to black.

The use of "black bottom" merchant shipping to support power projection is not without historical president. During the Falkland War, the British augmented their limited amphibious lift with various private ship types including liner, roll-on/roll-off, and container ships. The task force that sailed into the South Atlantic was composed of 41 percent sea control ships, 22 percent troop lift, and 37 percent axillary and supply ships. Fifty-nine percent of the ships transporting the ground forces were from the merchant marine.[8] These supporting commercial ships accounted for one third of the vessels lost during the campaign.[9] This effort represents the scale and distances that would be required to push across the Pacific Ocean and as such provides insights into the path forward.

The USS* Wisconsin *(BB-64) morred next to the USS* Oklahoma *(BB-37), 11 November 1944. ***(U.S. Navy photo.)***

One unique advantage the Marine Corps brings to the table is its on-going partnership with the maritime prepositioned ship program and the inherent operational familiarity this provides in working with merchant shipping. Whether augmenting exercise lift under the Freedom Banner series or conducting off-loading and concurrent equipment maintenance, operational forces are renewing their merchantmen embarkation and planning skills. From this baseline of knowledge will spring the potential new and innovative tactics, techniques, and procedures needed to secure the lift demanded to project sufficient combat power to reassure a far-flung maritime alliance along the Pacific Rim. These ships represent the tip of the spear of a merchant fleet that will be needed to span the open oceans in any peer-competitor power projection scenario oriented on the east side of the Golden Meridian.

As of February 2013, the National Defense Reserve Fleet (NDRF) stood at 132 ships of various types. This government owned fleet is operated under the Department of Transportation by the Maritime Administration in concurrence with memorandums of agreement signed by the DOD. The Fleet is organized into a Ready Reserve Fleet (RRF) and the balance of the NDRF. The RRF represents 46 ships that are available on short notice ranging from 5 to 10 days. The majority of these are roll-on/roll-off ships able to carry impressive amounts of rolling stock and supplies needed to sustain maneuver ashore. The balance of the NDRF is broken down into ships planned for retention and those slated for disposal.[10] This fleet has proved its value in a logistics role. As recently as the Persian Gulf War, 95 percent of the cargo for Allied forces went by sea in U.S.-flag ships crewed by American seafarers.[11] The future of power projection demands the Marine Corps lead the way in developing techniques to transition these lift assets into forward areas where in-stream off-loading can facilitate the maneuver demands envisioned by OMFTS.

In addition to the government owned fleet, the President has the authority to requisition any American-Flag or American-owned ships even when the latter is flying a foreign flag.[12] For U.S. flag shipping, that means access to 191 additional ships of various types, the majority of which are containerized. Of these, 93 receive operating subsidies under the provisions of the Jones Act, which tie them even closer to government control and use when

demanded.[13] While additional shipping is out there under foreign flag, crewing these ships may prove problematic given potential divided loyalties of those embarked. Tapping into this lift as a power projection resource will require additional work in the area of logistics over the shore and improved seabasing concepts. Imaginative use of containers for multiple roles ranging for troop transport to prepackaged resupply are first steps in expanding the reach of ground combat power as it seeks to extend its range under a free flowing OMFTS construct.

Finally, the Marine Corps should seek to take a more active role in shaping the Maritime policies that impact power projection lift. In previous government talks, the Departments of Commerce, State, and Treasury were instrumental in formulating many of the provisions that shape our U.S. Flag fleet. Absent from these talks was the DOD despite the fact that many of the qualifying provisions for government subsidies compel commercial carriers to meet the needs of military necessity in the ship design and operation.[14] Without strong representation from military members fully attuned to the subtleties of seaborne power projection, it is unlikely that the full potential of this program to support the needs of national defense will be realized.

Moving forward, it is time to reengage and expand the scope of the next OMFTS war game. Rather than limit this event to members of the naval Services, it must include all Services and members from the Maritime Administration. Gaining battlespace dominance, a key under pinning of any power projection scenario, must move from the realm of assumption within the game to an active outcome from this event. Controlling space and the cyber gateways are two approaches that must be explored to sharpen the spear and provide an effective counter to an improving A2/AD shield. Finally, the game must be realistic in the scale and scope of the threat. Planning to defeat technologically inferior opponents with the penny packet employment of scattered company teams dependent on communications systems to tap into the firepower needed to readdress organic combat power shortfalls on the ground will not provide a realistic backdrop for force planning or concept development.

Next, it will take top-level leadership to engage in difficult debate on the policies linked to the strategic lift needed for power projection. Historically, the greatest strides in this area have been linked to Presidential direction supported by the defense establishment and the legislative branch. The Marine Corps has the intuitional knowledge to define the parameters and capabilities needed both within the Navy and Merchant Marine to move this discussion in a direction favorable to national interest. It is incumbent on a new generation of staff officers to reconnect to the founding roots of the Corps and become "so acquainted with maritime affairs as to be able to serve for and during the present war."[15] Without an understanding of lift requirements, maritime law as it relates to operating and construction subsidies, and the accessibility of U.S. and foreign flag shipping, it will be difficult to provide the executive branch with meaningful recommendations on power projection-related strategy. Given the long lead times associated with ship construction, the limited scope of our shipyards, and the dwindling pool of merchant seamen, it is time to address the renaissance of this fundamental strategic capability.

Finally, greater experimentation in the employment of all forms of lift is demanded. The Marine Corps is a leader in using Merchant Marine capabilities in its normal exercise and deployment cycle. Expanding the use of RRF shipping in annual training events will validate this important capability, increase understanding of its potential and limitations, and provide the operational bedrock on which creative ideas can mature and develop. These events have the potential to refine the connectors required to link non-traditional lift into the OMFTS concept and provide the relevant power combat power ashore, with superior mobility, to ensure the land component commander can bring any future contest to favorable resolution. These are solid steps on the path ahead to ensure we retain our unique operational capabilities as "Soldiers of the Sea."

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Where is the NECC?

It needs to be included in planning and execution

by Capt Walker D. Mills

In recent years, the Marine Corps has become obsessed with naval integration, and that's a good thing. Former Commandant Gen Robert B. Neller called for greater efforts at naval integration, calling it "Green in support of Blue."[1] In his *Commandant's Planning Guidance*, Gen David Berger echoed that call and labeled naval integration "an imperative."[2] The new Chief of Naval Operations, ADM Michael Gilday said, in his confirmation hearing, "there is no daylight between us," referring to himself and Commandant Berger in response to a question about the Marines' push for closer integration with the Navy. So, with all the calls for integration, where is the Naval Expeditionary Combat Command (NECC)? After all, the Marine Corps itself is a naval expeditionary force according to the Commandant.

You might be asking, "What is the NECC?" precisely because it is missing from most Marine Corps commentary and thinking. If you were to Google it, you would find it below Northern Essex Community College in the search results. Despite the relative lack of renown, the NECC is and will be essential for emerging and future Marine Corps concepts like *Expeditionary Advanced Base Operations* (EABO). The NECC, established in 2006, is the type command on which the Navy puts the responsibilities to man, train, and equip most of its functions that are not performed on ships, submarines, or airplanes. It is operationally controlled in combined task forces that consolidate the Navy expeditionary combat force (NECF) under singular command in each theater.

These forces include the Seabees: naval construction units that are similar to but distinct from the Marine Corps' engineer community and that have more capability. The Seabees are the go-to naval unit for building and maintaining runway and port infrastructure, hardening bases, and constructing expeditionary facilities.

The Navy Expeditionary Logistics Support Group is also part of the NECC. Responsible for "providing expeditionary logistics capabilities for the Navy, primarily within the maritime domain of the littorals," it is a key part of any maritime fight that needs fuel, ordnance, or cargo sustainment.[3] It is also responsible for expeditionary communications.

The NECC also contains the Coastal Riverine Force, which is responsible for port and harbor security—defending high-value assets like amphibs and aircraft carriers during strait transits and maritime security. In addition, the NECC has cognizance over explosive ordnance disposal units, which play a critical role in both mine countermeasures and dive and salvage operations. They are optimized for inshore and offshore littoral operations—operations in the very zone that the Marine Corps has identified as an essential part of its future. The NECC is rounded out by the Navy Expeditionary Intelligence Command and training and support elements. All told, it includes some 20,000 personnel, many of whom are currently deployed supporting operations around the globe.

Despite its capability, the NECC has largely been missing from commentary and discussion in and about the Marine Corps. The NECC has not been the focus of a feature article in *Proceedings* for years and perhaps ever in the *Marine Corps Gazette*. Most Marines do not know what it is or, more importantly, how it could support them. It has also been missing from published concepts and comments by senior leaders. It was defined in the appendix of *Littoral Operations in a Contested Environment* but never used, and in the 32 pages of the 2016 *Marine Corps Operating Concept*, it was mentioned once as part of a simple bullet without explanation, "Leverage the NECC." Gen Neller's guidance was a short fragmentary order, but it also did not mention the NECC. Gen Berger's planning guidance, while never specifically using the terms NECC or NECF, openly asks the question of

> whether it is prudent to absorb [some of the NECF] functions, forces, and capabilities to create a single naval expeditionary force whereby the Commandant could better ensure their readiness and resourcing.

This question about potential contributions of the NECC to EABO should be front and center; the ignorance of what the NECC can do is a loss for the Marine Corps.

In the 2017 *Littoral Operations in a Contested Environment* concept, the Marine Corps identifies a list of "proposed capabilities." Many of these capabilities are resident within the NECC, even though the command itself is not mentioned in the document, such as the abilities to:

- Establish expeditionary advance bases.
- Conduct littoral mine detection, avoidance, and clearance

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- Sustain distributed naval forces with precision munitions and sufficient fuel in high intensity combat
- Rapidly establish mobile, clandestine expeditionary logistics bases to provide sustainment to afloat and expeditionary operating forces.
- Conduct casualty and medical treatment and evacuation.

According to the Navy and Marine Corps' new concept, EABO will involve employing forward arming and refueling points (FARPs) and other expedient expeditionary operating sites for aircraft such as the F-35, critical munitions reloading teams for ships and submarines, or expeditionary basing for surface screening/scouting platforms in austere, temporary locations.[4] In brief, that is a lot of what the NECC does. Seabees can build and repair the runways and facilities at FARPs and build expeditionary basing. Naval Expeditionary Logistics Groups transport (and are developing the internal capability to reload) munitions on planes, ships, mobile landbased launchers, and submarines. But to leverage the capabilities of the NECC, Marines first need to understand it and account for it in new plans and concepts.

There has been some progress. Marine engineers and Seabees have been working together to repair and refurbish the "Airport in the Sky" on Catalina Island as part of the DOD's Innovative Readiness Training Program: a task not unlike what they might be expected to perform on other islands in the Pacific in wartime.[5] More recently, Exercise PACIFIC BLITZ, which was held across Southern California, included multiple units from the NECC and I MEF, though not necessarily integrated.[6] The East Coast planning efforts for the upcoming Large-Scale Exercise 2020 features an "expeditionary syndicate" led by Expeditionary Strike Group 2, II MEF, and NECC co-leads.

During my own time in the Corps, I have spent significantly more time training with partner militaries than I have with Sailors or Soldiers in our own military. I cannot remember a training event where I ever worked with Sailors from the NECC. This results in myopia across the force at a time when naval integration is becoming increasingly central to our core responsibilities and future vision. Our lack of engagement with the NECC might be the worst example of this myopia, but it extends to the other Services as well. Until I attended the Defense Language Institute on an Army installation, I had never met an officer in the Army or Air Force in a professional setting. Sometimes I wonder if there are Marines who think we can defend the Pacific by ourselves, ignoring that the Army alone has more than 80,000 soldiers based in the Pacific and continues to expand their roles.[7] I am not arguing that Marine Corps leadership is unaware of the NECC or our sister Services, but it is important that the whole force, from top to bottom, has a strong understanding of the NECC's role and capabilities. The NECC is perhaps the organization that the Marines will work closest with when executing EABO; the NECC will help enable EABO. It is also not the only organization Marines should expect to fight beside. The Army possesses over 100 seagoing vessels that will likely be used for intratheater transport in the littorals and be key to any future Pacific campaign because the Marine Corps and the Navy do not have the same capability. New Army multi-domain task forces will also be present in theater, and the Air Force will likely deploy small units built around its "Rapid Raptor" concept. Marines need to understand these capabilities and train with them in a joint way.

In his paper, "On Littoral Warfare," Naval War College professor Milan Vego writes that "littoral warfare requires the closest cooperation among the services, or 'jointness.'"[8] That cooperation is rooted in understanding and fostered by joint training. If Marines do not understand or discuss the NECC, it is because they have not been adequately exposed to it. The NECC, by name and definition, is, like the Marine Corps, a naval expeditionary force. The command has the capability to support EABO in everything from running decoy FARPs to maintaining and building fuel sites and repairing port facilities. In order to validate and implement future and emerging concepts, the Corps needs to seek out more opportunities to expose itself to and train with specific partner forces and units. The Marine Corps must increasingly seek joint training opportunities with the units in other Services it is most likely to work with and must work to highlight that training and increase Marines' exposure to the NECC.

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When the Chickens Come Home to Roost

Range maintenance needs reorganization

by LtCol Stephen Olmstead, USMC(Ret)

Our training facilities and ranges are antiquated, and the force lacks the necessary modern simulators to sustain training readiness.

—Commandant's Planning Guidance, *2019*

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Innovations in targetry, weapons effective ranges and lethality, aviation sensor capabilities, speed, small unmanned aircraft system integration, and cyber are all clamoring for ranges and opportunities upon which Marines are able to train. The cry continues: we must modernize our ranges! In the last decade, the Marine Corps has invested over $1 billion in range modernization and recapitalization, and the beast is still hungry. The basic purpose of this article is to illustrate that, in spite of that investment, the effective sustainment of ranges and protection of that investment remains a moving target. As the 38th Commandant stated,

> We have under-funded maintenance at our installations for far too long and failed to appreciate the growing risks associated with those decisions.

The reality is that unless you are the guy trying to maintain the ranges, the interest level in range sustainment falls somewhere between paving a parking lot and chasing roof leaks. Range maintenance is a complicated issue, and the truth is that for over a decade we have admired the problem and done little to successfully address it. There is nothing sexy about maintaining ranges and range training areas (RTAs), and as long as the operational forces can still put bullets downrange, you will get very little feedback on the condition of the ranges—whether some of the targets work or all of the targets work. *While range maintenance and sustainment has previously been the responsibility of installation commanders, those roles and functions are now blurred under current organizational constructs.*

Range maintenance is a complicated issue, and the truth is that for over a decade we have admired the problem and done little to successfully address it.

Prior to 2001, the Marine Corps' approach to range modernization and sustainment was nothing short of institutional myopathy. Issues of range maintenance and sustainment were problematic because the funding streams involved were not "fenced"; therefore, installation comptrollers aligned funds based upon commanders' requirements.

The installation commander was essentially the fifth element of the MAGTF, and both answered to a common Marine forces commander who shaped requirements. Rarely was the condition of a range a focus of an operational commander, but woe be the installation commander who failed to provide the best possible barracks and chow halls. Consequently, the best intentions of program managers to properly fund range modernization and maintenance often resulted in those funds being diverted to more pressing facilities requirements.

Based largely on a 1988 study done by the Deputy Commandant, Installations & Logistics, titled "Marine Corps Land and Training Area Requirements Study (1990–2004)," commonly referred to as the LATAR study, the Marine Corps recognized it did not have a comprehensive range and maneuver area development program. This was because of the absence of a central institutional organization that was properly staffed, sufficiently funded, and charged with that responsibility. The recommendations led to the creation of the Range and Training Area Management (RTAM) Branch, Training and Education Command (TECOM), under the Deputy Commandant, Combat Development and Integration, with centralized con-

trol of, and overall responsibility for, live fire ranges and maneuver areas. This branch would formulate policy, develop and oversee programs, and prioritize the modernization and recapitalization of installation ranges enterprise-wide for live fire and maneuver areas based on training needs.

For the first time, ranges were to be viewed and programmed as institutional assets. This raises the question: If ranges and training areas are to be addressed from a maintenance perspective as institutional assets then doesn't it stand to reason that local installation organizations, contract vehicles available, workforces, and equipment should have uniformly similar *capabilities* appropriately scaled to the installation? The obvious answer is yes; however, each Marine Corps installation is vastly different in staffing and equipping, contract interpretation and capacity, process, and overall effectiveness. If the institutional approach to range recapitalization and modernization is proving to be successful, then the question that must be asked is: why is the institutional approach to range maintenance not working, and what can be done to remediate the issue?

No one can, in good faith, argue that the overall condition of ranges, RTAs, and training opportunities across the Marine Corps are not vastly superior to those that existed two decades ago. This exposé is not an indictment of that effort but rather a warning that the investment is at risk unless roles and functions are clearly defined and properly aligned to the organizations that can best execute them. RTAM, TECOM, has done a superb and herculean effort to bring all Marine Corps ranges and RTAs under a centrally managed, centrally funded program. Standard ranges now include automated targetry, moving targets, robotic targets, head facilities, covered ammunition distribution areas, control/observation towers, fortified trenches, facades, gravel roads, earthen berms, sound systems, and specialized lights. So, what is the problem?

As an example of how quickly range and RTA maintenance becomes a problem, let us use the SR-10 tank gunnery range at Camp Lejeune. This one range has 838 acres of grass, 12,000 feet of earthen berms, 18.2 miles of range roads, 2 range gates, 6 lateral limit signs, a range tower, an ammunition distribution facility, 102 stationary infantry targets, 30 moving infantry targets, 40 stationary armor targets, and 8 moving armor targets. The entire range was built as a military construction project. How is the maintenance accomplished? The targets are all classified as Class III, property as part of a system, and are therefore maintained with Operations & Maintenance (O&M) funding. The berms, roads, towers, range gates, and grass, are all Class II, real property, and should be maintained using Facilities Sustainment, Restoration, and Modernization (FSRM). However, FSRM is typically funded well below the requirement and so maintenance on real property is augmented by O&M funds. What must also be considered is that FSRM is intended to support facilities—brick and mortar work. Such facilities have average life cycles and planned maintenance over a 40- to 50-year time frame. Ranges such as SR-10 are subjected to destructive forces on a daily basis in the form of .50 caliber machine guns, 120mm main guns, and 72-ton armored tanks. Ranges do not fit the current FSRM model.

Ranges are maintained by operations and maintenance funding. *(Photo by Cpl Samuel Brusseau.)*

Have your eyes rolled into the back of your head yet? It gets better. The electrical wiring that powers the automated targets is also Class II and is maintained by the local public works division, but the data lines on the range are the property of the installation G-6 (Communications). Now for the *coup de grâce*. For the most part, installations have little to no organic range maintenance capability as a result of strategic workforce reductions and the conversion of civil service and military line numbers on installation tables of organization to contract billets as a result of A-76 studies, as well as having no clear pathway for the procurement and sustainment of needed range maintenance equipment. The lack of Procurement Marine Corps funding to procure range maintenance equipment and the current moratorium on adding such equipment to the Marine Corps non-tactical vehicle program forces installations to purchase or lease equipment using Base Operating Support O&M funds to accomplish their mission.

The result: near total dependency on contracts and contracted labor to perform RTA maintenance. In the mid- to late-2000s, RTAM, TECOM attempted to accomplish this through the acquisition and fielding specialists of Program Manager, Training Systems Command in Orlando, FL, on behalf of the entire enterprise. This contractor operated and maintained contract

was essentially designed to include everything on the range footprint from soup to nuts. However, the cost was very high, and the legal assessment of the contract was that it too closely resembled a personal services contract. With few exceptions, such contracts were banned in the DOD.

This led to a second enterprise contract attempt called the ground training systems support contract. This contract eliminated many of the maintenance functions on ranges such as vegetation management except for the area immediately surrounding a target, road maintenance on ranges, and maintenance on other real property. This contract was again found to be deficient and often unenforceable because it was impossible to separate real property maintenance on ranges. Finally, a third enterprise contract (a regionally focused version of the ground training systems support contract) was developed that added much of the real property back into the maintenance equation; however, Navy-Marine Corps Acquisitions Regulations Supplemental, the Davis–Bacon Wage Act of 1931, and *MCO 11000.5, Facilities Sustainment, Restoration and Modernization Program*, governing real property, so limited what a contractor could do that the essence of RTA maintenance—à la "construction-like activities" not to exceed $2,000 in labor—was out of the scope of the contract. As an example, the contractor could not paint more than 200 square feet, maintain vegetation more than 10-feet beyond a target, provide berm repairs caused by weather erosion, on and on. With such a limited contract, often the subject of vague interpretations by multiple layers of oversight, how is the installation to accomplish all the remaining maintenance on the range?

Installations have little choice but to initiate new contracts using Base Operating Support O&M funds to conduct the myriad functions that the enterprise contract can no longer address. These contracts require long lead times for advertising, award, and execution and are expensive. The most basic range maintenance issue frequently takes more than a year to resolve. In a nutshell, that is the problem. So, what is the solution?

Step One: Eliminate the contract authority issues encountered by Program Manager, Training Systems, by elevating the contract administration to the higher contracting authority—Naval Facilities Command. Naval Facilities Command has habitual relationships with the regions through local resident officer-in-charge of construction offices that can perform contracting officer representative duties. This singular step eliminates the limitations currently imposed by the construction-like activities clause of the Navy-Marine Corps Acquisitions Regulations Supplemental and the wage limitations of the Davis–Bacon Act.

Step Two: Establish an RTAM program separate from all other RTAM functions. This program should align Marine Corps Orders and policy to separately identify ranges and training areas as unique entities requiring a holistic approach to maintenance that includes all of the various supporting funding streams—FSRM, O&M, and Procurement Marine Corps. Responsibility for such a program should be aligned with that organization best suited to be the program sponsor.

Step Three: Identify, by installation, across the enterprise what the requirement is for ranges and training area maintenance, the equipment, and personnel necessary to meet that requirement and make adjustments over the Program Objective Memorandum to provide an organic range and training area maintenance capability to each installation. Then, and only then, will range and RTAM efforts truly be materially effective, cost effective, responsive, proactive, and scalable.

There is no way to avoid the hard reality that a comprehensive review and overhaul of range maintenance efforts across the Marine Corps is necessary and is going to require changes to business as usual. Marine Corps leadership, both installations and those with programmatic responsibilities, must take back the responsibility for the protection of the investment in ranges by establishing viable range and training area maintenance capabilities, which they can control and direct. This can only happen with changes to funding, personnel management, and the implementation of policies that reflect an integrated approach to range maintenance and sustainment. The risk at the installation level is real, and it is here! Time to go and feed the chickens.

Contractual support for range maintenance requires long lead times. *(Photo by Sgt Tayler Schwamb.)*

Expeditionary Warfare School LTG John J. Yeosock Memorial Award 2019

Assuming the Threat Away

The Marine Corps Operating Concept's failure to address near-peer area denial missile threats

by CPT Benjamin Schiff, USA

As adversaries continue to develop new capabilities, the DOD must evolve to account for the new threats. If Marines established an expeditionary advanced base (EAB) today, they would face missile attacks directly on their position and would have no recourse. The *Marine Corps Operating Concept* (MOC) for 2025 attempts to make this transition by focusing on EAB operations.[1] However, the MOC has a critical gap that places significant risk on Marines deployed in the future operating environment. Specifically, the Marine Corps must innovate in response to the adversarial modernization of unmanned aerial systems (UASs), cruise missiles, and tactical ballistic missiles. Although ground and sea-based air and missile defense are Title 10 responsibilities of the Army and Navy, air and missile defense system development must be a critical focus for the Marine Corps. Therefore, to operate EABs and exercise local sea control in the future operating environment against a near-peer threat, the Marine Corps must develop a directed-energy air and missile defense system capable of defeating cruise missiles and short-range ballistic missiles (SRBMs).

One problem the MAGTF will face in the future operating environment is our adversaries' use of precision strike long-range rockets and ballistic missiles at the tactical level. UAS, cruise missile, and tactical ballistic missile threats have proliferated at an accelerated rate over the last two decades as the United States' adversaries pursue anti-access/area denial as a strategy to counter the U.S. military's strengths.[2] As adversaries increase their air and missile threat capacity, SRBMs will no longer be a strategic asset operating at echelons above corps. Marines will begin to face SRBM threats at the tactical level. In 2018, a DOD report stated that China had approximately 1,200 SRBMs capable of precision strike.[3] Russia has already distributed its SRBMs to the brigade level.[4] The proliferation of adversary ballistic missiles sheds more light on the Marine Corps' lack of any missile defense capabilities, despite the identification of this capability gap after the Persian Gulf War.[5] The rise of ballistic missiles and their new role at the tactical level of war poses a significant threat to Marine Corps operations in the future operating environment.

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> ***... develop a directed energy air and missile defense system ...***

Another problem is that the MOC does not account for the increased threat from UASs and missiles. The MOC states, "MAGTFs may be task-organized for missions to seize, establish, and operate multiple EABs."[6] However, the Marine Corps does not have the capability to provide air and missile defense for the EABs. Without air defenses, the MOC assumes our adversaries will be unable or unwilling to target EABs because the Marines will not meet the threshold for an enemy to engage with air and missile capabilities.[7] This assumption is invalid because it wishes away adversaries' capabilities and ignores the problem.[8] With growing inventories of precision strike SRBMs, adversaries will be able to strike EABs within a weapons engagement zone despite the EABs' dispersion and small footprints. The threshold for U.S. forces to present a valid target for adversaries will continue to drop as adversaries' inventories of long-range rockets and SRBMs increase. EABs, no matter how small or dispersed, will break the threshold and present a valid target for the adversary to prosecute. The MOC's failure to account for realistic air and missile capabilities forces them to incur significant risk to mission and risk to forces when operating inside an adversary's weapons engagement zone.

One reason the MOC fails to account for adversarial air and missile defense is that the Marine Corps views this defense as a capability solely under the force protection warfighting func-

tion.[9] The Corps states that a priority in the future operating environment is to establish "local sea control and power projection into contested littoral areas,"[10] and views sea control and power projection as a responsibility of the fires warfighting function, traditionally fulfilled by aviation and artillery assets. However, the Corps cannot accomplish sea control and power projection without a capable air and missile defense system. Without viewing this defense as a component of the fires warfighting function, the Marine Corps will not be able to truly have local sea control or project power into contested areas.

Some of the problems the Marine Corps faces with procuring and implementing this defense system are the cost of interceptors and the large sustainment footprint required for traditional air and missile defense systems. Indeed, current interceptor-based air and missile defense systems cost more than the missiles they are designed to defeat. An Aegis SM-3 Block 1B interceptor costs around $14 million, while the Chinese CSS-5 Mod 5 anti-ship ballistic missile only costs $7 million.[11] The Marine Corps cannot afford to acquire an interceptor-based system at the expense of other capabilities. Traditional interceptor-based systems are also too large and require too much support equipment to be able to operate in the expeditionary environment described by the MOC. Additionally, it would be impossible for the Marine Corps to sustain air and missile defense interceptors in a quantity greater than adversaries' SRBM inventories, especially at EABs. An air and missile defense solution that allows the MOC to be effective must overcome significant cost and sustainment issues.

Currently, no air and missile defense system would meet the requirements for the MOC. It would require a mobile, directed-energy system capable of being transported from ship-to-shore, similar to the Army's Intermediate Short-Range Air Defense system that consists of a reconfigurable turret mounted on a Striker.[12] This turret can be mounted on the joint light tactical vehicle, which is already in the Marine Corps' inventory.[13] However, the new system would require a high-energy laser, greater than 50 kW, to have the capability to defeat enemy UASs, cruise missiles, and SRBMs.[14] This weapons system "burns through" enemy air and missile threats by directing the high-energy laser onto them while they are in flight.[15] It expends no rounds when fired, thus reducing the lifetime cost and sustainment requirements. The only additional sustainment needed for this system is the fuel required to power the lasers. The ability to tie into a shore-based power grid when operating EABs reduces the sustainment requirements even further.

This new system is a solution for the MOC because it would provide force protection from air and missile threats for EABs established inside of enemy weapons engagement zones, despite the growing air and missile capabilities of the United States' adversaries. In addition to providing protection for its own forces, the Marine Corps could utilize EABs to project power and have local sea control with capable air and missile defense systems. Robust air and missile defense capabilities allow this power projection by imposing anti-access/area denial on the enemy. Incorporating this defense into the fires warfighting function will enable it to achieve sea control.[16] Air and missile defense systems established at an EAB in a contested littoral environment would allow the Marine Corps to control the airspace in that environment, increasing the risk calculus for an enemy attempting to operate aircraft, missiles, or ships in that area. Additionally, U.S. Navy ships would have freedom of movement through that area under the protection of the EAB's defense systems. This would allow the Navy to utilize Aegis ships that would otherwise defend strategic assets in those areas for other purposes and extend the joint force commander's area

***A standard SM-3 Block 1A being launched from the guided missile cruiser USS* Decatur *(DDG73).* (Photo courtesy of the U.S. Navy.)**

of influence. Air and missile defense systems are more than a force protection requirement for the Marine Corps; they provide a robust fires capability, allowing the joint force to extend its operations.

Furthermore, a directed-energy air and missile defense system would solve the cost and sustainment issues facing the Marine Corps. Traditional defense systems are prohibitively expensive to sustain. However, a directed-energy weapon can achieve a higher probability of kill than interceptor-based defense systems for less than $30 per shot.[17] This is a dramatic decrease from the Marine Corps' current Stinger system, which costs $110,000 per interceptor.[18] While sustainment and transportation requirements are a problem with traditional systems, directed-energy missile defense systems can easily fit into almost any unit's ability to produce power. The cost, transportation, and sustainment benefits of a directed-energy system require the Marine Corps to prioritize the development of a system capable of defeating advanced UASs, cruise missiles, and SRBMs.

An argument against the Marine Corps' procurement of air and missile defense systems stems from Title 10 responsibilities. Sea-based air and missile defense is a Title 10 responsibility of the Navy, while ground-based air and missile defense is a Title 10 responsibility of the Army.[19] Opponents of Marine Corps air and missile defense would argue that, in a joint environment, the Navy can provide this defense while the MAGTF is afloat. The Army, then, can provide defense while the MAGTF is ashore. However, this is an unrealistic expectation that is incompatible with the MOC. The Army will be unable to provide this defense to the Marine Corps in the future operating environment because it will not participate in the seizure and operation of the EABs with the Marine Corps.[20] Additionally, the Army will need to utilize its limited air and missile defense systems to protect its own forces. If the Marine Corps relies on the Army to provide force protection and fires at its EABs, the argument could be made that the Army should seize and operate the EABs themselves. To perform its role in the joint force and to effectively execute the MOC, the Marine Corps needs air and missile defense systems capable of operating in expeditionary environments, despite it not being a Title 10 responsibility.

Without a capable, directed-energy air and missile defense system, the Marine Corps cannot bring the capabilities of the MAGTF to bear against the United States' adversaries under the MOC. Although it is not a Title 10 responsibility, the Marine Corps needs to prioritize the development of a defense weapons system that provides the capability to defeat the growing UAS, cruise missile, and SRBM threats EABs are likely to face while executing the MOC in the future operating environment. Unless the Marine Corps procures a directed-energy air and missile defense system, Marines deployed to EABs in a near-peer fight face a significant risk of enemy air and missile attack.

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The Value of Redeployable Shelters

Creating a dynamic deployment capability

by Col Mike Sweeney, USMC(Ret)

>Col Sweeney served in a number of command and staff positions. In his spare time, he works with World Housing Solution to help create portable housing solutions for the military.

The U.S. military has always had the ability to rapidly deploy anywhere in the world at a moment's notice. This ability will be tested by a renewed emphasis placed on rapid deployment as a result of a Pentagon strategy known as Dynamic Force Employment, which calls on the military to keep adversaries off balance by making troop movements more unpredictable.

In his April 2018 statement before the House Armed Services Committee, then-Chairman of the Joint Chiefs of Staff, Gen Joseph F. Dunford, Jr., said,

> The National Defense Strategy directs the Joint Force to introduce unpredictability to adversary decision-makers through Dynamic Force Employment. Dynamic Force Employment allows us to develop a wide range of proactive, scalable options and quickly deploy forces for emerging requirements while maintaining readiness to respond to contingencies.

Rapidly deployable shelters (RDS) are one of the key assets in our ability to rapidly respond to global crises and combat situations across varying geographies and conditions. These RDS are the mobile solution our military needs to meet the Dynamic Force Employment imperative for quickly constructing bases. This includes living spaces and operational structures for command and control, communications, logistics, and other support activities.

Innovative expeditionary solutions like RDS are evolving, offering new levels of versatility, efficiency, safety, and cost effectiveness that can help our troops rapidly deploy in the face of unexpected conflict. As the Department of Defense looks to allocate *its* $738 billion fiscal 2020 budget, the procurement of RDS should be a spending priority to ensure effective mobilization capabilities for our expeditionary military forces.

Versatility and Efficiency

Future operating concepts, advanced technologies and weapons systems of potential adversaries, and a contested electro magnetic domain will require mobility in future engagements.

The medium-to-large operating bases, which were so critical to operations in Iraq and Afghanistan, will not likely be a luxury that our combatants will be able to rely on in the same manner they were previously used to. Sustainment of deployed forces will require a logistics approach that aligns with a mobility-based support and sustainment struc-

The Arctic shelter was tested at Camp Pendleton before being utilized at Bridgeport. *(Photo by Cpl Laura Gauna.)*

RDS are lightweight, set up rapidly, and reusable. *(Photo by Cpl Laura Gauna.)*

ture. RDS fit nicely within this model and reduce logistics requirements across the board.

An increase in energy efficiency, integrated technology, and reduced fuel and water consumption resulting from enhanced technologies equates to a reduced logistics "tail." Reducing the dependence on supply-chain challenges will not only serve our service members but also reduce the burden to the taxpayer.

Investing in structures that can be deployed, constructed, and redeployed with hand tools makes both operational and fiscal sense. These structures do not need heavy equipment for transport and construction and can be built by two- to four-man teams.

Reducing Risk

Over the course of operations in Iraq and Afghanistan, 52 percent of casualties came not from combat but rather from requirements to resupply and refit deployed forces. A little more than half of the approximately 36,000 U.S. casualties that happened over a nine-year period during Operation Iraqi Freedom and Operation Enduring Freedom occurred from hostile attacks during land transport missions, *mainly associated with resupplying fuel and water*.

The efficiency of RDS units equates to less water and fuel consumption as compared to our legacy and *ad hoc* structures, which translates to a reduced logistics footprint and fewer people on the road to move material and fuel. The reduced time spent by Marines outside the camp dramatically limits the risk of injuries and fatalities by minimizing the dependence on external resources.

Cost Effectiveness

The military spends upward of $10 billion on fuel annually. This data is significant because it demonstrates a real opportunity for the DOD to reduce the logistical burden and fuel costs while meeting its goal to minimize its carbon footprint and increase base camp security. Studies show that while base camps constructed with current expeditionary structures typically cost less to acquire than insulated rigid structures, the return on investment on a more efficient military camp produces between $27 million and $49 million in fuel savings and maintenance over the span of 15 years.

By replacing standard military structures with RDS, money spent on fuel can be reallocated toward greater defense technology while simultaneously reducing the DOD's carbon emissions—an initiative that benefits us all.

As the DOD budget ebbs and flows, investment in rapidly deployable structures makes fiscal sense and supports a diverse operating environment. Replacing traditional structures (cloth and metal shipping containers) with eco-friendly, RDS can play a key role in enhancing our responsiveness and our resiliency and, most importantly, ensuring that our men and women in the Armed Forces can respond more quickly and safely in the face of a humanitarian crisis or combat situation.

USMC

RDS can reduce costs spent on other items to support deployed forces. *(Photo by Cpl Laura Gauna.)*

The Civil Affairs Force

A reimagining

by LtCol Anthony P. Terlizzi, USMC(Ret)

It is another early morning on Pulau Laut. Children watch fishing boats of varying types head out into the South China Sea while a couple hundred meters down the beach a group of men cluster around an old wooden jukung, bantering over who will be responsible for taking it back out to sea once the repairs are completed. Life is pretty much the same as it has always been for the people living here. However, there is one exception, a Marine and his Tentara Nasional Indonesia-Angkatan Laut[1] *colleague will be assisting these men in repairing that old wooden boat. "Selamat pagi, Pak. Apa kabar?" The Marine greets the eldest of the men, his Behasa Indonesia is about as good as theirs!*

The Marine is a member of a civil affairs (CA) detachment assigned to III MEF, MEF Information Group's Civil Reconnaissance Company, and he and his CA team are operating to further U.S. interests as a part of 7th Fleet's forward deployed littoral combat ship within the area of operations of the nearby naval expeditionary force. The team has been on Pulau Laut for almost two months conducting civil reconnaissance and civil engagements, and soon they will be moving to their next island destination. During that time, these 21st century coast watchers[2] *have utilized a commercial off-the-shelf drone to document the type and frequency of maritime traffic in the nearby shipping lanes, survey the light footprint of infrastructure on Pulau Laut, and provide endless entertainment to the islanders who would otherwise not normally experience such "toys." At the end of each day, the team uploads the data they have gathered to their Marine Civil Information Management System portal.*[3]

>LtCol Terlizzi served for 23 years in the Marine Corps holding multiple senior staff and leaderships positions. A former Artilleryman, Regional Affairs Officer, Joint Staff Officer, and Civil Affairs Officer, his last active duty position was Director, Marine Corps Civil-Military Operations School (MCCMOS). After retirement from active duty, he served as the Senior Fires Analyst at the MAGTF Staff Training Program and is currently a contractor with Corps Solutions, LLC., and lead instructor at MCCMOS.

New threats, new missions, and new technologies require us to adjust our organizational design and modernize our capabilities. While others may wait for a clearer picture of the future operating environment, we will focus our efforts on driving change and influencing future operating environment outcomes.

—Commandant's Planning Guidance, *2019*

Although this is fiction, it is not beyond the realm of possibility. In fact, it should be the norm: small groups of self-sufficient Marines operating deep within contested spaces to provide presence, survey the activities of our adversary(s), and provide a counter to their efforts to shape the operational environment. The Marine Corps defines a concept as,

> an expression of how something might be done; a visualization of future operations that describes how warfighters, using military art and science, might employ capabilities to meet future challenges and exploit future opportunities.[4]

The *Marine Corps Concept for Civil Affairs* envisions CA Marines operating in small, highly capable teams or detachments providing persistent presence, disrupting enemy or adversary access to key terrain—such as the information environment—while simultaneously protecting access for friendly forces.[5] There is no reason why the Marine Corps cannot use existing CA capabilities to start doing this now.

The United States' unipolar moment was short. Today, U.S. interests are being challenged globally; while there is still no power that can realistically challenge the United States militarily as a global equal, military challenges abound. With this in mind and considering the following observation from the *Commandant's Planning Guidance,*

> Significant change is required to ensure we are aligned with the 2018 National Defense Strategy and Defense Planning Guidance, and further, prepared to meet the demands of the Naval Fleet in executing current and emerging operational naval concept,

we need to consider every tool we have in the toolbox. Civil affairs is one such tool.

Civil Affairs and Contested Space

While this article is not about the People's Republic, the growth of Chinese power in the Asia-Pacific serves as a relevant backdrop to illustrate how the Marine Corps can better utilize its CA forces. China is on the move almost everywhere. China's "whole of government" effort represents a patient, long-term strategy to secure its regional goals short of initiating a conflict that may undermine its number one priority: internal stability. This approach to challenging the status quo is both political and hybrid in nature[6] and has been described in various fora as "salami slicing," where there is a slow accumulation of small actions, none of which justifies a war, but which adds up over time to a major strategic change.[7]

So how to compete? The *Commandant's Planning Guidance* states,

> Rather than heavily investing in expensive and exquisite capabilities that regional aggressors have optimized their forces to target, naval forces will persist forward with many smaller, low signature, affordable platforms that can economically host a dense array of lethal and nonlethal payloads.

Finding an effective way of deterring and defeating Chinese hybrid campaigns and their associated political warfare operations is not easy. Moreover, options are affected by American culture (i.e., instant gratification or feedback that we are achieving something now). Taking a realist perspective of power—or at least the visible manifestation of power—is understandable, even desirable. Certainly, visible and tangible actions can and do send signals to an adversary. Exercising freedom of navigation by sailing a guided missile destroyer through contested space is one such manifestation, but so too can be less visible actions in these contested spaces. Aircraft carriers, strategic bombers, and HIMARS can and will send a signal to a potential adversary. Take, for example, the latter. Adding CA Marines to the planning and employment of HIMARS for expeditionary advanced base operations makes perfect sense. CA Marines operating in a distributed manner conduct civil reconnaissance: a targeted, planned, and coordinated observation and evaluation of specific civil aspects of the environment. Civil reconnaissance focuses specifically on the civil component, the elements of which are best represented at the tactical level by using areas, structures, capabilities, organizations, people, and events.[8] That information is used to assist in the planning and employment as well as the associated messaging required to support such operations. But that is only a part of the equation. Many nations desire reassurance from the United States that they are committed to the region, but do not want that visible manifestation of power on their territory. Properly vetted, trained, and equipped CA Marines provide such an option.

Many nations desire reassurance from the United States ...

For instance, the U.S. Special Operations Command example of civil-military engagements (CME) is illustrative. By joint doctrine, CME is a civil affairs-supported task under civil affairs operations. CME is a U.S. Special Operations Command program of record. Funded through Major Force Program-11, the CME program is SOF civil affairs-executed capability which provides an indirect line-of-operation capability through persistent CME in specific countries and regions to shape the civil dimension of the operational environment.[9] While the focus of this program is ungoverned or under governed spaces, the concept should be executed by CA Marines in the littorals. CA Marines supporting naval construction battalion (Seabees) operations throughout the entire planning to execution chain can increase the effectiveness of these efforts.[10]

Similarly, CA Marines can be temporarily assigned to American embassies or United States Agency for International Development (USAID) missions to support national security objectives. A similar program has existed in the form of a CME's civil-military support element—a U.S. Army CA team which assists the U.S. Ambassador with civil-military programs and projects that support U.S. and host-nation objectives. This would not necessarily suggest CA Marines as project managers attending to development projects—that should not be the priority of what CA Marines do; however, it would be a complementary approach to USAID activities within a region. In the scenario described in the introduction, the CA Marine surveys local infrastructure on Pulau Laut. This information is then shared with USAID and the Indonesian Government, and they determine what actions, if any, are worth pursuing. The CA Marine gains access to the region, provides useful information to those who can use it, and interacts with the locals to help shape perceptions. While arming a CA Marine with a check book might be one approach, we would be foolish to think such actions can compete equally with the billions of dollars the Chinese can spend. The difference is that the CA Marine can conduct specific, localized assessment of needs that can be addressed by regional partners, nongovernmental organizations, or USAID as opposed to the one-size-fits-all juggernaut that China brings, and—as already articulated—supporting our governmental and nongovernmental partners provides the CA Marines access to the contested spaces we desire to influence.

The 21st Century CA Marine

So how do we get there? First and foremost, we need to take a realistic reassessment of current CA doctrine, training, and structure. CA forces have three core competencies that focus on the civil component. These core competencies are essential and enduring capabilities provided to the MAGTF.

The first competency—CA activities—are specifically planned, executed, and assessed by CA forces, and provide unique capabilities to the commander. They consist of the following functions:

civil reconnaissance, civil engagement, civil information management, civil-military operations center, and civil-military operations (CMO) planning.

The second competency—military government operations—are established when, through the course of military operations, replacement or sustainment of civil authority is required to maintain stability and governance. They consist of transitional military authority and support to civil administration.

The third competency—CA supported activities—are those functions in which CA plays a key planning, coordinating, or synchronizing role, but for which they are not the proponent or primary executor. These supported activities include foreign assistance, foreign humanitarian assistance, populace and resources control, and CME. These missions are executed through a combination of capabilities provided by elements of the MAGTF or joint force.

These competencies and functions must be supported with updated doctrine, training, and organization of the force. We could expand this look to include current information-related structure (i.e., communications strategy, psychological operations, etc). I would also include other civilian-military-related capabilities such as foreign area and regional affairs officers and specialists. While we do not necessarily need to blow up the system, we need to let go of old models.

The joint definition of CMO is:

> Activities of a commander performed by designated military forces that establish, maintain, influence, or exploit relations between military forces and indigenous populations and institutions by directly supporting the achievement of objectives relating to the reestablishment or maintenance of stability within a region or host nation.[11]

The focus of this definition has been *objectives relating to the reestablishment or maintenance of stability*. While important, this is the wrong emphasis. The MAGTF needs to focus on *forces that establish, maintain, influence, or exploit relations between military forces and indigenous populations and institutions*. CMO are conducted to support mission objectives and commander's intent:

> Through this approach to all-domain warfare, composite warfare empowers subordinates to execute decentralized tactical operations—independently or integrated into a larger Naval or Joint Force—through mission command and flexible supporting relationships responsive to ever-changing tactical situations.[12]

Distributed CMO, as described in the introduction to this article, is the epitome of this approach. Stability must be an objective: it is important, but it should not be the driver for persistent CMO. Add an appropriate combination or mix of communications strategy, psychological operations, and corpsmen to the CA team, and you create an engagement team designed to either inform or influence the civil component within the battlespace:

> While organized and equipped congruently, we cannot expect our Selected Marine Corps Reserve (SMCR) units to maintain the same levels of readiness as our Active Component units. What we desire and expect in our SMCR units and Individual Ready Reserve (IRR) are Marines and units 'ready for mobilization.' Once mobilized, our Reserve Component forces will undergo additional pre-deployment training to achieve the necessary readiness for deployment and employment.[13]

The current construct of reliance on the Reserve Component CA groups to provide the bulk of deploying CA forces is a recipe for disaster. We simply cannot get the right people to the right place at the right time. Once again, we need to break old habits. The Marine Corps has been comfortable with relying on the Reserve Component to provide the CA force because they were only needed "post-phase III," or they were in support of "reconstruction," or the reestablishment of essential services, or dare I say it, "development." The truth is that subject matter expertise (so-called functional specialists) for such endeavors in Operations IRAQI FREEDOM and ENDURING FREEDOM never really existed in the Component CA groups, and if it did, it was pure coincidence. The Marine Corps CA MOS-conferring school did not even exist until 1 October 2011, and it does not train functional specialists.[14] The Marine Corps requires a vetting process for CA Marines in the same way we vet Marines who desire to become reconnaissance Marines. There are many motivated, patriotic, hard chargers who want to be reconnaissance Marines, but we select only those who are best qualified. Similarly, the criteria for SMCR Marines to become CA Marines should not be based on finding a convenient place to drill for the next couple of years. Finally, the nature of mobilization orders and funding authorities are not currently flexible enough to get the Reserve CA Marine into the area of operations fast enough and to keep them there long enough. Distributed CA activities must be a full-time job, not tied solely to exercise support, and CA Marines on the front line of the competition continuum need to be the best civil-military operators. They are the "contact layer" and that requires an investment.

Investing in CA Marines is even more critical for the Active Component:

> Unless specified within this document, all reference documents from previous Commandants are no longer authoritative; thus, Service and advocate-related publications using the Marine Operating Concept or Force 2025 as 'REF A' must be revised. Current advocate plans must be reviewed within the context of this guidance, and appropriate changes made.[15]

As a result of Force 2025, the Marine Corps divested in the three Active Component CA detachments at the three MEFs:

> And despite our best efforts, history demonstrates that we will fail to accurately predict every conflict; will be surprised by an unforeseen crisis; and may be late to fully grasp the implications of rapid change around us. The Arab Spring, West African Ebola Outbreak, Scarborough Shoal standoff, Russian invasion of eastern Ukraine, and weaponization of social media are but a few recent examples illustrating the point.[16]

Each of these examples used on the first page of the *Commandant's Planning Guidance* are directly related to the civil component and understanding the civil component, yet we divested ourselves of the very capability that is specifically designed to document, understand, and engage with the civil component? This decision should be re-examined. In the meantime, available resources should be pooled and provided the necessary training to create complementary capabilities toward an influence practitioner. If we get down to the basics, the CA Marine is a delivery platform designed to achieve effects in the battlespace. The Marine artillery officer basic course is six months. We do not bat an eye at this investment. We should apply the same rigor to the contact and blunt layer CA Marines as we do the surge layer Marines. If you are a foreign area officer or foreign area specialist (or regional affairs), training should include CA. A multi-year investment has already been made. A few more weeks will not make or break a career. If you are a psychological operations Marine, CA training should be included. The Marine Corps information operations center is already doing this informally and as they can. If you are a communications and strategic operations Marine, CA should be included within your professional skills—the target audience is civilians! These are all complementary activities aimed at informing and influencing target audiences so the training continuum to produce these Marines should be complementary. Moreover, the CA Marines must be employed in a manner that best supports the objectives of the MAGTF commander. Creating a "civil reconnaissance" company within the MEF information group may be one such approach? The creation of an "influence battalion" similar to the Marine security guard or Marine security forces concept might be another approach? Regardless, CA activities must be integrated into the overall targeting effort to ensure complementary, harmonized actions to achieve desired effects in the battlespace. Finally, and like the Reserve Component, these Active Component Marines must be properly vetted. The major thrice passed over awaiting another year to retire is not necessarily the natural fit to be a CA Marine.

Conclusion

The ability for the MAGTF commander to affect the battlespace goes beyond the application of kinetic forces and lethal fires. The power of the information has been acknowledged, with information now a warfighting function. Understanding that there are almost always civilians living, working, and playing within battlespace, we have to determine the most effective way to inform and influence their actions. Whether it is "little green men" in the Ukraine or Chinese "fishermen" in the South China Seas, our adversaries understand the power of weaving messaging and actions. We do not need to reinvent the wheel to counter these threats. Yes, significant change is required, but some of that change lies within our mindset. It is ironic that the Marine Corps still considers *NAVMC 2500, Joint Manual for Civil Affairs* "current." Dated November 1966, it is highly likely it has never been read by Marine Corps leadership, but it says:

> Civil affairs operations are as diverse as the range of military-civil relationships. They bring civil attitudes, needs and goals to the attention of the military commander and they convey similar matters to appropriate civilian agencies. They involve … recommendations to the military commander as to the conduct of his operations and troops that will promote cooperation and support on the part of the individual citizens and the government of the country. They include essential liaison and the numerous official and personal contacts associated with securing support from and living harmoniously with a civilian community.

Somehow the CA force became purveyors of poorly conceived projects and conduits of solatia payments. There is so much more to CA than that. It is time to reimagine how we use the CA force.

Notes

1. Indonesian Armed Forces Marine Corps.

2. The coast watchers were allied military operatives stationed on remote Pacific islands during World War II to observe enemy movements.

3. Marine Civil Information Management System is a program of record that provides Marines a tool to capture data and share civil information in support of the mission and is available on any public commercial Internet worldwide.

4. Headquarters Marine Corps, *Concepts and Programs*, (Washington, DC: 2019); available at https://www.candp.marines.mil.

5. Headquarters Marine Corps, *Marine Corps Concept for Civil Affairs*, (Washington, DC: July 2019).

6. Ross Babbage, "Stealing a March: Chinese Hybrid Warfare in the Indo-Pacific: Issues and Options for Allied Defense Planners, Volume I," (Washington, DC: Center for Strategic and Budgetary Assessments, 2019).

7. Robert Haddick, "Salami Slicing in the South China Sea. China's Slow, Patient Approach to Dominating Asia," *Foreign Policy*, (August 2012), available at https://foreignpolicy.com.

8. Headquarters Marine Corps, *MCRP 3-03A.1, CA Tactics, Techniques and Procedures*, (Washington, DC: July 2007).

9. Christian A. Carr, "Civil-Military Engagement Program: Enhancing the Mission of Regionally Engaged Army Forces," *Military Review*, (Fort Leavenworth, KS: Army University Press, March-April 2016).

10. The United States Navy does not have maritime civil affairs; they rely on Marine civil affairs for this capability.

11. Joint Staff, *Joint Publication 3-57, Civil Military Operations*, (Washington, DC: July 2018).

12. *Commandant's Planning Guidance 2019.*

13. Ibid.

14. Functional specialist refers to a subject matter expert in a joint stability function or U.S. Government stability sector. See Joint Staff, *Joint Publication 3-07, Stability*, (Washington, DC: August 2016).

15. Ibid.

16. Ibid.

Proposed Organization of the Marine Corps Rifle Company

by 1st Lt Terrence L. Hayes

As a weapons platoon commander, I have noticed that the way in which the rifle company is organized administratively is vastly different from the way they are task organized and employed tactically. This became obvious while conducting the Integrated Training Exercise when the mortar section was employed as an individual unit to support both platoon and company attacks. I rarely interacted with my machinegun and assault section as well as their squad leaders. The disparity in the way the company is organized administratively and the way it is employed causes confusion and is not conducive to having clear lines of reporting or fair evaluations.

The Weapons Platoon

By removing the weapons platoon, the administrative organization of the company will more closely reflect its tactical employment. The platoon commander retains the duties and responsibilities of the fire support team (FiST) leader and is essentially the officer in charge (OIC) of all things related to company-level fires.

The mortar section will become its own element in the rifle company led by a staff sergeant. This resembles the same way a current section of 81mm mortars are employed. The mortar section is employed by and receives tasking from the fires OIC. Because of this close relationship between the fires OIC and the mortar section, the mortar section leader advises the fires OIC on the best employment of the 60mm mortar section and reports to the fires OIC tactically and administratively.

The machinegun section as it currently stands will no longer exist. Each rifle platoon will have a machinegun squad of 0331s. Each machinegun squad will consist of a squad leader, UAS operator, and two machinegun teams. Each machinegun team will consist of a team leader, gunner, assistant gunner, ammo man, and designated marksman. Currently, the assistant gunner is also the team leader, but this comes with a series of difficulties. The most principle of the difficulties is trying to pull them outside of their gun and get them to focus on what is going on around them. By freeing them up from barrel changes and round counts, they are better able to direct their fires, assess the enemy and friendly situation, and ultimately better support the unit. The addition of a designated marksman allows the support-by-fire element to be more accurate on point targets.

The New Rifle Company

The rifle company will be comprised of four elements: the command element, the headquarters element, fires element, and the maneuver element. Although not officially used in these terms, in execution it follows this basic structure when considering the warfighting functions. The command element includes the company commander and first sergeant whose duties and responsibilities are unchanged according to the responsibilities outlined in *MCRP 3-11.1, Infantry Company Operations* (Washington, DC: HQMC, October 2014).

The headquarters element is where the warfighting functions of intelligence, logistics, force protection, and information management live. Commanded by the company executive officer, he is assisted in his duties by the company gunnery sergeant, although the company gunnery sergeant will still have the duty of advising the company commander. The company executive officer will also assume administrative responsibility as it applies to all Marines within the headquarters element, including: the operations chief, assistant operations chief, intelligence NCO, logistics NCO, and communications NCO.

The fires element is commanded by the fires OIC and consists of the FiST and the mortar section. The FiST consists of the team leader, fire support officer, joint tactical air controller, artillery scout, mortar scout, communications NCO, and UAS operator. The mortar section is led by a section leader who is a 0369 Staff Sergeant. The mortars headquarters includes the section leader, fire direction center chief, check plotter, and radio operator. The three mortar squads will consist of a squad leader, gunner, assistant gunner, and ammo man. The employment of the 60mm mortar section in this way allows maximum flexibility and a more conducive framework to exercise initiative in the execution of mission type orders.

The maneuver element will consist of three rifle platoons made up of a platoon commander, platoon sergeant, two rifle squads and a machinegun squad. The rifle squads will consist of the headquarters element which has a squad leader, assistant squad leader, UAS operator, and designated marksman. The assault, support, and security elements/fireteams will consist of a team leader, rifleman, grenadier, and automatic rifleman. The machinegun squad will be as described in the previous section.

Evaluation

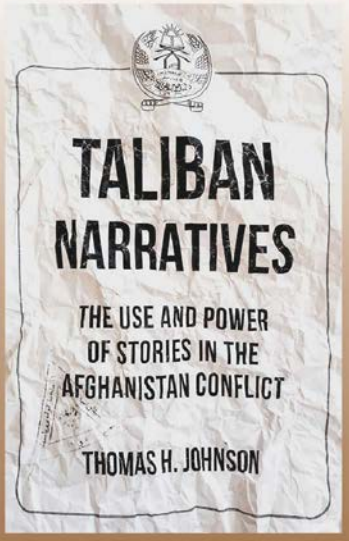
It is not fitting for the weapons platoon commander to evaluate section and squad leaders when they typically do not employ them tactically nor do they have a sufficient amount of time to observe them operating in the field. Without having proper first-hand observation of a Marine's technical, tactical, and leadership proficiency, it is difficult to give an accurate evaluation of squad leaders and section leaders with whom I am not consistently in contact. By virtue of their MOS, machinegun squads are often attached to or in direct support of a rifle platoon, and mortars are usually retained at a company level unless divided among the rifle platoons on few occasions. This gives the rifle platoon commander, a more advantageous position to give an accurate evaluation of machinegun unit leaders.

Conclusion

By reorganizing the rifle company this way, the way a company is organized administratively will better reflect the way it is organized operationally. This allows for more clear lines of reporting and more accurate evaluations of all unit leaders.

Taliban Narratives

reviewed by Maj Felix Guerra



TALIBAN NARRATIVES: The Use and Power of Stories in the Afghanistan Conflict. By Thomas H. Johnson. Oxford, UK: Oxford University Press, 2017. ISBN: 978-0190840600, 336 pp.

People remember good stories. After eighteen years of U.S. involvement in Afghanistan, the Taliban have told better stories than the United States. Dr. Thomas H. Johnson, a counterinsurgency expert who has studied Afghanistan for over 30 years and served as an advisor to U.S. military efforts in Afghanistan, concludes that despite making an effort in information operations (IO) to win the trust and confidence of the Afghans, the United States has not succeeded in IO. In his latest book, *Taliban Narratives: The Use and Power of Stories in the Afghanistan Conflict*, Johnson argues that the Taliban have a more compelling message that resonates with the Afghan population. Throughout the book, Johnson provides anecdotes on why the Taliban succeeded in its IO campaign and why the United States failed while supporting his argument with sobering data.

Johnson argues that a large part of the Taliban's success results from the themes in its IO campaign, the various mediums used to broadcast their message, as well as—most importantly—the narrative that forms a convincing story for the population to believe. The Taliban disseminate its IO through long-established Afghan mediums. Johnson states,

> The Taliban's IO is effective because it is indigenous and relies on traditional tools like *Shabnamah* (night letters), *tarnas* (chants), poems, and a variety of other culturally effective artifacts.[1]

Marines may find it difficult to comprehend the importance of poetry within the Afghan conscience. Poetry is a medium the Taliban have both infiltrated and dominated with their narratives. Apart from dominating the Afghani customary and culturally significant channels, the Taliban have exploited modern platforms to distribute its message. The Taliban launched their first official website, *Alemarah*, in 2005, and their use of the Internet has evolved with the introduction and popularity of social networking sites. Additionally, the Taliban attempted to expand its IO following. Johnson uncovers how the Taliban began targeting Western audiences with its IO message in 2008 by creating English language websites. Beyond the Taliban's wide range of mediums for IO, the main reason for success remains in its ability to broadcast different stories than can either appeal to the illiterate poppy farmer or the Kabul University student. Johnson discovers that the Taliban tailors its message to the different audiences in Afghanistan. The Taliban have an in-depth understanding of how best to apply its IO message to center a story on the main themes of culture, politics, religion, or a combination of the three. Johnson also finds common sub-themes in the Taliban narrative including *jihad*, martyrdom, resistance, independence, justice, victimization, nationalism, and collective memory. The stories the Taliban tell have led to their success in IO.

Johnson's book shows that the United States has failed in IO. After reading Johnson's analysis of the Taliban's dynamic narrative for the first half of the book, his assessment of U.S. IO efforts show a robotic and unappealing U.S. narrative in the remaining chapters. For example, the 2007 NATO-ISAF (International Security Assistance Force) strategic master narrative's first theme states,

> The government of the Islamic Republic of Afghanistan, NATO-ISAF, and the U.S. are committed for the long term to ensuring a democratic, stable, peaceful Afghanistan that is inhospitable to terrorism. The Afghan people can rely on its allies, including the U.S. government and NATO, to stay the course.[2]

The United States starts at a disadvantage in the IO competition against the Taliban. For instance, Johnson recognizes the United States cannot compete with the Taliban in the narrative of religion. Nonetheless, by avoiding religion, Johnson states, "The U.S. and Kabul basically have conceded 90 percent of the IO battlespace to the Taliban."[3] The United States missed the mark in IO from the beginning of the war when the justification for U.S. activities in Afghanistan was directly related to the 11 September 2001 terrorist attacks. Johnson cites statistics

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showing the majority of Afghans were unaware of the 11 September terrorist attacks. Despite the obstacles to a successful IO campaign, U.S. attempts were cursory and ill-informed. Johnson shows the United States could never tell a story in its IO campaign that attracted the average Afghan.

Johnson's book exposes the uncomfortable truth that the United States has failed in its IO efforts in Afghanistan. Johnson reveals the missed opportunities and puts forward ideas of how the United States can improve in IO. One should not view this book as praise for the Taliban in beating the United States in IO because Johnson does address weaknesses in the Taliban's IO campaign. However, one should approach this book as a case study on the Taliban focusing on the culture and grievances of the population to create stories to use in its successful IO campaign. Johnson states,

> The challenge for the U.S. in Afghanistan was to develop a strategy for defeating the insurgent narrative just as decisively as the enemy's capability.[4]

This book is perfect in providing a Marine an understanding on how telling a story is an effective tool in IO and will allow commanders to take a self-critical look at their IO efforts.

Notes

1. Thomas Johnson, *Taliban Narratives: The Use and Power of Stories in the Afghanistan Conflict,* (Oxford, UK: Oxford University Press, 2017).

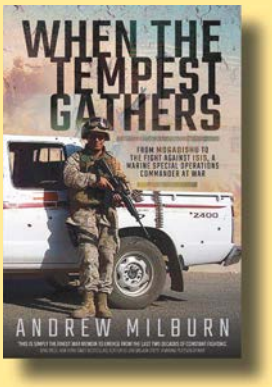
2. Ibid.

3. Ibid.

4. Ibid.

USMC

For Further Reading



WHEN THE TEMPEST GATHERS: From Mogadishu to the Fight Against Isis, A Marine Special Operations Commander at War. By Andrew Milburn. South Yorkshire, England and Havertown PA: Pen and Sword Books Limited, 2020. ISBN: 978 1 52675 055 6, 336 pp.

reviewed by Col Christopher Woodbridge

The enduring character of war, characterized by violence, danger, and chance, has always produced opportunities for remarkable men with unique skills and character to serve with distinction and to amass "collections" of truly exceptional experiences. In the fields that today we know as special operations, unconventional warfare, anti-terrorism, and counterinsurgency, individuals throughout history have developed near-legendary standing. The 19th century produced Sir Richard Francis Burton and Frederick Townsend Ward. The first half of the 20th century gave us T.E. Lawrence and Marines like Edson, Carlson, and Pierre "Pete" Ortiz. The "shadow warriors" of Vietnam, the Cold War, and the creation of U.S. Special Operations Command following the failure of Operation Eagle Claw, have all contributed to the culture of quiet professionalism that marks today's special operators. The combat memoir of Col Andrew Milburn, *When the Tempest Gathers*, establishes this Marine leader's name among this storied group.

Andy Milburn has never been the "ordinary Marine." Born in Hong Kong, educated in the United Kingdom up through law school, and widely travelled in the Middle East to include Iran, Andy's opportunities for life experience were atypical even before enlisting in the Marine Corps. Selected for a commission, he first became an infantry officer and later a special operations officer. Commanding Marines in combat at all ranks from Somalia to Iraq, he has also been among the Corps "intellectual capital" critical thinkers and leading operational planners.

While in command of the Marine Corps' Special Operations Regiment, today the Raider Regiment, he was the first Marine to command a Combined Special Operations Task Force. This multi-national force of U.S. and allied special operators and Iraqi special forces were central to the fight against the Islamic State in Iraq and Syria (also known as ISIL and Da'esh). This tour forms the focal point of the book and best demonstrates Col Milburn's synthesis of his tactical cunning born from combat experiences as a junior officer with depth of knowledge and creative problem solving of a scholar. His leadership, the courage and perseverance of all his troops were critical to the eventual destruction of the ISIS Caliphate.

I first met Andy Milburn in the Al Qaim/Husaybah area of western Iraq during Operation Iraqi Freedom. During this time between 2004-2005, the Marine Corps had not yet established Marine Corps Special Operations Command (MARSOC). Andy was part of the Corps' effort to understand and prepare Marines for special operations and coalition warfare beyond the certification of our special operations capable MEUs. The measured, deliberate, and thoughtful approach he applied to the assessment of combat operations on the ground, and his personal courage in accomplishing this mission, were quietly impressive. This work proved invaluable when by 2006 MARSOC became the Marine Corps Service component of USSOCOM.

Ultimately, this book is not the chest-thumping, self-promoting war story that some veterans have published. Sincere humility and—painful—honesty are the hall marks of this genuine tale of the triumphs and challenges of leadership in today's wars. From the loneliness that comes with the responsibility of making life-and-death decisions, to the heavy tax that long separations from family and home levy on us, this is most importantly a compelling and completely authentic story.

Tactical Decision Game 03-20

Cache Search

by Capt Jason Topshe

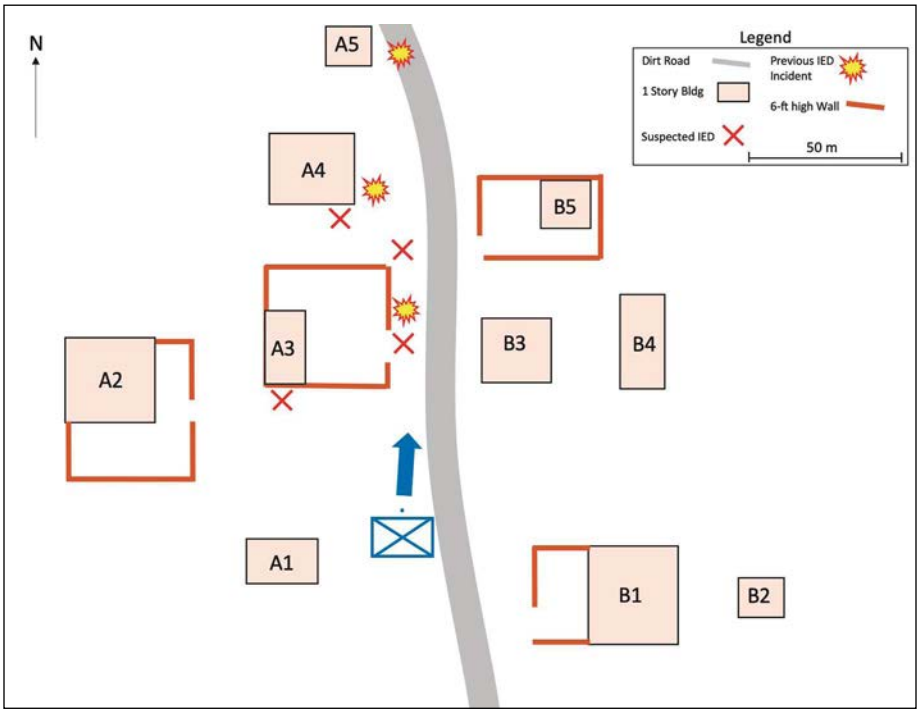
Situation

You are 3d Squad Leader, 1st Platoon, Company B, 1st Battalion, 1st Marines, deployed to Farah Province, Afghanistan. Your squad was tasked with finding and destroying a suspected Taliban weapons cache reported to be located somewhere in the village of Wadi Zai.

The last reported activity involving U.S. forces in the area is from an Army patrol which conducted a route clearance mission almost seven months ago. That patrol identified a possible IED on the road in vicinity of Building A5. However, when they dismounted their vehicles to investigate, one soldier stepped on a pressure plate IED located near the southeast corner of Building A4. A second soldier moved to provide first aid, but he also stepped on a pressure plate IED along the eastern wall of Building A3. In the ensuing minutes, both died of their injuries. The possible IED in vicinity of Building A5 was later confirmed and rendered safe.

During mission planning, through the use of sensors provided by unmanned aerial systems, and through reliable reports from intelligence sources, you have identified four possible IED locations in the village. These are marked by a red "X" on the map.

The remainder of your platoon is located 2km south at Forward Operating Base Driftwood. As your squad patrols into the village from the South, your Platoon Commander comes over the radio with the following information: "Intel reports indicate a high probability the enemy weapons cache is located in Building A3. Get there ASAP and search that building."



TDG 03-20.

>Capt Topshe is the Operations Officer, Talent Management Oversight Directorate, HQMC.

As you approach Building A3 on foot from the south, you notice disturbed earth in three locations surrounding the building, specifically in locations that you identified as likely IEDs during mission planning. Your interpreter is also talking to a local man who claims to live in Building B1. He nervously tells you that you should not go in there because the entire compound is filled with "bombs."

You report the situation back to your Platoon Commander and request explosive ordnance disposal (EOD) support to further investigate and render any IEDs safe before entering the compound. He comes on the radio with this reply: "Negative. EOD currently unavailable. Find another way to get into that compound. You need to find that cache."

The compound walls are about six-feet high, and you know your Marines can scale them with the help of a buddy. Through your interpreter, you ask the local man if he knows of a safe way to

get into the compound while avoiding IEDs, but he says that he is not sure. He adds that the Taliban used to use the building, but they do not go in it anymore because they forgot where the "bombs" are. After you spend a few minutes talking with the local man, your Platoon Commander comes over the radio and says the following: "Quit delaying. Search that building or I'll put someone else in charge of your squad who will."

Troops and Fire Support Available

- (1) Rifle Squad with (15) Marines
- (1) Interpreter
- 155mm howitzer battery located 5km west
- Squad-sized QRF with (4) MRAPs located 2km South at FOB Driftwood.

Requirements

1. How do you respond to your Platoon Commander?

2. In three minutes or less, develop a plan and give orders to your squad.

Considerations

What are the potential risks and benefits associated with obeying your Platoon Commander's order to search the building? What are the potential risks and benefits of disobeying him?

USMC

Quote to Ponder:

"We have already noted that a significant problem in intelligence is not the lack of information, but the difficulty in interpreting that information."

—MCDP 2, Intelligence

Index to Advertisers

Editorial Policy and Writers' Guidelines

Our basic policy is to fulfill the stated purpose of the *Marine Corps Gazette* by providing a forum for open discussion and a free exchange of ideas relating to the U.S. Marine Corps and military and national defense issues, particularly as they affect the Corps.

The Board of Governors of the Marine Corps Association & Foundation has given the authority to approve manuscripts for publication to the editor and the Editorial Advisory Panel. Editorial Advisory Panel members are listed on the *Gazette*'s masthead in each issue. The panel, which normally meets as required, represents a cross section of Marines by professional interest, experience, age, rank, and gender. The panel judges all writing contests. A simple majority rules in its decisions. Material submitted for publication is accepted or rejected based on the assessment of the editor. The *Gazette* welcomes material in the following categories:

- **Commentary on Published Material**: The best commentary can be made at the end of the article on the online version of the *Gazette* at https://www.mca-marines.org/gazette. Comments can also normally appear as letters (see below) 3 months after published material. BE BRIEF.
- **Letters**: Limit to 300 words or less and DOUBLE SPACE. Email submissions to gazette@mca-marines.org are preferred. As in most magazines, letters to the editor are an important clue as to how well or poorly ideas are being received. Letters are an excellent way to correct factual mistakes, reinforce ideas, outline opposing points of view, identify problems, and suggest factors or important considerations that have been overlooked in previous *Gazette* articles. The best letters are sharply focused on one or two specific points.
- **Feature Articles**: Normally 2,000 to 5,000 words, dealing with topics of major significance. Manuscripts should be DOUBLE SPACED. Ideas must be backed up by hard facts. Evidence must be presented to support logical conclusions. In the case of articles that criticize, constructive suggestions are sought. Footnotes are not required except for direct quotations, but a list of any source materials used is helpful. Use the *Chicago Manual of Style* for all citations.
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- **Book Reviews**: Prefer 300 to 750 words and DOUBLE SPACED. Book reviews should answer the question: "This book is worth a Marine's time to read because…" Please be sure to include the book's author, publisher (including city), year of publication, number of pages, and the cost of the book.

Timeline: We aim to respond to your submission within 45 days; please do not query until that time has passed. If your submission is accepted for publication, please keep in mind that we schedule our line-up four to six months in advance, that we align our subject matter to specific monthly themes, and that we have limited space available. Therefore, it is not possible to provide a specific date of publication. However, we will do our best to publish your article as soon as possible, and the Senior Editor will contact you once your article is slated. If you prefer to have your article published online, please let us know upon its acceptance.

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