MARINE CORPS
Gazette
Professional Journal of U.S. Marines

MARCH 2022 Vol. 106 No. 3 www.mca-marines.org/gazette

A publication of the Marine Corps Association

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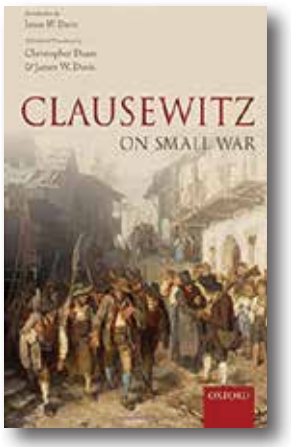
MARINE RAIDERS

March 2022
Volume 106 Number 3

MARINE CORPS Gazette
Professional Journal of U.S. Marines

7 Cover Article
Sustaining Stand-in Forces is the logistical challenge of future force design. (Photo provided by MajGen Keith D. Reventlow & Mr. Matthew Williams.)

DEPARTMENTS



102 Book Review

IDEAS AND ISSUES

Logistics/Installations & Sustaninment

Maneuver Warfare

EABO/Innovation

Talent Management

Wargaming/Advertiser Content

Maneuverist Papers

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MARINE CORPS Gazette
Professional Journal of U.S. Marines

MARCH 2022

Editorial: Sustainment Challenges Today and Tomorrow

This month's annual Logistics focus edition looks at challenges and opportunities across the logistics and installations communities that collectively sustain Marine Corps forces and operations worldwide. As the Corps implements many of the visionary changes described in *Force Design 2030* and the newly published *Concept for Stand-in Forces*, solutions to sustaining combat power for these distributed forces operating in forward locations continues to be the focus of modernization efforts in the logistics community and continues to generate significant professional discourse and debate. The processes of creative problem solving, critical thinking, and experimentation all provide valuable ideas and insights on overcoming the obstacles to successful generation and sustainment of advantage over adversaries in the future. Disagreement and debate serve to strengthen our concepts and plans going forward. This intellectual honesty is a hallmark of the Corps and is clearly evident in the broad range of articles in this month's focus area.

Starting with an update letter from LtGen Edward D. Banta, Deputy Commandant for Installations and Logistics, on page 6 we present fifteen articles directly related to various aspects of logistics and sustainment in the current and near-future operating environments. Some articles examine the opportunities presented by emergent technology and novel techniques and procedures such as "Meeting Logistics Challenges in a Contested Environment" by MajGen Keith D. Reventlow and Mr. Matthew Williams on page 7, "Additive Manufacturing" by Maj Catherine DeLeal on page 24, "Energy Security" by Mr. Hubert Smigelski on page 35, and "An Untethered MLR" by Col Omar J. Randall on page 37. Some articles such as "The Seven Principles of (EABO) Logistics" by Capt Taylor Sneed on page 10 and "Sustaining Stand-in Forces" by Maj Daniel Katzman on page 14 are more speculative opinions on the challenges of sustaining the future force. On page 20, Col Aaron A. Angell looks at sustainment through the lens of our Warfighting doctrine in "Logistics as Maneuver," an excellent complement to our offerings on maneuver warfare in the edition.

In further response to the Maneuverist Papers, Marinus Era Novam adds "Exploring Context" on page 68 to the ongoing discourse on the subject. Drawing insights into warfighting and competition in the South China Sea and beyond from western and eastern traditional games we present "Chess vs. Wei-Chi" by Capt Paul S. Panicacci on page 73. The practical application of mission-type combat orders and the disconnect between how we train and how we fight are explored by Mr. Brendan B. McBreen in "What are Your Orders, Sir?" on page 80.

Finally, the Maneuverist Papers continue with "The Institutional Impact of Maneuver Warfare" by Marinus on page 96. This installment looks at the mixed results of the Corps' efforts to adopt and institutionalize Warfighting across the force.

While the *Gazette* does provide a platform for the Corps' leadership to publish official information, the professional journal will never be a "house organ" for promulgating "a party line" or stifling the free exchange of ideas. Some may see professional debate and disagreement as inconvenient or distracting, but the ability to challenge each other intellectually helps us develop stronger arguments and strengthens individuals and the Corps. The MCA and the *Gazette* will keep true to this purpose.

Christopher Woodbridge

Force Design

I almost give the full benefit of the doubt to Commandant Berger and staff regarding the Corps' China-focused dismantling of the combined arms concept by jettisoning tanks and other so-called artifacts of past battles in the face of the future threat. Although I respect the Chinese people for their general valuing of thrift, hard work, family, and education—and I wish we Americans were more like that—the Thucydides Trap (that except in the fewest historical exceptions the greatest power will always be in conflict with the next in line) and the Chinese people's acceptance of order over freedom facilitated by the powerful combination of capitalism, sacrificing human and environmental health, and a one-party state as well as the nearly guaranteed corruption that comes from that has long had me recognizing China as "the enemy." Regarding missiles, although I was always going to choose the infantry—even in my days when dinosaurs roamed the earth—missiles made me even more certain that I would choose being, if necessary, as close to the earth with even its small undulations to hide in than be in a tank or up in an airplane. Additionally, I was in Force Recon, so I know what operating as a small independent force is all about. So, I get it. But I have finally figured out why my long stay in the peanut gallery has my stomach churning at Commandant Berger's dismantling of the Corps as a fully integrated combined arms force in all its aspects. Sorry, but I just do not think I would be anywhere close to unhesitatingly die for an Army tanker or an Air Force pilot; realistic or not, I would go into battle thinking that a Marine version of the same would do so for me. I just put this all together when I ended a recent email to my long-time Marine Corps-found friend with, "The Marine Corps, the world's finest fighting force ever." Can we be that without being a combined arms force—where we are fully and internally adaptable to all situations and can apply at our own discretion what proves in the next battle to be an anachronism or necessary? But ultimately, I think what distinguishes us in the most desperate and under resourced (other than our grit) moments of battle are not perfectly planned, prepared, aligned, and best budgeted for forces, but rather that we are in the worst-case scenario in reality or spirit together for our country, our Corps, and for each other. I would always want to know there are Marine tanks and many other even anachronisms there in front or behind me.

Reed M. Benet

Diversity, Equity, and Inclusion

As I read Generals Ottignon and Woodworth's article, I was hoping to gather some analytical insight on what the Marine Corps perceives as its current diversity baseline. As a former HQMC operations analyst, I truly appreciate all the mentioned planned and current data analysis and research efforts.

In the following part of the article, I found an assessment metric that stood out, "It takes approximately 27 years to be promoted to brigadier general. If we are doing it right, and we promote and retain equitability across the force, the brigadier general officer population in 2048 should mirror the second lieutenant population of today." Given this information and data that seventeen percent of today's brigadier generals are minorities, I was disappointed that the authors chose not to present the 1994 population of second lieutenants to establish a current baseline. As a comparison, online census data shows that in 1994 the percent of degrees earned by minorities was 22 percent.

Another area I was hoping would be discussed—but was not—is the effect that the Post 911 Operation ENDURING FREEDOM and Operation IRAQI FREEDOM environment and surge to a 202K force has had upon today's field-grade officer diversity. In 2017, as a lieutenant colonel reviewing diversity slides for my deputy commandant, I noticed that despite Company Grade diversity rising from 11.3 percent in 1995 to 20 percent in 2017, African American diversity reduced from a high of 7.5 percent in 2000 to a low of 4 percent in 2010. Analysis of Officer Candidate School candidates from 2007–2016 showed some interesting correlation. From 2007–2011, the average annual number of OCS Candidates was 3,184 (only 4 percent comprised of African Americans) while from 2012–2016 the average number decreased to 1,950, (8 percent made up of African Americans). Additionally, the percentage of African American field-grade officers reduced from 6.5 percent in 2011 down to 5.2 percent in 2016.

LtCol Chris Frey (Ret)

In their recent *Ideas & Issues (Talent Management/Manpower Policy)* article, "Diversity, Equity & Inclusion" (*MCG*, Jul21), LtGen Ottignon and BGen Woodworth wrote, "Civilian businesses have the luxury of bringing in diverse talent at any level in their hiring process." A few sentences later they note, "The goal then is to get to a point where when we compare the diversity of a cohort at entry with the same group at their various points along their career path; we would ideally see the same diversity percentage throughout."

Perhaps they missed the forest for the trees? The Marine Corps will always face dwindling diversity percentages as we work our way up the rank ziggurat precisely because civilian businesses can hire talent at any level. The Marine Corps is not the only organization chasing the "diversity carrot." All businesses are, and as such, the Marine Corps is locked in a battle to retain anyone who is not an "old white guy."

The Marine Corps will always face dwindling diversity percentages as we work our way up the rank ziggurat ...

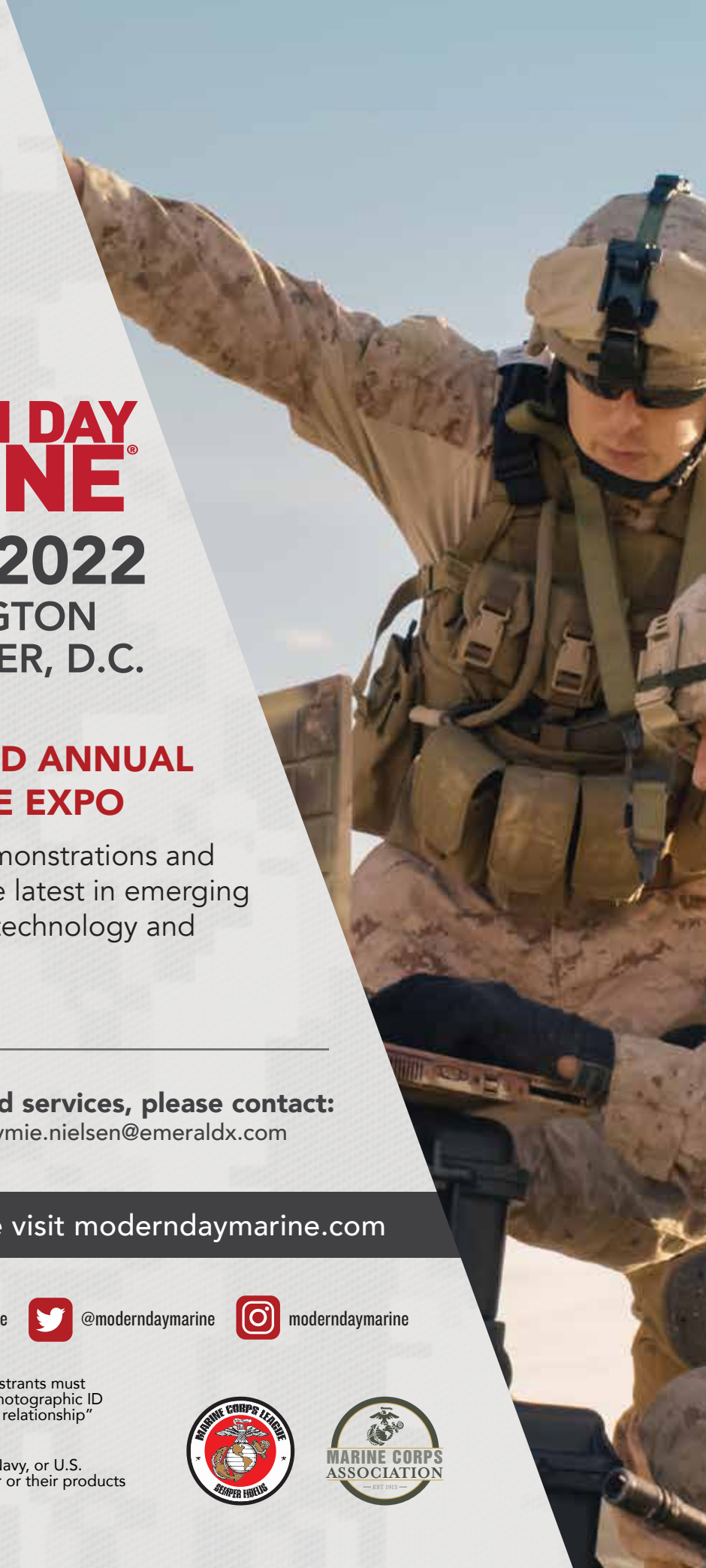
When faced with an offer to take a civilian job where there will likely be better pay, no deployments or combat tours, and no moves every two to three years, it is understandable that a woman or a person of color who has gained decades of valuable technical skill and leadership experience in the military might take that offer—and their retirement check—rather than slog it out for another five to ten years to make O-6 or flag rank.

Until the "diversity demand" is eliminated, the Marine Corps will always be faced with a senior rank structure full of old white guys.

Patrick McGinn

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 2022

A MESSAGE FROM THE DEPUTY COMMANDANT FOR INSTALLATIONS AND LOGISTICS

Our Commandant has stated it clearly in his planning guidance, force design documents, and in an article addressing Stand-in Force capability: *the Marine Corps will be trained and equipped as a naval expeditionary force-in-readiness and prepared to operate inside actively contested maritime spaces.* As such, **the Marine Corps Logistics Enterprise must transform to sustain the future force over great distances, across multiple bases, stations and installations, and in the face of multi-domain threats.**

Central to this transformation, the Marine Corps must resolve the paradox of effectively organizing, training, and equipping a force that is mobile, lethal, and low signature, yet possesses the requisite amount of redundancy and self-sustainability to persist in a contested environment. We will no longer have the luxury of weighing down units with logistics capabilities that improve self-sufficiency at the cost of making them heavier and less agile.

We must continue developing and retaining high-quality, multi-skilled Marines that can think critically about the enemy and our capabilities. We need logisticians that understand the future threat environment, their contributions to the competition continuum, and realize that the same capabilities that threaten battlefield maneuver hold at risk our force generation and deployment platforms. Our logisticians must appreciate that our bases and stations are no longer sanctuaries and must be resilient in the face of these threats—whether from kinetic fires, cyberattacks, or the effects of climate change. The *Marine Corps Gazette* provides an excellent forum to articulate ideas, foster discussion, and stimulate debate on meeting these challenges.

We received nearly 30 submissions for this year's *Marine Corps Gazette* Installations and Logistics edition. I applaud all those that were willing to put pen to paper whether printed here, published online, or submitted for later publication. Major General Reventlow and the team from DLA highlight the challenges of global distribution in a contested environment—a perspective often underappreciated at the tactical level. Captain Sneed's "The Seven Principles of (EABO) Logistics" offers valuable guidelines that could prove helpful in devising future tactics, techniques, and procedures. The MCB Albany and MCAS New River submissions reflect the creative approaches needed to better posture our installations for the future. Major Katzman's article assessing the supportability of EABO provides an excellent counterpoint to our current thinking and highlights known capability shortfalls and requirements, underscoring the challenges we face ahead.

We must continue to examine and challenge traditional thinking related to the logistics capabilities across the Marine Air-Ground Task Force, integrated with the Navy and the Joint community. I am committed to creating maneuver space for all Marines, whether in the halls of the Pentagon, at our bases and stations, or on the battlefield, to help us innovate and experiment in order to accomplish this transformation. I hope you enjoy this edition of the *Gazette* and it sparks your thinking in sustaining the future force.

Edward D. Banta
Lieutenant General, U.S. Marine Corps
Deputy Commandant for Installations and Logistics

Meeting Logistics Challenges in a Contested Environment

Joint logistics

by MajGen Keith D. Reventlow & Mr. Matthew Williams

Gen David H. Berger has noted on several occasions that he considers logistics to be the "pacing function" when discussing potential future conflict with peer and near-peer competitors. In testimony to the Senate Armed Services Committee in June of last year, Berger stated,

> If we don't, then we'll have the very best capabilities that we can't sustain for. We're not going to allow that to happen. Logistics is key. We —within the Marine Corps, we view it as our pacing function right now.[1]

How logistical support is planned and executed at the tactical, operational, or strategic level must be challenged and reexamined to ensure the joint force can operate effectively across all domains.

Historically, over the last 100 years, the United States' unfettered ability to project power and sustainment has been a key component of the joint force's success. Today's emerging peer and near-peer threats will challenge global power projection and create threats to our logistics networks and the warfighter's ability to maneuver.

The emerging *Joint Concept for Contested Logistics* identifies new and significant challenges to the Services' ability to transition from competition to conflict. As technology, weapon systems, transportation, and cyber capabilities evolve, the Services are presented with an unprecedented range of multi-dimensional warfare. As a result, logistics sustainment will require a shift away from the traditional methods to new, innovative ways to enable success in a contested environment.

>MajGen Reventlow is the Commanding General of DLA Distribution.

>>Mr. Williams is the Deputy Director, J5, of DLA Distribution.

As the Nation's Combat Logistics Support Agency, the Defense Logistics Agency (DLA) manages an end-to-end global defense supply chain for the Services and Combatant Commands. As part of the Joint Logistics Enterprise (JLENT), DLA plays a critical role in the logistics support of our warfighters. As one of DLA's six major subordinate commands, DLA Distribution provides storage and distribution to the Services through a global network of distribu-

Supporting our Combatant Commands, The Defense Logistics Agency Distribution Expeditionary Team provides agile logistics capability during critical exercises such as U.S. European Command's SABER STRIKE 18. *(Photo provided by authors.)*

tion centers. DLA Distribution is well postured to support during competition but will be challenged in the transition to conflict. DLA operates under a cost recovery model that is optimized for efficiency and to provide best value for the customer. As a result, there are no future readiness funding provisions inside DLA's Defense Working Capital Fund (DWCF) for prepositioning war reserve materiel to leverage during conflict or to mitigate denial of power projection. Moving forward requires a change in funding methodology as well as determination of the geographic capability arrayed globally to support the future operating environment.

This article identifies DLA Distribution's potential contribution to mitigating the contested logistics problem, how best to address this challenge, and what capabilities exist today to provide a significant increase in capacity to facilitate a rapid transition from competition to conflict.

DLA Distribution operates globally in over 50 locations and stores over $128 billion of inventory that supports 2,500 weapon systems. In the event of a contingency, DLA Distribution surges operations at its distribution sites by leveraging its existing workforce, exercising surge clauses in storage and distribution contracts, and utilizing its Global Distribution Expeditionary Contract to meet short-term labor requirements. Most sites operate a single-shift operation, although increased capacity can be achieved by adding additional shifts or days of operation.

In both CONUS and OCONUS, nearly all of DLA Distribution's warehouses are located near major Service customers to provide responsive support. However, in a contested scenario, the OCONUS locations are not well positioned to support future operations, thus necessitating a shift away from current operational locations to a well-developed disbursed network comprised of smaller, lower risk sites. These sites could be simple warehouses that are either active in supporting customer requirements in competition or cold site warehouses activated in conflict. The intent of the Cold Site Concept is to increase and disperse storage capability throughout a theater and to mitigate the impact of denied or degraded strategic lift capabilities.

The Defense Logistics Agency Distribution Expeditionary Team offloads material for in the-ater in support of U.S. European Command's SABER STRIKE 18. *(Photo provided by authors.)*

DLA Distribution is United States Transportation Commands' (USTRANSCOM) largest shipper supporting the joint warfighter through USTRANSCOM's Next Generation Delivery Service (NGDS) small parcel and Global Heavyweight Services contracts. The NGDS uses commercial small parcel carriers to directly deliver materiel to customers and eliminates additional touches inherent with normal warehousing and transload operations. During a conflict, the ability to distribute supplies via inter-theater or commercial airlift may become limited to outside the weapons engagement zone (WEZ) or outright denied. The subsequent shift away from NGDS and Global Heavyweight Services will force greater use of strategic air and surface routes to move the materiel and commercial air missions terminating short of final destinations. This will require transferring materiel to theater routes for the "last tactical mile." DLA Distribution is a consumer and customer of transportation by leveraging USTRANSCOM for strategic lift and global combatant command theater transportation for last tactical mile delivery. The need to bridge from strategic to theater movement will create key logistics nodes (KLN) located outside of the weapons engagement zone. DLA Distribution's Cold Site Concept supports logistics at the KLNs to facilitate uninterrupted movement of materiel to the warfighter.

> ***The intent of the Cold Site Concept is to ... mitigate the impact of denied or degraded strategic lift capabilities.***

The forward stocking of DLA stored materiel OCONUS remains a key enabler for the Services. In almost every contested logistics scenario, a large volume of weapon systems sustainment inventory will be required. In a protracted scenario, however, forward stocked items will be quickly consumed and therefore serve only as a minor hedge against warfighter demand. Thus, what is stocked becomes a secondary concern to the integrity of the distribution network itself. When the OCONUS stocks become expended, the strategic

Forward stocking of DLA stored materiel can be an effective hedge in a crisis, but will quickly be consumed in a protracted scenario making the distribution network itself the primary concern. *(Photo provided by authors.)*

and theater transportation network and KLNs will become vitally important since most of the materiel will originate from CONUS and transition to OCONUS, thereby requiring cross-docking operations and reaggregation for onward movement at the KLNs.

The nature of the DWCF construct is at odds with the concepts of contested logistics mitigation and readiness considerations. DOD working capital funds were designed to force efficiencies into operations through fee-for-service. Further, the DWCF incentivizes the acquisition and storage of materiel that supports current operations, not contingency readiness. With few exceptions, DLA does not have the authority to purchase large quantities of war reserve items, which has the effect of limiting DLA Distribution locations and workload.

A recent example of the tension between readiness and the DWCF was the establishment of a DLA Distribution storage facility in Busan, Korea. In 2017, at the request of the Army and in anticipation of potential requirements on the Korean Peninsula, DLA purchased $40 million of Class I and Class IV materiel ahead of need as well as leased a facility, provided manpower, rotated stocks, and regionally restricted the materiel from sale to other customers. Although a valid wartime requirement, DLA had to recover its costs through normal cost recovery rates charged to all customers. After several years of existence and with Army concurrence, DLA closed the facility to reduce costs and rotated the majority of the stock back to CONUS.

Set against the realities of our near-peer competitors and the contested logistics problem, the JLENT must think differently about how DLA is funded and recovers costs to address readiness and agency effectiveness in a near peer conflict. Potential funding could be provided in the form of direct funding from Congress, a direct inject from the Services, or possibly increased Obligation Authority specifically earmarked for readiness.

As a combat support agency, DLA plays a significant role in any contingency scenario in support of the joint warfighter. DLA Distribution's support in a contested logistics scenario fundamentally comes down to three things: ability to surge at its current CONUS and OCONUS locations, ability to rapidly stand up and transition operations to a KLN, and funding through the DWCF, Contingency Funds, or direct fund from military Service. DLA remains dependent on USTRANSCOM and the global combatant command theater assets and recognizes the limitations of each. DLA recognizes that continued joint, coordinated planning within the JLENT is critical to the success of the joint force in a contested logistics environment which will require all parties to think differently, plan together, and act now.

DLA Distribution's Expeditionary Team provides a full-range of distribution capabilities in support of Combatant Command requirements. *(Photo provided by authors.)*

Notes

1. U.S. Senate, *The Posture of the Department of the Navy in Review of the Defense Authorization Request for Fiscal Year 2022 and the Future Years Defense Program*, (Washington, DC: June 2021).

The Seven Principles of (EABO) Logistics

Sustaining Stand-in Forces

by Capt Taylor Sneed

Whether it is *Force Design 2020, 2025*, or *2030*, what the past decade has taught Marines is that there will always be a need to adapt and evolve our tactics to meet the challenges of the global geopolitical landscape. As a force, Marines must compete with the pacing threat. Unlike the traditional mission of "locate, close with, and destroy," compete is a bit more gray. Competing implies perpetual struggle, not destroying a singular enemy. Under the context of game theory, competing is an infinite game, so how do logisticians support a competition that does not end? Like all great philosophical questions pertaining to warfighting, military professionals must begin with doctrine. *MCWP 3-40*, *Logistics Operations*, outlines logistics principles that "like the principles of war, are guides for planning, organizing, managing, and executing. They are not rigid rules, nor will they apply at all times."[1] These principles are the starting point for figuring out how to support expeditionary advanced base operations (EABO), but as logisticians and military professionals, we must recognize that EABO is unlike anything we have fought before. The solutions proposed must fit EABO even if that requires an overhaul of existing practices. As a logistics planner in 3d MarDiv, we have experimented with logistical solutions to EABO problem sets. In solving each challenge, the seven principles of logistics endured and remain essential to enabling mission accomplishment.

>Capt Sneed served as the Logistics OIC for TALISMAN SABRE 21 and has served as a Logistics Officer with 4th Marine Regiment and 3d MarDiv in Okinawa since 2019.

A HIMARS launcher being loaded into a C130 by Marine Corps, Air Force, and Royal Australian Air Force personnel. *(Photo by LCpl Ujian Gosun.)*

The most important aspect of logistics is that it needs to be responsive. Responsiveness provides "the right support in the right place at the right time."[2] In the Middle East, Marines were able to pre-stage supplies across the area of operations to provide a wide range of support. In an EABO environment, they do not have vast desert plains to spread out our logistics. Fitting an entire battalion on one island will prove difficult, let alone an additional CLB to support it. As an institution, the Marine Corps needs to push more capabilities down throughout the force. During Exercise TALISMAN SABRE 21, company reinforced sized fires EAB's with combat logistics platoons proved effective but were still found lacking in capabilities that are resident in low density military occupations such as food service, contracting (KO) and field ordering officers (FOO), and pay agents. Traditionally, low-density skills and assets are held at higher levels to control their use. In the future, we should look to reverse this practice by creating more incidentally trained personnel with the authority to act at the battalion and company level. Just as independent duty corpsmen can certify water for consumption, they should also certify foraged food. Setting up heat and serve rations is no more difficult than operating generators. KOs, FOOs, and pay agents enable foraging. KOs at the regimental level with appointed FOOs with their pay agents at an EAB enable responsive support to forward deployed forces without having to reach back to higher

headquarters. This allows units to better provide support organically when they need it and where they need it.

Logistic support plans should be simple and not overly complicated. Simplicity "fosters efficiency in both planning and execution."[3] Efficiency often gets oversimplified to doing what is easy, but what is easy is not a bad thing. Marines would much rather hit the easy button than use a complex process; we need more easy buttons in the Marine Corps. The "easy button" is a simplified version of a complex process. Our current supply chain system requires using exclusive suppliers, and to go outside of this requires completing an intricate approval process. This system of checks and balances works in garrison but begins to fall apart further forward. To simplify the process in EABO environments, foraging lets Marines acquire what is needed in the operating area rather than trying to predict what will be needed and carrying it in or trying to have it shipped to the EAB. While this idea sounds simple, current administrative procedures have impeded Marines from realizing the full potential of having pay agents at the battalion and company level. Laws and policy prevent us from buying food, purchasing parts, and repair services for principal end items. JP-8 can be created with additives from diesel, but our equipment can also simply run on diesel. Marines will always be hungry, equipment will always break, and so long as we have engines, they will need fuel. For food and repair parts, policy must be reevaluated to give Marines more available options before having to get an exception to policy. For fuel, Marines should look to adapt their equipment to the predominant source available in their planned operating area. During TALISMAN SABRE, diesel was the primary fuel source in Australia. Military and civilian supplies had to special order JP-8 and adapters. Adapting Marine equipment to operate on diesel will incur extra Class IX block costs, but that cost is vastly cheaper than deploying JP-8 from DLA strategic stores. Holistically, it is more affordable to adapt our equipment. By adapting to the world rather than forcing the world to adapt, we will find that answers to current logistical problems simplify themselves, making it easier to support Marines in EABO.

Resources are finite and must not go to waste. Logistically, this means economizing the implementation of resources. Economy "is providing sufficient support at the least cost without impairing mission accomplishmen."[4] After the initial deployments to Korea, Vietnam, Iraq, and Afghanistan, moving people and things was accomplished by truck. They are organic, affordable, and reliable. While our ground fleet of vehicles is designed to ford several feet of water, their tires are not big enough to float vehicles from island to island. The use of ships and planes is an operational necessity in EABO, but the problem is that the surface and air connectors belong to other Services, are low in density, and are expensive. The cost and scarcity require economic employment, but this is alleviated through more ships and planes. The Marine Corps relies on the Navy for its blue water surface movements, but in the littorals, it is worth looking at expanding Marine green water capabilities. Akin to a medical battalion construct, establishing a "green water" navy squadron attached to Marine units enables greater surface mobility. As an organic unit within a MEF, it provides the ability to move Marines around the EABO battlespace, enable better sensing capabilities, and better command and control to Marine and Navy fires. In regard to air support, we need more C130s. Marine C130s facilitate the rapid deployment of forces. A procurement rule of thumb should be that if it does not fit in a C130, we should not own it. This requires replacing much of the ground transportation fleet with a smaller truck that fits in a C130 like Army's FMTV that the HIMARS system is built upon. To get more C130 sorties, rather than procure and stand up more squadrons, basing more of the existing squadrons in the Pacific provides a more economical solution. In the continental United States, unlike in the Pacific, the robust civilian road freight and rail networks allow for comparatively easy and affordable deployment of forces. In the Pacific though, it is an operational necessity to fly. Moving more C130s to the Pacific reduces costs and burdens of utilizing Joint Force Aviation. While repositioning squadrons from the United States to the Pacific negatively impacts the current Global Force Operating Model, the *CPG* states that the Commandant is willing to accept risk in some areas to succeed in the EABO environment—this is a risk he should accept. To better enable sustained EABO, Marine units should have surface and air connector assets within their equipments sets, or at the very least, in a direct support relationship.

A HIMARS being reloaded for the next fire mission. *(Photo by LCpl Ujian Gosun.)*

A Marine tests fuel after the additive process. *(Photo by LCpl Samantha Sanchez.)*

No plan survives first contact, thus adaptation and flexibility are essential to planning logistical support. Flexibility "is the ability to adapt logistics structure and procedures to changing situations."[5] The ability to adapt begins with preparation and training. The more skills Marines have, the more prepared they are to exploit opportunities and react to change. In an EABO environment, Marines not only need to know how to do more, but they need this knowledge when they arrive to the Fleet Marine Force. Historically, the model was to have Marines basically trained initially and have them learn advanced individual skills once assigned to the operational forces. The problem with this logic is that in the rush to fill manpower shortfalls, more shortfalls are created when Marines are sent back to schoolhouses for advanced training. Moreover, it was near impossible during COVID to send Marines back to the schoolhouse—especially in III MEF. An example of overcoming this was selecting the top performers from the Motor Transport Operators' Basic Course to go straight into the Wrecker Operators' Course. When these Marines reported to the fleet, they had more skills and knowledge to enable mission accomplishment. Just as the Infantrymen's Course was lengthened and expanded to give grunts more knowledge, the institution must do the same for logistics MOSs. Motor transport operators should come with a license to drive any piece of rolling stock and pull any trailer in the fleet. Supply Marines should know fiscal, warehousing, packaging, and how to expedite when arriving to their first unit. Given a basic knowledge of combustion, hydraulic, pneumatic, and electrical systems, a mechanic should be able to take a technical manual and fix any piece of ground equipment. This goes the same for communications and ordnance mechanics. Combat arms shoot, move, and communicate; combat service support must enable respectively. By spending more time in initial training, we create a stronger force from the ground up. The better we train combat service support Marines, the more flexible their responses can support EABO.

EABO is a major deviation from the three-ship Amphibious Ready Group. Attaining EABO is not without growing pains, but through those pains Marines learn and excel. Attainability "is the ability to provide the minimum, essential supplies and services required to begin combat operations."[6] To affect the EABO battlespace, Marines must sense and shoot. Sensing requires highly technical equipment with specialized operators and maintainers. Shooting, on the other hand, is more complicated. Ground-based fires are limited in their ability to affect EAB operations hence why missile batteries are slated to replace many cannon batteries. Missiles, unlike small arms, are expensive and sensitive—Marines cannot just throw them in the back of a truck at the ammunition storage point. This creates two problems: supply and transportation. Missiles are sensitive and costly to make. Their size and complexity require equally large and capable assets to move them around which translates to greater cost across the board. This increase in costs competes with other needs and forces Marine to forgo spending in other areas. The *Commandant's Planning Guidance* acknowledges this through the divestment of MOSs and equipment that do not meet the needs of EABO, but as Marines continue to figure out how to conduct EABO, they will likely find that their original plans do not work exactly as planned, and it will take both more and different resources to attain EABO.

Once Marines establish EABs, they must persist and sustain our presence to compete effectively. Sustainability "is the ability to maintain logistics support to all users throughout an area of operations."[7] There are two constants in the Pacific: the sun and the ocean. Sunlight provides a near limitless source of power that reaches all potential areas of operation. The ocean provides near limitless source of drinking water. To sustain EABO, Marines must tap into the sun and ocean. Utilizing solar energy reduces reliance on fuel and shrinks the footprint required to support EABs. Moreover, even with overcast skies, you cannot turn off the sun. As the civilian sector continues to develop more efficient and portable solar systems, the Marine Corps must look to it as an alternative source of power. As for the ocean, converting salt water to fresh water is easily scalable from the platoon to regimental level. Currently, III MEF is using the Parker Hannifin's Platoon Water Purification System, a tool-less kit that fits into the back of an ultra-light tactical vehicle that can produce 600 gallons per day. This system replaces bulky containers and specially trained Marines to give

smaller units greater flexibility. Adapting green energy enterprise wide gives the Marine Corps the flexibility to go anywhere. After a typhoon, it is not uncommon for power and rudimentary water systems present in much of the Pacific to be damaged and unreliable. Solar power and generating fresh water eliminate this issue and frees forces to focus on other missions. By having systems that allow Marines to tap into readily available green resources, this furthers the capabilities of 21st Century foraging and increases their ability to sustain in places once deemed too austere to support.

Not only do Marines need to sustain, but they need to survive. Survivability "is the capacity of the organization to protect is forces and resources."[8] EABO will require us to blend in, not dig in, and once engaged, higher roles of health service support will be too far away. Constructing defensive positions that can survive naval surface fires and missiles requires heavy equipment and extensive fortifications. While heavy equipment is available to contract in much of the Pacific, creating large positions clearly gives away positions. Instead, Marines should look to hide it what already exists. In TALISMAN SABRE, firing positions were hidden inside barns and would rotate farmer's fields between fire missions. Vehicles and equipment were covered in blue and yellow tarps that resembled those used by the civilian populace. Camouflage works well in the tree line but not so much an urban environment. No matter how well Marines hide, inevitably they will suffer casualties. Unlike recent conflicts in the Middle East, there will not be a "golden hour" to evacuate casualties, and the local medical care may not be better than the corpsmen attached to EABs. This is further compounded by the fact that it could be days before casualties are flown out to shipboard care. To better chances of survival, Marines require better medical training at the individual level. The training given to Army Special Forces Medics should be learned by front-line corpsmen to sustain life. As a part of work ups, corpsmen should work at local emergency rooms and trauma centers to further practice their skills. Traditionally, a shock trauma platoon stabilizes patients, but moving over twenty quadcons of equipment is too cumbersome for EABO. Increasing individual medical abilities mitigates the difficulties of casualty evacuation in EABO. The ability to survive starts with the ability to preserve life. Blending in makes Marines harder to target. Both are essential to EABO survivability.

Pushing resources down and throughout, keeping it simple, economizing and being flexible with our resources, achieving attainability, and then sustaining and surviving will be essential to logistics in EABO. These concepts require vast deviation from traditional schools of thought, but EABO and competition require a departure from the past while embracing everlasting principles. Alexander the Great said that "my logisticians are a humorless lot, they know if my campaign fails, they will be the first ones I slay." As the humorless lot, it is up the logisticians to make EABO work. The Commandant outlined his campaign. It is now upon all logisticians to experiment with new ideas and share our knowledge amongst each other so that we may thrive in competition.

Notes

1. Headquarters Marine Corps, *MCWP 3-40, Logistics Operations*, (Washington, DC: 2016).
2. Ibid.
3. Ibid.
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Sustaining Stand-in Forces

Evaluating the logistical supportability for Expeditionary Advanced Base Operations

by Maj Daniel Katzman

"In a distributed and contested environment, logistics is the pacing function of the Marine Corps." [1]

As the Marine Corps returns to its naval roots, there is a renewed focus on how the Marine Corps can support the naval force. *Expeditionary Advanced Base Operations* (EABO) has a foundation in the *Marine Corps Operating Concept* and outlines how the Marine Corps can enable the naval force. EABO is not the only role for the Marine Corps; however, it is emerging as a critical role across the conflict continuum against peer competitors. It will be most challenging logistically during an outright war.

EABO describes how Marines will distribute among a series of expeditionary advanced bases (EAB) to support the maritime portion of a peer conflict. EABs—characterized by their small size, dispersion, mobility, and low signature—are designed to operate in the littoral areas around key maritime terrain, within the enemy's weapons engagement zone (WEZ). These EABs are task-organized to provide various capabilities, such as ground-based fires or logistical support for the fleet, as required by the Maritime Component Commander. Regardless of the EAB's capability, they will enable friendly operations while reducing the fleet's risk.

In a modern, high-end conflict, EABO is not logistically supportable given the need to persist and operate within the enemy's weapons engagement zone at a significant distance from friendly support bases. EABs used for fires in support of sea control or forward arming and refueling points (FARP) provide the required sustainment scope to appreciate the logistics dilemma. When these EABs operate simultaneously to realize operations at scale, a logistics distribution challenge arises that is greater than the Marine Corps or joint force can support.

>Maj Katzman is a Logistics Officer, currently serving as Plans Officer, 1st MLG. This article was written while a student at Maritime Advanced Warfighting School.

Fires EAB Vignette

An EAB supporting sea control using landbased anti-ship cruise missiles (ASCM) will require shooting platforms, personnel to operate the platforms, ordnance, and fuel to support operations. While the Marine Corps does not have a shorebased ASCM firing capability yet, a HIMARS or Joint Light Tactical Vehicle (JLTV)-like platform firing the Naval Strike Missile (NSM) is the envisioned solution.[2] Those systems provide an example from which size and fuel consumption can help determine EAB logistics requirements. Each platform is assumed to carry and shoot one NSM at a time based on similarities to the current HIMARS capability to carry and shoot one Army Tactical Missile System, which has similar physical dimensions to the NSM. The NSM and its shooting platform provide the critical component of fires EABs.

A fires EAB needs to produce a salvo sufficient to achieve a mission kill on an enemy combatant to prove effective in supporting sea control. In the Wayne Hughes book *Fleet Tactics*, a historical analysis of ASCM missile engagements outlines that the probability of a missile hit against a defended ship is 0.264.[3] Assuming a shot doctrine of two missile hits to achieve the desired mission kill, the EAB would need to be capable of firing eight missiles against one defended enemy ship. The shooting platforms do not have to be collocated but need to be close enough to mass their fires on the enemy ship within the overlapping ~100nm range of the NSM. It is prudent to anticipate that enemy ships will not operate independently in a conflict but instead in a surface action group of at least three ships. Therefore, additional ordnance would be required for rapid reloading and engaging the other ships in that group. The capability for multiple salvos from each shooting platform will require an ammunition truck to carry ordnance for a quick reload to continue to provide effective sea control.

Using the Marine Corps proposed Navy-Marine Expeditionary Ship Interdiction System force structure, a platoon would consist of 9 launchers and 30 personnel, not including attached support personnel from the battery HQ.[4] An additional twelve Medium Tactical Vehicle Replacement-like (MTVR) vehicles would transport supplies and ordnance for multiple salvos. Twenty-four Marines would operate them from the headquarters battery, also filling vi-

Figure 1. Example Fires EAB Laydown.[8]

tal roles such as communications, ordnance, and service personnel. Finally, an additional platoon of 36 Marines would be required to provide local security, including 9 JLTV-like vehicles to provide their needed mobility. In total, a fires EAB would require 90 personnel, 18 JLTV-like vehicles, and 12 MTVRs. Sustainment would require 5,400 pounds of subsistence and 9,956 pounds of fuel per day; each 8 missile salvo would require a resupply of 7,048 lbs of ordnance.[5]

A 2013 RAND study provides several potential employment scenarios that detail the EAB locations required to establish sea control along the first island chain.[6] Using the Lombok Strait and surrounding passages in Figure 1, seven separate EABs will be necessary. Given the geographic separation, each EAB will need to produce its own eight missile salvo. This requirement drives each EAB's need to have the complete set of personnel and equipment outlined in the previous paragraphs. Of note, these EABs are not specific sites but instead broadly defined Position Areas Artillery where Navy-Marine Expeditionary Ship Interdiction System platoon and attachments will be able to fire, displace, reload, and be prepared to fire the next salvo.[7] The previously mentioned mobility is vital to their ability to execute survivability displacements after firing.

When scaled to the Lombok Strait and surrounding passages, the associated set of EABs would require a total of 63 shooting platforms, 84 supply vehicles, 63 security vehicles, and 630 personnel. For sustainment, the fires EAB vignette requires 37,800 pounds per day of subsistence, 69,673 pounds per day of fuel, and 7,048 pounds of ordnance per salvo or more likely 21,144 pounds per engagement with a 3-ship surface action group. Assuming one engagement per day, this vignette requires approximately 65 short tons per day of sustainment delivered to the 7 geographically separated sites.

FARP EAB Vignette

A FARP EAB supporting aviation operations would provide rearming and refueling for Marine Corps and Navy aircraft to extend time on station or increase sortie rates.[9] These EABs will require aviation fueling equipment, vehicles to transport equipment and supplies, and material handling equipment to support ordnance movement from storage or transportation to the aircraft. Again, any equipment that is not self-mobile would require transportation assets to enable mobility within the area of operations. Distributed Short-Take Off Vertical Landing Operations (DSO), as a subset of Distributed Aviation Operations, outlines the concept for the employment of mobile FARPs in EABO.[10]

The premise of DSO is that F-35Bs can operate from land or sea bases outside the enemy's WEZ, utilizing mobile FARPs to increase sortie generation.[11] A DSO study outlines a scenario where nine mobile FARPs, supported by three mobile distribution sites (MDS), can provide 24/7 FARP support to 28 F-35Bs per day.[12] Each FARP has mirrored personnel and equipment to provide all required aviation ground support capabilities. The FARPs collectively service each F-35B twice per day with fuel and ordnance. Not all mobile FARPs will be active at once; they will rotate sites as depicted in Figure 2 to increase survivability. While the FARP size is scalable, the medium size is the smallest that can provide 24/7 operations, requiring a total of 1,479 person-

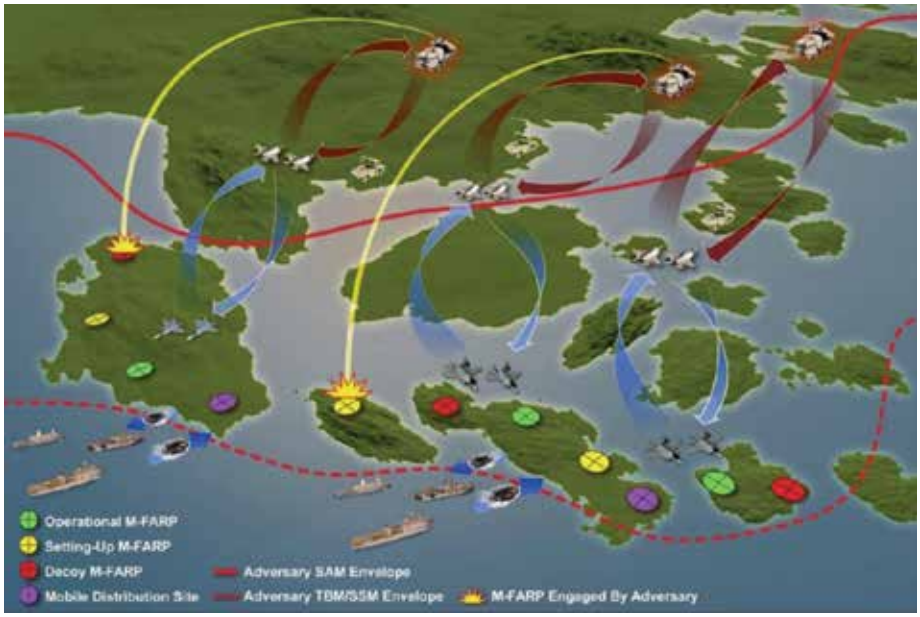

Figure 2. Notional Mobile FARP Laydown.[15]

nel and 387 vehicles to support the 9 mobile FARPs and 3 MDSs.[13] These sites would consume 88,740 pounds of subsistence and 162,213 pounds of fuel per day. Assuming the aircraft would require 12,000 pounds of fuel and resupply of ordnance each time, the daily requirement would be 672,000 pounds of fuel and up to 560,000 pounds of ordnance.[14]

Support to Navy aircraft, like the P-8, will increase the fuel and ordnance requirements for these FARPs. For example, P-8s based out of Guam, conducting maritime patrol and reconnaissance somewhere inside the first island chain, could be supported by a FARP in the Philippines, such as one of the mobile FARPs above.[16] Departing from Guam and operating on station for approximately 4 hours, a P-8 would need 30,000 pounds of fuel to return to Guam safely. It would require P-8s rotating every 4 hours to provide 24-hour coverage on a target area. The supporting aircraft would require refueling support from the FARPs in the Philippines six times a day and may need an entire reload of sonobuoys and Harpoon missiles or MK54 torpedoes.[17] The total sustainment would be 180,000 pounds of fuel and 63,096 pounds of ordnance and sonobuoys per day.

When you combine the support to Marine Corps and Navy aircraft, the subsistence requirement remains the same at 88,700 pounds per day, assuming supported aircraft crews require no subsistence. On a daily basis, the fuel requirement aggregates to 1,014,213 pounds while the total ordnance requirement is approximately 623,096 pounds. Therefore, the complete daily support for FARP EABs would be 863 tons.

Combining the Vignettes and Supportability

As described, the proposed vignettes will each require significant logistical support to provide an enduring presence. Furthermore, the anticipated scale of EABO means simultaneous execution of the vignettes.[18] The result is that their logistics requirements are additive, there is no economy of scale to be gained, and they will likely compete for priority of logistics support. The vignettes' combination results in a daily sustainment requirement of 928 tons, establishing the logistics requirement for EABO.

There are countless permutations of combining connector types for accomplishing the daily sustainment requirement. Total deliveries will range from 8–180 per day depending on the type of connectors used and their respective capacity.[19] This quantity of deliveries places an extremely high demand on the distribution system and creates an EAB observation vulnerability. Any attempt to reduce deliveries by increasing the delivery size will require additional ground or mobile storage. With the distribution requirement established, additional factors only complicate the challenge.

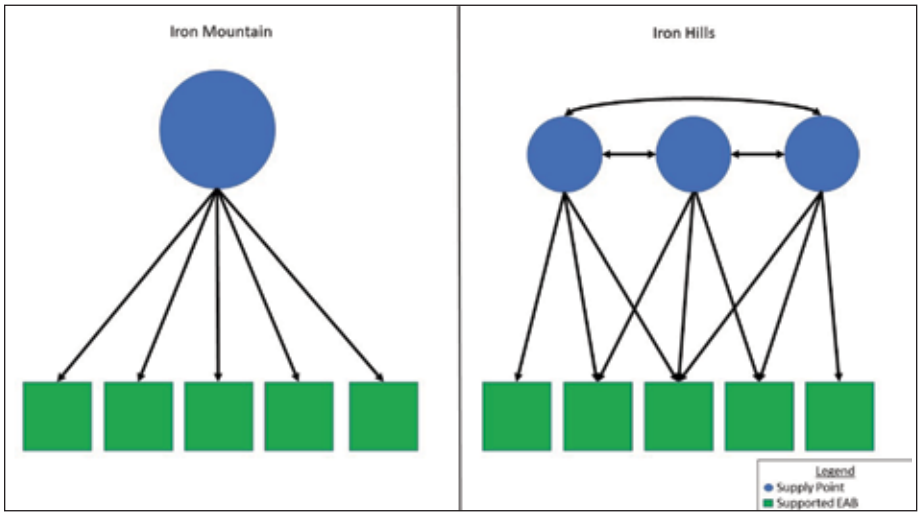

Figure 3. Notional supply and distribution networks.

Supply and Distribution Network

In light of the enemy threat, supply points for distributed operations, like EABO, must evolve to be more dispersed and located outside the enemy's WEZ. The traditional model for an "iron mountain" assumes significant sustainment risk, which led to the idea of dispersing supplies to multiple "iron hills," which will avoid disastrous loss.[20] The risk reduction loses economy of scale. Increasing supplies and distribution capacity to manage stockage levels between these supply points provides partial mitigation to the loss of economy of scale.[21] The net result is the increased cost for extra supplies and a more complex, less efficient distribution network to overcome the dispersion. Figure 3 depicts the differences in the distribution and supply models and demonstrates the complexity and increased distribution capacity requirement resulting from dispersing supplies to multiple supply points.

Additionally, geography, long distances, and enemy action complicate the distribution network. The most challenging geography for EABO is non-contiguous terrain, like the Lombok Strait and surrounding passages from the fires vignette. EABs operating in areas separated by water cannot leverage a common ground resupply point, requiring air or naval assets to distribute supplies. Furthermore, with supply points located outside the enemy's WEZ, lines of communication will be longer both in terms of distance and time.[22] This time-space challenge requires additional distribution capacity to ensure constant deliveries. Finally, enemy actions will result in losses in the distribution chain.[23] These cannot be avoided in a high-end, modern conflict and will destroy both the distribution asset and its payload. These factors' resulting impact is the requirement for redundant capacity that sits underutilized or gets re-tasked until losses occur.

Push vs Pull Logistics

In addition to the intricacies of the distribution and supply network, push versus pull logistics adds another complexity level. Push logistics are forecastable items, including the subsistence, fuel, and ordnance requirements out-

lined earlier. While less efficient than pull logistics, it is the best way to ensure logistics support given the time-space considerations for distribution. Conversely, EABs cannot forecast pull logistics, which are often critical items such as repair parts. EABs can bring a Class IX block, but since it is impossible to bring every part, equipment will become degraded or deadlined as a result of lack of parts, negatively impacting the EAB's capability. While repair parts are a single example of a pull item, they illustrate any other unforecasted supply requirement's challenges. The timely delivery of logistics in EABO will depend on a robust and resilient supply and distribution system capable of meeting both forecasted and unforecasted requirements.

Other Logistics Function Requirements

Other selected functions of logistics highlight some additional sustainment challenges created by EABO. Distanced from higher levels of care, casualty and medical evacuation become incredibly challenging. Given the current doctrine's consolidation of medical capabilities, operations at distributed EABs will only be capable of minimal medical treatment for any sustained injuries. This increases the risk to personnel because of impacts on the "golden hour," and any casualty or medical evacuation will compete for the same distribution assets required for resupply.

Maintenance will be a challenge for EABs operating in austere environments with minimal supplies and personnel. As previously mentioned, EAB forces can bring a parts block, increasing their sustainability—assuming that the operators can repair the equipment. When special tools, equipment, or maintainers are required, they will either have to be part of the EAB force or be readily available for support to widely dispersed forces. Even if available, these personnel and equipment still have the challenge of getting to the EAB. If the equipment's repair cannot be done on-site, recovery and evacuation for maintenance add another complexity level.

While not all-inclusive, these selected functions demonstrate more competition for logistics priority within EABO. These competing logistics priorities are subject to the same distribution complexity resulting from inefficient distribution networks, losses to enemy actions, and unforecasted requirements. Moreover, logistics support will compete with the movement and maneuver operational function for the same surface or air assets. These factors only further complicate the daily challenge of distributing 928 tons of supplies, making EABO at scale unsupportable in a modern, high-end conflict. Gen Berger testified that

> the operational logistics system, both ground and aviation is insufficient to meet the challenges posed by a peer/near-peer conflict, especially in the Indo-Pacific where significant distances complicate sustainment of a deployed force.[24]

How It Could Be Supported

Others would argue that EABO is logistically sustainable and there are mitigations for the complexity and challenges. First, the Marine Corps is already executing limited EABO. Second, joint capabilities provide additional capacity for sustainment, enabling the expansion of EABO. Finally, future capabilities throughout the joint force are sufficient to provide the necessary support.

In 2019, the 31st MEU conducted EABO, demonstrating a FARP supporting aviation and support to HIMARs fires missions. The MEU seized an airfield and set up a FARP that could support both rotary-wing and KC-130J aircraft.[25] The ability to support larger fixed-wing aircraft demonstrates significant progress toward supporting EABO at scale in a conflict, given the increased sustainment requirements for providing that capability. The MEU then conducted a notional adjacent island seizure, leveraging the first EAB to support the operation. The second island served as a base for HIMARS to conduct long-range precision strikes. This is an example of EABs supported with equipment, personnel, and capabilities organic to a standard MEU.

The *Tentative Manual for EABO* identifies Operational Contract Support (OCS) and prepositioning as key enabling logistics capabilities. OCS can leverage local sources of supply to reduce distribution requirements for common logistics items significantly. Fuel and water are two of the most considerable sustainment requirements for EABO that OCS can fulfill. Prepositioning can provide the initial supplies while OCS gets up and running. Furthermore, it can reduce deployment requirements by having equipment staged in the operating area. Combined, OCS and prepositioning will lessen movement and sustainment requirements, resulting in a significant reduction of distribution requirements.

From a joint perspective, the Air Force and Navy will also serve as critical enablers for EABO sustainment. The Air Force's air mobility assets provide a distribution capability that can access many of the forward areas utilized for EABs from bases outside of the enemy's WEZ.[26] With substantially more capacity than Marine Corps aviation, the Air Force will make considerable contributions to sustainment. From the Navy, the Marine Corps can "begin with leveraging joint maritime efforts such as Naval Logistics Integration, Seabased Logistics, and Distributed Agile Logistics."[27] The inherent lift capacity of ships, their ability to serve as mobile supply points, and their capability to carry surface connec-

The timely delivery of logistics in EABO will depend on a robust and resilient supply and distribution system capable of meeting both forecasted and unforecasted requirements.

tors will be critical to enabling EABO at scale. These seabased assets will reduce the distances for lines of communication and provide significant increases in distribution capacity. Furthermore, the development of new platforms will increase distribution across sea lines of communication in the future.

The Marine Corps and Navy are pursuing new amphibious platforms to enable distributed operations. Most promising is the Light Amphibious Warship (LAW). Its design incorporates sufficient range to carry supplies from distant landbased supply nodes or seabased supply nodes from amphibious or maritime prepositioning ships.[28] The LAW, augmented by new unmanned surface and air vehicles, can drastically increase distribution capacity, making EABO sustainable.

Rebuttal

Previous success in demonstrating EABO and joint force capacity does not guarantee supportability moving forward. The examples from the 31st MEU are not to scale, which fails to show EABO's true logistics challenge. The scope of EABO's logistics problem and the competition for distribution assets within the joint force will demand too much of current capabilities and capacities. The joint competition extends to future budgets, which places the future programs intended to make EABO supportable at risk.

While OCS and prepositioning of resources can significantly reduce the sustainment distribution for EABO, they have inherent risks. For prepositioned equipment and supplies, there is the risk that they will be discovered or damaged before their use. If the compromise of these assets goes undiscovered, critical shortages will result that will degrade or prevent an EAB's operations. Similarly, OCS requires trust that the host nation's support will be available and reliable during a time of conflict. The sustainment requirements of EABO demand reliability and neither prepositioning nor OCS can provide guarantees.

The assets identified as critical joint enablers for EABO are the same resources needed to support competing concepts from other Services. The Army's Multi-Domain Battle Concept advertises to provide very similar sea control capabilities to those outlined in the fires vignette above.[29] Sustainment for the Army will require many of the same seabasing and air mobility assets, competing with those necessary to support EABO. Additionally, the Air Force aims to distribute their aviation operations to increase survivability in a modern conflict, increasing requirements for finite and limited air mobility assets.[30] Finally, the Navy is likely to execute distributed maritime operations, resulting in an increased distribution requirement for sustainment, which will demand more from an already stretched Combat Logistics Force (CLF).[31] These CLF ships are the same that will be required to resupply any seabases supporting EABO. Given competing priorities across the Services, the Marine Corps cannot expect to be the sole recipient of the joint assets. When combined with the risk of losses as a result of enemy action discussed earlier, joint assets are not a guaranteed solution for supporting EABO.

The combination of the LAW and unmanned vehicles promises to provide relief in the future but provides no assurances. Acquisition programs, new and old, are plagued with schedule delays and cost overruns. For the fiscal year 2021, the LAW program's approved funding was $24 million, already 20 percent less than the requested $30 million.[32] There is no guaranteed budget to support future capabilities necessary for sustaining EABO. Each program competes for resources within the Service, and the Services compete within the DOD.[33] The competition for funding is never-ending, and the possibility of reductions to the defense budget only exacerbates the problem. In a fiscally constrained environment, the prioritization of logistics programs like the LAW is doubtful. Despite these challenges, procurement must be sufficient to meet distribution throughput with enough redundancy to overcome combat losses to make EABO sustainable. Even if these programs make it through the acquisition process in the quantities required, they are subject to the same interservice competition outlined previously.

Each Service's distributed operations concept is likely individually supportable. The joint force cannot consider these concepts in isolation, though, as they all combat the same threat and are likely to be executed simultaneously. The competition for existing capabilities and capacities combined with future programs' uncertainty furthers the complexity of EABO in a modern, high-end fight.

Conclusion

The vignettes demonstrate the enormous scope of the logistical requirement to sustain EABO. The distribution of these supplies would take a herculean effort, mired by the distribution challenges explored here, which only begin to scratch the surface of the issue's true intricacy. The complexity of the logistics requirements makes EABO potentially unsustainable in a modern, high-end conflict.

This analysis does not doom EABO to failure in the future. As discussed, the joint force may have the capacity, but the Marine Corps must compete for it. Likewise, future capabilities may prove successful in meeting the distribution challenge, but they do not exist yet. Using these assumed logistics capabilities and capacity for planning before they are tested would be premature as they are too uncertain to be considered reliable. Knowing that the pacing function is logistics, sustainment must be approriately prioritized and resourced for EABO to be successful.

Moving forward, more fidelity is required to refine the total logistics requirement. Better defining the concept of employment will enable the development of a feasible concept of support. In developing the concept of support, more analysis is needed for prepositioning, OCS and the associated risk, and a detailed distribution analysis given current and future distribution platforms. There are many permutations for combinations of land and seabased supply points, distribution paths, and connectors. The most promising of these must be thoroughly developed and wargamed or experimented with

to determine their ability to support EABO. In this analysis, interservice competition and future capabilities are critical factors.

Notes

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8. *Employing Land-Based Anti-Ship Missiles in the Western Pacific*.

9. Headquarters Marine Corps, *Expeditionary Advanced Base Operations Handbook*, (Washington, DC: 2018).

10. Greg LaRow, *2d Marine Aircraft Wing (MAW) Aviation Operations in Amphibious Environment Study*, (Belcamp, MD: Defense Systems Information Analysis Center, 2019).

11. While rotary wing aircraft are not precluded from supporting EABO, their limited range would require basing or amphibious ships operationing inside of the enemy's WEZ, assuming significant risk. See Alan M. Pratt, *F-35 Operational Concept and Training Requirements Technical Report for the 2d Marine Aircraft Wing (MAW) F-35 training requirements Study*, (Belcamp, MD: Defense Systems Information Analysis Center, 2017).

12. Systems Planning and Analysis Inc completed a study titled "Distributed Short Take-Off Vertical Landing," (STOVL Operations: An Initial Look at Concept Development Feasibility Final Report" that is referenced in the 2D MAW studies as well as several other sources discussing DAO and DSO. The report findings are cited from secondary sources for the development of the F-35 vignette in this paper. The medium size was chosen for the vignette as it is the smallest that is capable of providing 24/7 support required. Without the source report, the breakdown of vehicles required is assumed to be an even distribution of MTVRs, LVSRs, and JLTVs.

13. *2d Marine Aircraft Wing (MAW) Aviation Operations in Amphibious Environment Study*.

14. Robert C. Owen, "Distributed STOVL Operations and Air-Mobility Support: Addressing the Mismatch between Requirements and Capabilities," *Naval War College Review*, (Newport RI: Naval War College, 2016).

15. *2d Marine Aircraft Wing (MAW) Aviation Operations in Amphibious Environment Study*.

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17. Joe Gould and Aaron Mehta, "U.S. Could Lose a Key Weapon for Tracking Chinese and Russian Subs," *Defense News*, (May 2019), available at https://www.defensenews.com.

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Logistics as Maneuver

Strategic messaging across the competition spectrum

by Col Aaron A. Angell

"Marines and the Marine Corps are tools for the Nation to use in the enduring competition that takes place in international relations. Every day, Marine capabilities and force posture affect the thinking of our competitors and potential adversaries. The more credible the Marine Corps, the more attractive we are to allies and partners. The more credible the Marine Corps is as a deterrent force, the more we affect our potential rivals' thinking."

—MCDP 1-4, Competing

Every military action must be designed to simultaneously build operational readiness and be a strategic message. This idea is inherent in the employment of combat forces across all domains, yet there is much greater benefit in deliberately applying this same idea to logistics. In effect, this idea transmutes logistics into maneuver, particularly at the strategic and operational levels of war. This is the essence of Dynamic Force Employment (DFE)—first presented in the 2018 *National Defense Strategy* (*NDS*)—which provides impetus to leverage every operation, activity, and investment for the purpose of messaging geopolitical allies, partners, and competitors. Logistics capabilities show commitment to security and peace in day-to-day competition. Further, logistics capabilities posture the force to respond in crisis and contingency. Logistics is a maneuver element with strategic messaging effects, and the deliberate use of logistics assures force projection, force closure, and force sustainment.

>Col Angell is currently the Commanding Officer, Marine Corps Logistics Operations Group.

Logistics as Maneuver

The 2018 *NDS* introduced DFE as a way to present a ready force with a resilient posture. The objective is to sustain war-winning capability using forces that provide strategic predictability for partners and allies while also presenting operational unpredictability

"Although nuclear weapons may give an alternative [deterrent], there is no deterrence, however, without logistics. … This is because logistics, where military activity meets the national economy, leads strategy by making the intent to use force reality. … Having the ability to sustain forces effectively was both a tactical and strategic weapon. … Core to deterrence are the capabilities most military women and men enjoy talking about; strike aircraft, long-range artillery and naval task groups. But it is logistics that determines the circumstances of their use; the time it takes for arming, when and where refueling may occur, and how quickly the detritus of battle can be repaired." [1]

to adversaries. The intent is to deter war. DFE certainly includes the use of combat forces, particularly those with high-end weapon systems that can literally impact an adversary. Yet, DFE also includes the posturing of forces, capabilities, materiel, and services. Posturing the force shows commitment and investment far beyond the use of combat forces in operations and exercises. The posture of the force may even have a greater impact in strategic messaging effect.

Forward posture has strategic messaging effects toward local, regional, and global competitors and potential adversaries. The enduring and episodic presence of forces and capabilities expresses the commitment to support partners and allies. Episodic presence without a predictable and set frequency also shows the operational and strategic agility of the force to be anywhere at any time. Operations, activities, and investments can be deliberately overt, covert, or even clandestine. The messaging of operations and activities may be modulated, sequenced, or timed for varying effects in the local, regional, or global geopolitical arenas. This approach illustrates how logistics can be incorporated into combined arms at the strategic and operational level, in much the same way that traditional maneuverists at the tactical level combine fires capabilities for greater effect.

Posturing of forces, equipment, and supplies, as well as the establishment of forward bases all have strategic messaging impacts. Logistics networks established in forward operating areas provide a resilient and responsive foundation for forces and capabilities to operate across a theater and globally, even when contested. This positioning of capability may be tied to episodic preparation for humanitarian assistance and disaster relief or tied to enduring commitments of force presence with partner nations. Logistics enablers may be positioned ashore or afloat according to the geopolitical context and informed by the intent to commit or remain visibly flexible. When ashore or in littoral areas, relationships with partners and allies are strengthened through the execution of operations, activities, and investments that build potential coalition and multi-national force interoperability.

Examples of logistics operations, activities, and investments to use as DFE to message the ability or "intent to use force" and for strategic "maneuver":

- **Prepositioning equipment and materiel (afloat and ashore).**
- **Conducting exercise-related engineer construction projects (runways, landing zones, drop zones, firing positions, forward arming and refueling points).**
- **Conducting port (sea and air) and distribution (roads, rail, inland waterways) studies.**
- **Conducting engineer reconnaissance (to include water and energy foraging).**
- **Establishing, adjusting, and using local and regional contract relationships (contingency contracting, Navy World Wide Expeditionary Multiple Award Contract, DLA Contracting Services, Logistics Civil Augmentation Program, and Air Force Contract Augmentation Program).**
- **Renting/buying/leasing facilities (billeting, supply warehousing, forward caching, maintenance).**
- **Civil Action Program activities to include medical civic action program, dental civic action program, and engineering civic action program ENCAP.**

Endstate: Sustain a ready forward force. Assure partners and allies. Deter potential adversaries.

Figure 1. Logistics as maneuver examples.

Logistics activities in a forward operating area build resilience for the force. An expeditionary force requires a flexible and responsive logistics network, including what is available in the forward operating environment. Logistics activities include seaport and airport studies, coordination with local and regional service providers for contractual agreements, maturation of acquisition and cross-Service agreements, and theater security cooperation events. Additionally, expeditionary forces often sustain through contracted products and services, which strengthen the ties with local and regional partners and allies. Operating in a forward operating area requires the calculated use of all available resources, including those from foreign nations. Leveraging the full logistics system in a forward-operating environment increases the probability of sustaining forces even when contested.

Operating in a forward operating area requires the calculated use of all available resources, including those from foreign nations.

Risk across the Competition Spectrum

Certainly, the challenge in sustaining a force changes across the competition spectrum. Here we will use a simplified representation of the competition spectrum with three general conditions: competition, crisis, and conflict (Figure 2). In execution, a force must be prepared to transition between these conditions rapidly, yet in planning it is appropriate to understand the assumptions and opportunities through

each condition. In execution, a crisis can emerge very rapidly. Depending on the reactions and counteractions of forces, the situation may rapidly escalate more into conflict (or war), or it could de-escalate back to competition. In planning, if assumptions are based solely on the worst-case conflict scenario, then opportunities for leveraging existing logistics resources will not be recognized.

Logistics capabilities will utilize a redundant network by leveraging resilient logistics webs and balancing local, theater, and global materiel posture.

Further, planners who do not consider these opportunities neglect the strategic messaging that could be incorporated into a campaign plan in competition. Deliberate use of logistics operations, activities, and investments in competition can deter crisis and conflict.

In competition, the force gains relative advantage with forward capabilities to support joint force and political objectives. In this context, the force builds host nation capacity, expands distribution networks through engagement and training with foreign forces, and develops day-to-day sustainment options. Regular demonstration capabilities may include rehearsing force projection from homestation and force closure in the respective theater, as well as supporting day-to-day operations, activities, and investments. Additionally, forces may present new capabilities, adjust forward posturing of forces, and invest in the establishment and refinement of advanced bases. The desired endstate is to assure partners and allies and deter competitors from becoming adversaries.

In crisis, the force responds with a range of flexible options to de-escalate emergent issues or shape first engagements. Here logistics can be used to create risk and impose costs for the adversary by expanding forward presence and posture. To further assure allies and partners, there may be an overt exercise of force closure, an increase in prepositioning capability, or adjustments to host nation support agreements across the theater. With increased risk to friendly forces, additional protective measures may include the use of mobile, survivable nodes, and shifting to concealed distributed stocks. The intent of these options is to prevent further escalation of force, which may include coercion through increased posture and intent to act.

In conflict, the logistics capability will enable the joint force to win wars and consolidate gains. To disrupt adversary action, logistics capabilities will support a surge of forces. Based on potential operations in the information environment, the force may shift to a data-informed resupply model for prioritization and distribution of limited resources. Logistics capabilities will utilize a redundant network by leveraging resilient logistics webs and balancing local, theater, and global materiel posture. To assure resilience across the distribution network, the force may expand the security layer and prepare for rapid base recovery after attack. It is at this end of the spectrum that logistics is at greatest risk, yet there are likely to be greater force offerings to provide security across the depth of the distribution network.

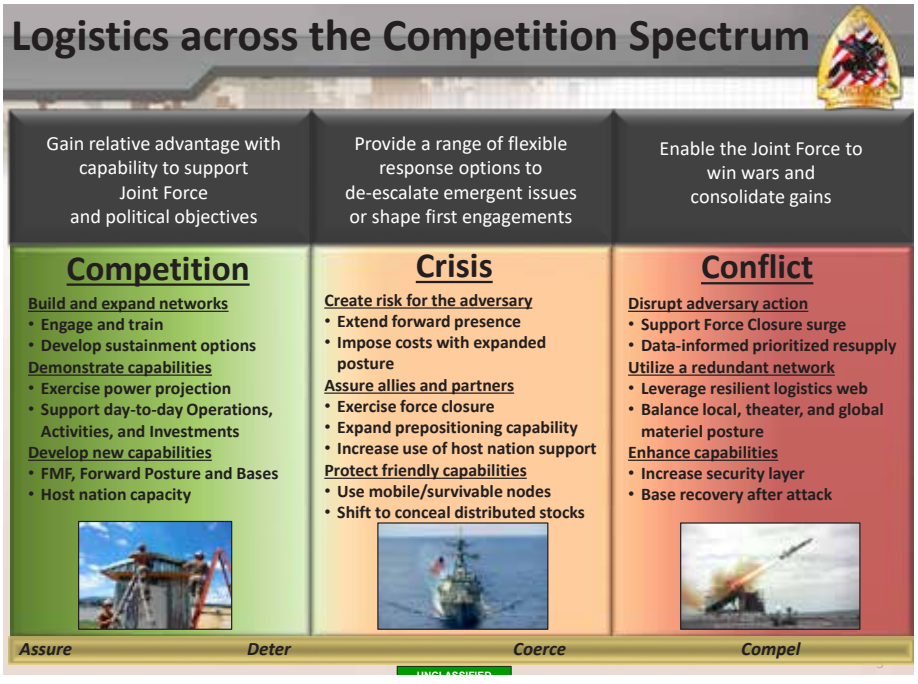

Figure 2. Logistics across the competition spectrum. *(Figure provided by author.)*

Conclusion

Using logistics as maneuver increases the range of flexible deterrence and response options. While combat action and overt military maneuvers with armed weapon systems may have some impact, the posturing of logistics capability in a particular theater may provide an even more grand expression of intent. The deliberate buildup of forces along a border draws attention. However, the presentation of a force can be a hollow demonstration if it is not backed up by a resilient logistics system. If the objective is to prevent war or even a limited military action, then the use of logistics as maneuver can be the appropriate investment to deter potential adversaries.

To step forward in using logistics as maneuver, planners should analyze opportunities that can be leveraged

and then advise commanders regarding where, when, and how to focus. The first step is to establish global, regional, and local awareness of logistics-related operations, activities, and investments that are already occurring. Next, planners should determine strategic maneuver gain and risk associated with logistics-related operations, activities, and investments. Nesting these opportunities with local, regional, and global military and geopolitical objectives embodies the concept of DFE. Some of these opportunities may be easy to leverage for strategic messaging by simply adjusting the communications strategy. Other opportunities will require detailed planning at the theater and strategic level. The prioritization and sequencing of resources (funding, in particular) must be aligned with theater engagement plans, theater posture plans, and Service-specific force structure and global laydown. Each of these plans follows a different process, and some are lengthy. The realization of these daunting challenges in resourcing cannot discourage planners from taking advantage of the opportunities. The desired endstates of this process are sustained readiness for forces forward, assured partners and allies, and deterred potential adversaries.

The desired endstates ... are sustained readiness for forces forward ...

Notes

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Additive Manufacturing

Fix them where they fight

by Maj Catherine DeLeal

Gen Berger has declared logistics the pacing function for achieving his planning guidance, reorienting the Marine Corps to maintaining our prowess as an unquestionably lethal amphibious expeditionary fighting force. As we look to reimagine future logistics and sustainment, we have come to understand the antiquated methods we have relied upon for decades will no longer sustain our lethality and have become an operational liability. Our lines of supply and sustainment are increasingly vulnerable during both low-intensity competition and potential large-scale conflict with a near-peer adversary. While not the only answer, additive manufacturing (AM) has emerged as a viable contributor to logistics and sustainment modernization efforts. Essentially, at its simplest level, AM provides a vital opportunity to modernize how we sustain the force by bringing the point of repair closer to the point of breakage, and it has the potential to dramatically expand what can be repaired at that point for continued fighting.

Briefly, standard manufacturing is subtractive manufacturing, and most of the parts and systems we operate are constructed from components that have been manufactured in a subtractive way. Generally, subtractive manufacturing starts with a larger sheet or piece of metal, and in a variety of processes which encompass a wide swath of techniques, it is reduced to a smaller piece requiring further finishing—like smoothing out rough edges or seams. This is time consuming, waste producing, and can also be more costly for a variety of reasons. Additionally, while the Marine Corps does have an expeditionary traditional fabrication capability, a Shop Equipment Mobile Machine Shop, it has a large footprint. Consisting of two 20' ISO containers and requiring significant heavy equipment support, it typically does not even go on a MEU because of its space requirements and emplacement needs. With AM or 3D printing, pieces or parts are constructed layer by layer through a computer-controlled process in much smaller footprints. This can speed up the parts creation process, eliminate waste, save money, and expand the type of materials parts can be made from. As the field grows, so too do the materials we can use. Currently, industry can 3D print in a wide variety of polymers, metals, and even concrete.

Currently, industry can 3D print in a wide variety of polymers, metals, and even concrete.

Most relevant to the Commandant's Expeditionary Advanced Base Operations concept, AM has the ability to move the point of repair of certain parts closer to the point of damage, procure certain parts faster or cheaper, obtain only the necessary components of larger subassemblies, and ultimately sustain our legacy systems plagued by diminishing manufacturing sources and material shortages (DMSMS). When and where the supply chain lags as a result of DMSMS or transportation requirements to overcome geographical challenges, AM can fill gaps. That is where Marines benefit. In garrison, units will see items with fewer days deadlined when a part can be printed in nineteen hours rather than shipped in nineteen days. Units will see part transportation and storage cost reductions when lower-demand items can be printed as necessary rather than stocked, just-in-case. During operations, units maintain momentum when certain broken or damaged equipment can be repaired at a combat outpost, repair and replenishment point, or a forward arming and refueling point in a matter of hours, compared to having to coordinate evacuation to a combat service support area or depot before then having to await repair or replacement.

The effort to ensure AM meets the Marine Corps' expeditionary needs as briefly outlined above is grounded in two efforts currently underway. The first effort embraces technology in logistics, which is crucial to how AM processes have the ability to deliver a digital Class IX block—a Digital Manufacturing Data Vault (DMDV). The DMDV is a central repository containing the technical data packages (TDP) required by the 3D printers to create parts. This

>Maj DeLeal is graduate of the U.S. Naval Academy and served six years on active duty, completing three OIF deployments with Marine Wing Support Squadrons. As a Reservist in the IMA program, she completed a year of with the III MEF G4 before assuming her current billet as the Director of Additive Manufacturing Policy.

has the real potential to drastically reduce a physical Class IX footprint and sizably contributes to solving how we sustain our forces as they are engaged in the distributed operations envisioned in the Expeditionary Air Base Operations concept. A skilled Marine with a 3D printer can access the technical data packages in the DMDV to create thousands of parts required to maintain our equipment inventory and then fabricate those parts closer to the point of need as described above.

The second effort underway is intertwined with the DMDV, and it is the development of the deployable AM equipment to accomplish fabrication. This is how the TDP files become the necessary parts. In December, we started fielding the first of seventeen Program of Record XFABs (expeditionary fabrication)—a 20' ISO container that works into our existing maintenance battalion expeditionary machining and welding capabilities. The following fiscal year, we are scheduled to field our pelican-case portable tactical fabrication (TACFAB) units to non-maintenance battalions across the fleet. The intent is to put AM in the hands of every battalion and provide them a deployable, expeditionary repair capability to fix what breaks as close to the point of breakage as possible.

AM is not just fabricating repairs onsite or reverse-engineering HMMWV door handles and antenna clips. While those are useful and helpful, they are truly the tip of the iceberg on what AM can provide a deployed battalion and the Marine Corps at large. Twenty years of combat operations has taught us that Marines—the individual rifleman, maintainer, operator, and communicator—possess a creativity born out of necessity that is truly remarkable. We have always prided ourselves on leaving it better than we found it and consistently doing more with less. As AM techniques began to infiltrate the personal interests of Marines, we began to see it amplify the sophistication of the improvements they introduced to their chains of command. Marines are inherently problem solvers out of sheer necessity and force of will. With AM, we enable them to do better than duct tape, 550 cord, and bubblegum, because we all know they will use whatever they can find around them. We were incredibly fortunate that our senior leadership nurtured our grassroots AM efforts by offering Marines innovation challenges and incorporating the best of their ideas across the fleet. This ultimately empowers them to improve their fighting hole by not just seeing problems but creating viable solutions informed by their experiences. We want our junior Marines to lead, and we recognize that officers and SNCOs are not the sole source of bright ideas. Our operators keenly appreciate how we value their input on the jobs they do every day, and as such, they remain out front in our research

and development. Marines are coming up with ideas that solve our immediate supply chain challenges but also move beyond repair parts and reverse engineering. The recent defense budgets will ensure that Marines maintain a growth mindset oriented toward the kind of innovations, which keep us agile and lethal in the face of an evolving enemy because we cannot count on money to solve the problem.

The DOD has expressed a growing interest in AM, and that, frankly, is opportune for Marine Corps logisticians.

One such example is a Steering Wheel Removal Device (SWRD). Certain common maintenance operations, both preventive and restorative, on MTVRs and LVSRs require removing the steering wheel with a slide hammer. The problem maintainers discovered was the slide hammer frequently broke the steering wheel, even when used correctly, resulting in deadlining an otherwise operational vehicle. Frustrated with deadlining vehicles and lost maintenance days while awaiting a new steering wheel, Marine maintainers designed, printed, and tested a polymer SWRD device—though it proved too fragile. However, upgrading to a 17-4 stainless steel printed device, these Marines led an effort that now provides the entire fleet with a solution. In the time that they were refining their SWRD, they calculated that I MEF spent over $6,000 and 25 days awaiting parts to repair steering wheels broken by the slide hammer in the last year. This is just one example of how frontline Marines lead us to meaningful improvements to their processes. That saves us money as well as time, and keeps us lethal and agile, while empowering Marines to lead us to solutions improves retention and talent management. This is the vein in which AM adds value to the individual battalion and to the Corps as a whole.

The DOD has expressed a growing interest in AM, and that, frankly, is opportune for Marine Corps logisticians. This ensures that AM within the DOD is not a fleeting technology or series of bright ideas that come to nothing substantial. It is imperative that we learn what is possible and then adopt what is sensible for EABO. We are looking across not just the DOD but also across our national industrial and technology base because where warfighters are in smaller formations spread throughout remote locations, dragging the iron mountain to them to keep them lethal simply will not work. The national industrial manufacturing base and the defense industry are creating systems that incorporate AM techniques at part and system inception. They are delivering end items with AM printed components. They are progressing AM techniques like cold-spray, which aims to improve depot-level maintenance across a variety of platforms that require coating or bonding of complex shapes, and realizes savings in materials, energy, and waste. Delving into more complex AM concepts, we are working with sister Services, industry, and universities to print vehicle hulls and attritable ship-to-shore connectors to deploy and sustain our forces. We are testing printing in concrete for gap closings and concealment structures.

As we learn how to use or incorporate AM to make improvements, we share that knowledge with fellow Marines through our MakerSpace courses and the DMDV TDP repository and with our sister Services through file sharing or through the Defense Logistics Agency's Joint Additive Manufacturing Model Exchange and Joint Additive Manufacturing Acceptability project. This is the behind the scenes AM effort that Headquarters Marine Corps and the Additive Manufacturing Operations Cell at MARCORSYSCOM orchestrate to ensure that FMFs benefit from what AM can offer to shape the battlefield. Sharing education, techniques, and TDPs ensures that AM is poised to meaningfully contribute to EABO logistics and sustainment.

Finally, Gen Berger has showed increased commitment to educating and retaining our forces. AM contributes to that effort as well. We are working with the national education base and looking to partner with a state-endorsed community and technical college system to incorporate parts of their curriculum, best practices, and, importantly, their certification into our MOS-granting schoolhouse. We are engaging this simultaneously with an effort to unite welders and machinists, and teach them 3D printing to create Fabricators. The envisioned Fabricator gives a maintenance battalion, for example, a triple threat Marine—one Marine with three vital repair skills. Additionally, ensuring our Marines learn the skills required to be nationally recognized, certificate-awarded fabrication experts will ensure we have a solid foundation to maintain our legacy systems.

AM is at the intersection of modernizing Marine Corps logistics and overall modernizations efforts across the DOD, national industrial, and education bases as we introspectively examine how we stay ahead of increasingly capable adversaries. We fight to win by harnessing these nascent AM technologies and applying them to age-old warfighting needs and legacy systems, as outlined in *MCO 4700.4* and *DODI 5000.93*. We embrace efforts like AM that demonstrate they will improve effectiveness and lethality.

As logisticians, engage your Marines to identify their maintenance and operations challenges as well as empower them to work with you on the solutions. Each MEF has a MakerSpace and AM capabilities with the tools and fabricators necessary to shape maintenance, repair, and sustainment. The task at hand is to pull AM into your concepts of support as we all pivot to distributed and dispersed expeditionary airbase operations.

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Architecting Naval Supply Chains

A quest to build holistic thinking

by Maj Julie Aho

Across the Marine Corps, logistics planners are brainstorming how to build redundancies into inventories and distribution networks. If current day America is any indication, the Marine Corps faces a combination of log-jammed aerial and seaports, competition with other Services for scarce resources, shortages of supplies and distribution assets, and fights with the Navy for cargo space as the Corps transitions from an era of operating like the Army to integrating with the Navy. Naval logistics is a fractured process executed in stovepipes without integration. For logistics to be the pacing function in the future operating environment, the naval logistics enterprise must devise new and innovative methods to stay ahead of adversaries who will continue to adapt and improve in ever more sophisticated ways. Marine Corps logisticians do not have a means to conduct the required supply chain assessments, analysis, and elegant artificial intelligence enabled forecasting to meet operational requirements and constraints. Communities have invented their own version of supply chain management (planning and execution) that are based on naive intuition and heuristics. To start, we need to focus on two key tenants of supply chain planning: architecture and design.

Supply chain architecture, in terms of naval supply chains, is nested upon the ability to rearm, refuel, repair, refit, and retrograde. A supply chain architecture is the foundation upon which a naval supply network would function to control the demand and replenishment signals between littoral forces and supply nodes. Supply chain design is the art and science of building a supply chain and establishing the governing policies to ensure the desired level of performance in the face of disruptions. In order to do this, planners must have both a current mapping of the physical supply chain and an understanding of its system dynamics in order to be able to apply the advanced analytics and applied artificial intelligence needed to effectively manage the many echelons of littoral forces, supply nodes, and the industrial base.

Supply chain architecture in a naval context requires mapping warfighter replenishment points to both dynamic and fixed supply nodes across multiple echelons of naval and joint forces, to include host nation, self-manufactured, and non-standard support. Distribution channels, by mode of transport, are then drawn across all fixed/dynamic nodes (Stand-in Forces), mapped against no-travel or transportation lanes with a risk index. As the replenishment points may be moving frequently and unpredictably and with deception, the resupply network will need to be continuously redesigned, leveraging artificial intelligence/machine learning (AI/ML) to develop inventory-stocking positions at each echelon to ensure human bias does not interfere with logistics in a high-threat, high-disruption environment.

To connect warfighters with the sustainment needed, a dynamic supply chain architecture must be constructed across theaters, in conjunction with the cyber domain, overlaid across institutional brick and mortar, strategic supply nodes, and distribution channels to guarantee logistics as a pacing function and not a delaying function. A robust supply chain architecture will not ensure adequate sustainment of Stand-in Forces by itself. Across each enterprise channel—whether it be by class of supply, weapon system, or theater—planners must design the network to ensure the agile flow of personnel and materiel to and from their respective nodes to meet operational needs. Today, Defense Logistics Agency (DLA) and U.S. Transportation Command (USTRANSCOM) own the design of the supply and distribution networks and draw the lines between nodes to flow forces and materiel. The future operating environment may require DLA and USTRANSCOM (including Military Sealift Command) to evaluate their current network and work closely with Service-level logisticians under each combatant command.

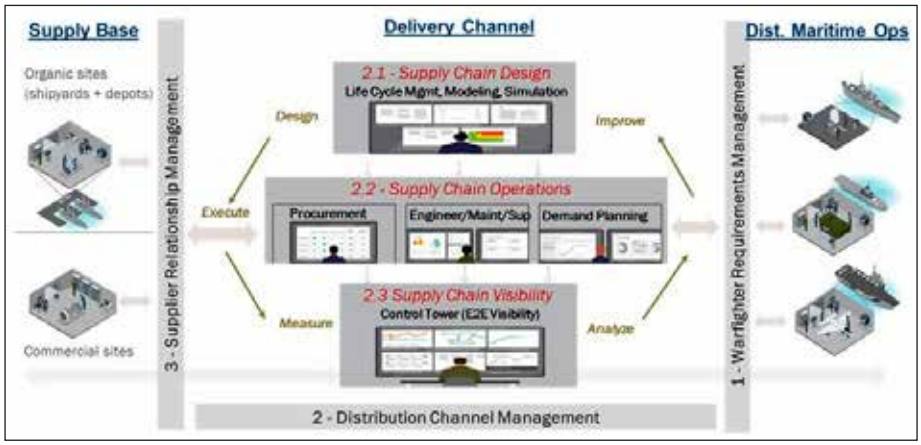
Needs vary significantly among the stakeholders of naval supply chains. At the tactical edge, logisticians require track and trace capabilities and the ability to resolve problems quickly. One echelon above, the first supply node requires visibility of the tactical layer but is also focused on inventory management, rapid fulfillment of warfighter requirements, transactions with adjacent supply nodes, and replenishment of critical supplies. One echelon

>Maj Aho is assigned to HQMC Installations & Logistics, Supply Policy & Sustainment. Her assignments include CLB-6, TTECG, and 1st MRSB; she has completed three deployments to the Middle East. She obtained a Master of Supply Chain Management from the University of Michigan.

above this, a supply node in a more secure environment may be focused on longer time horizons, coordination across theater stakeholders, and flow of materiel to and from theater or naval ships. At some point, tactical logistics transitions to operational-level logistics and then strategic-level logistics. Somewhere within the supply chain, someone is focused on delivery, fulfillment, distribution, warehousing, demand planning, purchasing, sourcing, supplier management, optimization, compliance, and more.

Now, more than ever, there is a requirement for technology and an entity empowered to orchestrate the supply chain. AI needs a command-and-control backbone to live on and employ a feedback loop to the people who make materiel management decisions. Components of supply chain design, such as evaluating the optimal placement of supply nodes and increasing throughput rates, is required to make the Marine Corps' supply chain a strategic weapon. To realize these benefits, a supply chain digital twin or technology capable of digitally modeling the supply chain is a current day technology solution that can provide these analytic insights. A supply chain digital twin is a digital representation of the supply chain built from authoritative transactional data, capable of end-to-end analysis and finding mathematically optimal courses of action to evaluate trade-offs. Further, it enables optimization and prescriptive analytics to understand implications of humans and computer-generated scenarios.

For the past year, HQMC Installations & Logistics has been exploring how digitally modeling physical supply chains with computer software can be used to find improvements across the force. This includes exploring commercial technologies that use data science techniques—to include optimization, discrete-event simulation, and machine learning—to provide long-term demand forecasting and what-if scenario analysis. A supply chain digital twin is a means to enable planners to continuously run scenarios to optimize the supply chain and wargame logistics for major theater operations, building confidence in the ability to embrace math and science through computer simulation in sustainment planning.



Warfighter first, combat-ready logistics enabling multi-domain distributed maritime operations through a secure, resilient, and rapidly innovating end-to-end supply chain network. ***(Photo by author.)***

A supply chain digital twin is just one tool in a suite of operational-level and theater-level logistics planning tools that will enable planners to develop strategies that properly balance efficiency versus effectiveness (agile and responsive). It leverages a digital environment to understand the supply chain from our suppliers to the point of consumption—delivering the insights needed to be logistically responsive, agile, and ready. Employment of operational-level supply chain planning technology needs to be designed into the developing LCE Force Structure to include roles/responsibilities for supply chain architecture, design, planning, and execution. The goal of every supply chain is to get the right materiel, to the right place, at the right time, in the right quantity. This cannot be achieved effectively and affordably without adequate Service-level planning integrated with theater operations and plans.

Further, the COVID-19 pandemic highlighted supply chains as a national security imperative and reinforced the premise that the defense industrial base is not properly postured to support a future fight. HQMC is engaged in a two-year, DOD-wide Supply Chain Resiliency Working Group stemming from Presidential Executive Order 14017, which focuses on the need for resilient, diverse, and secure supply chains to ensure U.S. economic prosperity and national security across six sectors of the economy. The Office of the Secretary of Defense is the DOD lead for ensuring direction on DOD supply chains by identifying risks, addressing vulnerabilities, and develop-

ing a strategy to ensure resiliency and security. However, sending a single major from HQMC to be responsible for representing the entire Marine Corps on this working group is woefully inadequate. The lack of an entity with responsibility across the wide functional areas this working group is addressing (kinetic capabilities, microelectronics, casting and forgings, energy and batteries, industrial base security) only substantiates the issue.

To accelerate supply chain planning across naval supply chains and facilitate orchestration internally, the following initiatives are proposed:

- *Critical Class of Supply Modeling*: The objective is to digitally model and simulate redundancies into inventories and distribution networks to ensure resilient networks of support. Develop a capability that simplifies the outputs of advanced supply chain analytics to simple applications that enable Marines to analyze different decisions across inventory on hand, distribution, and inventory placement. This could provide a common operating picture across the Marine Corps to serve as the single source of truth to evaluate strategic supply chain decisions from operational to tactical-level logistics.
- *AI-enabled Demand Forecasting*: Formally designate an entity to aggregate demand across the Marine Corps to deploy an AI-enabled approach to develop data-driven forecasting processes and communicate consumption data to DLA and key suppliers in support of force design, Expeditionary Advanced Base Operations sustainment requirements, and Marine Corps supply chain resiliency actions. The goals of this effort are to: aggregate data from the point of consumption to DLA; operationalize aggregated short, mid, and long-term forecasting processes; and establish a demand baseline for the Marine Corps to wargame global inventory plans. This is the starting point to develop a capability for the Marine Corps to optimize and wargame the supply chain to increase force lethality.
- *Supply Chain Resiliency through Illumination*: The intent is to map weapon system supply chains from the original equipment manufacturer to Tier 2/3 suppliers in support of program managers decision space while simultaneously exploring how additive manufacturing can offset risk. This will deliver the necessary insights to evaluate supply chain vulnerability, risk of disruption, foreign ownership, control or influence, and potential points of failure. Capabilities like this are needed to better understand the defense industrial base and a weapon system's risk exposure to foreign countries, parts with no alternative suppliers, and identification of high-risk vendors.
- *INDOPACOM Network Design*: How the Marine Corps architects the physical supply chain across INDOPACOM is key to its survivability and ability to respond to disruption. The Marine Corps must break from the old habits of "expanding the SECREP contract" and expanding the "Infantry Combat Clothing and Equipment contract" just because we have relocated forces. INDOPACOM presents the first unique opportunity for the Marine Corps to re-engineer the way it does supply chain planning and operationalize supply chain architecture and design.

The defense-industrial base is not adequately prepared to fulfill customer requisitions in a predictable, timely, and cost-effective manner. *(Photo by author.)*

Now is the time for the force design work to recognize the strategic gaps and overlaps across acquisition and sustainment roles and responsibilities, from the MEFs to the MARFORs, MARCORLOGCOM, MARCORSYSCOM, HQMC, TECOM, and the Supporting Establishment. The lack of an entity to synchronize, integrate, and orchestrate the Marine Corps supply chain with the Navy, DLA, and across the Joint Logistics Enterprise puts the Marine Corps at a deficit before we send the first Stand-in Forces over the horizon.

Logistics forces must become better at delivering the right sustainment at the right time to reduce the burden on the warfighter while simultaneously reducing the overall footprint

The lack of an entity to synchronize, integrate, and orchestrate the Marine Corps supply chain … puts the Marine Corps at a deficit before we send the first Stand-in Forces over the horizon.

and demand on the Marine Corps, the Navy, the Joint Logistics Enterprise, allies, and partners. CD&I must identify the gap that exists in Marine Corps operational-level supply chain planning roles/responsibilities, manning, and systems, and author/invest in the requirements so that the first and middle miles of logistics do not delay the last miles sustaining Stand-in Forces. The process of decision making in logistics must be tightened to keep pace with the speed of battle. Those who invest in data-driven supply chain planning and put into practice supply chain wargaming will be those who remain in the fight.

UBMC

Supply chain integration is as essential to sustainability as a fire support coordination center is to lethality. *(Photo by author.)*

Fleet Marine Force Engineering

A gap too far?

by Capt Samuel R. Houghtling

The Marine Corps is currently a year into redesigning the force for 2030 and beyond. Our fundamental requirement is to shape the presently atrophied force into one that can compete, fight, and win against peer adversaries, as outlined in the *38th Commandant's Planning Guidance*. Twenty years of low-intensity conflict, categorized by joint multi-domain supremacy, have conditioned the force to a context more remote from its naval expeditionary roots than perhaps ever before. We need a force that can compete and survive in a distributed maritime domain against an ever increasingly potent anti-access/area denial threat. The Marine Corps is rightly reprioritizing its future investment strategies away from heavy, logistically burdensome capabilities designed for large-scale, long-term conflicts ashore. Fundamental strategic requirements aside, the problem remains: we are not currently postured with the capabilities at a tactical level to support the maneuver of the Naval Expeditionary Force (NEF) throughout the competition-to-conflict continuum.

This article seeks to highlight the FMF Engineering concepts and capabilities currently lacking in a "Fight Now" environment. It also seeks to propose constructive solutions to the challenges facing *Force Design 2030*. Although this article focuses on the role of FMF engineers as distinctive enablers to the success of a naval campaign, it is equally important to understand how our shortfalls and capability gaps have ramifications across the entire joint force in terms of operational maneuver. This article seeks to address the critical topic of gap crossing operations as a subset of an assured mobility framework, but not to exclude other essential concepts that need more detailed analysis and dialogue.

>Capt Houghtling is a Combat Engineer Officer and has served as Company Commander of Engineer Company A and Engineer Company B, 9th Engineer Support Battalion, where he currently serves as the Assistant Operations Officer.

In 2020, the Marine Corps commenced divestment of its standard wet and dry gap crossing assets, to include the Assault Vehicle Launched Bridge, Medium Girder Bridges, Improved Ribbon Bridges, and Bridge Erection Boats, required for rafting operations. The Marine Corps rightly divested of these systems, as they do not meet requirements for attrition-worthy, highly transportable (via aviation or maritime assets), and flexibly employed capabilities needed to thrive in a distributed environment where force-mobility equates to survivability. Under current experimentation initiatives, the Marine Corps decided against acquiring the Joint Assault Bridge (JAB), an Army Program of Record. The Army utilizes Dry Support Bridges, Medium Girder Bridges, Improved Ribbon Bridges, and JABs—which require a heavy logistical footprint for tactical maneuver, operational lift, and robust maintenance requirements for Army Bridge Erection Boats and the M1A1 chassis used to employ the JAB.

Divestment strategies were justified in an article published in 2020 stating, "Such heavy capabilities are found in abundance elsewhere in the joint force inventory," and the author is "confident that we can rely on them to be there to support Marines in any high-end ground combat scenario into which we may find ourselves drawn."[1] While undoubtedly true in a macro-context, a tactical problem arises regarding the combined arms mobility of the currently forward deployed force, III MEF, which permanently resides inside the adversary weapons engagement zone without deliberate gap crossing assets. III MEF additionally fulfills the purpose of being a Stand-in-Force, in which we seek to check an adversary's advances by contesting the seaward littorals through the additional application of landbased kinetic fires. Furthermore, this infers a fundamental assumption that Stand-in-Forces must fight with what they have on hand with resupply estimates ranging from days to several weeks.

Assured mobility encompasses "the framework of processes, actions, and capabilities that enable the joint force to deploy and maneuver where and when desired, *without interruption or delay*, to accomplish the mission."[2] [Emphasis added.] Assured mobility focuses on proactive mobility, countermobility, and supporting survivability actions, which generate options and tempo for the maneuver force. Engineers accomplish these tasks by neutralizing obstacle effects across multiple routes to support the overall concept of operation. Assuring mobility not only affects the maneuver of friendly combat units but is critical to the supporting forces' concept of support for tactical logistics and sustainment.

A unit cannot effectively conduct maneuver without movement. Provid-

9th Engineer Support Battalion conducts rafting operations with 12th Marine Regiment in Okinawa, Japan. *(Photo by LCpl Alyssa Chuluda.)*

ing the physical ability for friendly forces to move freely across the battlespace is uniquely an engineer function. Engineers shape and manage the physical impacts of the environment against friendly and enemy forces—an inability to maneuver telegraphs a significant loss of initiative to our foes. Our adversaries will seek to further limit our mobility by destroying existing infrastructure or causing congestive effects on the mobility corridors in our area of operations. FMF engineers must solve these problems by employing alternative means to bypass congested or limited routes, replace or repair existing vehicle and personnel bridge infrastructure, and remain unpredictable (concealed) in our advance against the enemy.

The III MEF Area of Operations contains a variety of natural and manmade obstacles that impede friendly force mobility ashore. These range from mountainous tropical jungles with steep riverbanks and heavy vegetation to inland waterways and highly trafficked rivers with existing civilian bridges connecting primary and alternate supply routes. Manmade bridges present prime targeting opportunities for adversary forces that will ultimately force the FMF, and potentially NEF, to repair or replace destroyed spans or create alternate gap crossing locations to facilitate the movement and maneuver of personnel and equipment.

Gap crossing operations are a subset of an assured mobility framework across the battlespace. The common denominator to all mobility tasks is the ability to position combat power at-will by the commander to succeed on the battlefield. An inability to position combat power freely at the decisive point during offensive or defensive operations limits the lethality of our combined arms. Currently, there are no standard bridging capabilities in FMF units to meet the light and medium Military Load Classification requirements to accomplish gap crossing operations. Without deliberate gap crossing solutions, our collective ability to shape the operating environment is severely limited.

Based on terrain and geospatial awareness, the overall scheme of maneuver will drive gap crossing requirements. The use of heavy logistics vehicles and assets may not specifically be required during every type of assault or movement to contact by the ground combat element. However, in planning follow-on sustainment to maneuver elements, including the sustainment and mobility of supporting forces, commanders must consider all capability limitations when developing tactical logistics and rear-area support plans.

Engineers construct non-standard or expedient bridges with locally procured materials (timber, concrete, or stones), often requiring material handling equipment or other forms of heavy equipment to erect the types of bridges that would meet the mobility requirements for the force. The time needed to procure these materials in remote and austere environments and erect non-standard bridges that meet FMF mobility requirements is not feasible in a kinetic environment. Non-standard bridging requires specialized equipment and non-hardened materials such as metal or wood to produce components such as abutments, posts, or pilings. Non-standard bridging requires motor transport and logistics support assets to move materials to a site, vehicles and equipment to develop the site, and time associated with construction. Rapid production or fabrication of components is limited. The Marine Corps currently faces a capacity gap in several key areas, mainly vertical and horizontal construction in expeditionary and contingency environments. Current capabilities rely on specialized and limited equipment and resource (labor and materiel) intensive methods. It is seldom effective to employ non-standard bridging in support of front-line maneuver elements within zones of battle.[3] Non-standard bridging is not an acceptable replacement for employing standard bridging during gap crossing operations.

The Indo-Pacific Area of Responsibility requires the FMF to operate throughout a predominantly distributed maritime domain. III MEF, for example, does not contain a combat engineer battalion, and early distribution across the operating environment will immediately stress the capacity of existing engineer formations to support various combat and general engineer functions to the Marine Division, Marine Aircraft Wing, and Marine Logistics Group simultaneously. The future battlespace will require naval engineering units to work in distributed locations, with shorter timelines, and in contested environments that require unique construction requirements across multiple engineering functions without the ability to readily mass engineer forces—a

Marine Combat Engineers and Navy Seabees construct a non-standard bridge at Jungle Warfare Training Center, Okinawa, Japan. *(Photo provided by B Co, 9th ESB.)*

traditional engineer task organization construct.

The naval campaign ashore requires gap crossing assets to maintain mobility, enable movement, and preserve tempo for the naval and joint force commander. The FMF must maintain both standard and non-standard gap crossing capabilities to accomplish mobility tasks to support ground schemes of maneuver. There is a need for a suitable, transportable bridging system capable of supporting both vehicles and personnel. Such bridging must be ground or air-transportable, compatible with aerial delivery techniques, deployable quickly without additional construction support equipment, and capable of supporting combat vehicles over useful spans. MEF and NEF engineers must provide all aspects of mobility, countermobility, survivability, and general engineering support to the FMF and joint units operating in the theater.

Gap crossing capabilities must meet the Military Load Classification requirements for the largest expeditionary vehicle in the MEF inventory for use in rigorously austere environments. They must be capable of launching and emplacing bridge spans from existing vehicle platforms such as the Joint-Light Tactical Vehicle. They must be modular or self-deployable, with modules meeting tactical volumetric thresholds for transport aboard or attached to tactical vehicle assets, surface connectors, or applicable aviation delivered methods. We must pre-stage modular bridges, stored in all-weather containers, during competition in locations convenient to deployment during conflict. Minimal personnel and equipment will be available to construct standard gap crossing assets in the future.

FMF engineers must be trained and resourced to provide combined arms mobility during kinetic offensive and defensive operations and robust competition-oriented general engineering services. Both situations support a framework of assured mobility to the FMF and potentially joint customers in the AO. We must resource, train, and employ NEF engineers to their total capacity across multiple lines of effort to enable the tactical and operational maneuver of the fleet within the First Island Chain.

The stated need for standard gap crossing systems does not infer a desire to merely replace the equipment currently being divested by the Marine Corps. Our old systems satisfied a requirement to provide mobility options for heavy vehicles (i.e., tanks) and equipment across wet and dry gaps during sustained combat operations ashore. However, the divestment of bridging assets from the Marine Corps' inventory does not negate the requirement to provide deliberate gap crossing solutions to the force. The future may differ from today, but the current FMF vehicle inventory cannot cross a drainage ditch, let alone a natural or manmade gap.

Advancements in technology and environmental adaptation over time often shape the character of war; however, the nature of war will forever remain constant. One aspect of warfare remains undeniable; the FMF must retain the ability to generate tempo, maneuver space, and options as part of the naval campaign, afloat or ashore. We cannot accomplish this task without providing assured mobility within the seaward and inland objective areas. Today, many planners minimize the possibility of large-scale ground combat operations against peer competitors in the Marine Corps' future. Assailing their professional acumen is not the intent of this article. However, our last bloody engagement with the People's Republic of China included a gap crossing operations at the Funchilin Pass, which saved the 1st MarDiv, among all other units, from certain annihilation.[4] Are we willing to bet the lives of the Marines and Sailors living inside the weapons engagement zone against a determined foe who has a history of severing our ground lines of communication? The Marine Corps is one of the most historically conscious organizations in service today. We must create solutions to our tactical problems before we let history teach us a bitter lesson.

Notes

1. Gen David H. Berger, "The Case for Change Meeting the Principal Challenges Facing the Corps," *Marine Corps Gazette,* (Quantico, VA: June 2020).

2. Department of Defense, *Joint Publication 3-15: Barriers, Obstacles, and Mine Warfare for Joint Operations*, (Washington, DC: September 2016).

3. Headquarters Marine Corps, *MCWP 3-34, Engineering Operations*, (Washington, DC: May 2016).

4. Roy Appleman, *Escaping the Trap: The US Army X Corps in Northeast Korea, 1950*, (College Station, TX: Texas A&M University Press, 1990).

Energy Security

How MCLB Albany is optimizing the installation to support sustained operations

by Mr. Hubert "Ski" Smigelski

Marine Corps Logistics Base (MCLB) Albany's commitment to energy security has resulted in a more ready and mission-capable Marine Corps. With the vision "to lead the nation as the most energy-efficient and energy resilient customer-focused enabling platform for our Operational Forces," the base uses a multi-pronged strategy to accomplish its mission as a readiness enabler, focusing on: innovating uses of distributed energy generation to reduce reliance on a commercial grid, driving new cybersecurity and energy information strategies to provide secure and accurate energy data, and reducing energy costs through efficiency efforts and system improvements.

Leaning fully into the adoption, coordination, practice, and application of Marine Corps Policy Letter 9-19 and the three-pillar framework for energy security has led to significant progress in MCLB Albany's utility/energy security and sustainability. In Fiscal Year (FY) 2020, the installation reached its goal of covering all critical building energy loads in the event of an outage by increasing its sources of on-site generation. MCLB Albany completed an 8.5MW smart grid-enabled biomass steam-to-electric generator to complement 4.1MW from two dual landfill-methane/natural gas generators, 7MW of traditional backup generators, and a 31MW solar farm to support its regional outage priority. The generator project is an incredible asset in the installation's energy security portfolio that can cover a significant portion of the base's critical energy demand with a renewable-fueled generator in the event of a loss of main generation or commercial supply.

>Mr. Smigelski retired from federal service on 31 December 2021. At the time of his retirement, his civilian rank was GS-14.

In January 2017, MCLB Albany suffered severe infrastructure damage following a tornado, demonstrating the imperatives for energy security and resilience. *(Photo by Nathan Hanks.)*

Additionally, MCLB Albany benefits from its bore hole thermal energy storage systems (BTES). The BTES is a type of ground source heat pump, but rather than simple single-line wells that act more like a radiator, the system is comprised of a circular field of wells that perform more like a battery—removing heat in the warmer months and storing it for the cooler months. The BTES systems produce over 50 percent in electric utility savings and eliminated water cooling requirements. By the end of FY 2020, MCLB Albany had reduced both its energy use intensity by over 29 percent compared to FY 2015 baseline and potable water intensity by 55 percent compared to the 2007 baseline!

Through all these renewable energy projects, MCLB Albany will be the first DOD installation to reach energy net-zero. Net-zero means that 100 percent of the energy used has been produced on-site from renewable sources. This net-zero must occur over twelve months. MCLB Albany has easily clipped net-zero for nine months and is on target to be officially energy net-zero in February of 2022.

MCLB Albany has a Facilities Related Control (FRCS) pilot project in place to collect data from all current standalone systems into a central platform. This will enhance advanced aggregated data analytics, create a single source for all data and visibility requirements, and increase scalability while decreasing risk and vulnerabilities. Current capabilities include centralized monitoring and configuration of utilities and building automation controls, advanced analytics for energy and controls data, and alarm visibility from a map interface.

The FRCS pilot includes the integration of an artificial intelligence (AI) platform that will collect and aggregate

In 2021, MCLB Albany was one of two Marine Corps installations to receive the SECNAV Energy Excellence Award for outstanding contributions to energy security, new technology, innovation, and recognizing efficiency and progress toward energy resilience and self-sufficiency. *(Photo by Jennifer Parks.)*

data, create baselines for normal behavior, and detect anomalies for both preventative and predictive maintenance. Preventative maintenance is often based on hours of operation or simply length of time, requiring hundreds of manhours to change out parts that often still have substantial service life. In the face of declining budgets and shrinking manpower, the Installation & Environment Division personnel decided to start looking at both facility and equipment maintenance through a different glass. If there was a way to predict component or system failure before it happened and maintenance could then be performed, many shutdowns could likely be averted. MCLB Albany predictive analysis allows MCLB Albany to transition from routinely scheduled maintenance to maintenance when necessary, reducing labor and material costs, and strengthening production security.

The biggest challenge in setting up a system of sensors and controls that will communicate across the Marine Corps network is ensuring that all devices, connections, and communication data can be certified as safe and protected. This initially required obtaining an Interim Authority to Test. The Interim Authority to Test is a recognition from the authorizing official that we can test the system for one year. If the project shows that this should be a permanent solution, we will validate the system for controls and security implementations. We have already created a System Security Plan. If the decision is to make this permanent, then the request would be submitted to obtain an Authority to Operate the system on the Marine Corps Network.

Preventative maintenance is often based on hours of operation or simply length of time, requiring hundreds of manhours to change out parts that often still have substantial service life.

The base is currently engaged in adding sensors and controllers for Production Plant Albany's (PPA) blast booth. This new system will send the data collected to the artificial intelligence platform for analytics of equipment conditions. The ability to detect anomalies (reduced airflows, significant pressure changes, equipment vibrations, etc.) will give us a better picture of how the equipment is performing and when certain components may need to be evaluated for maintenance. We predict that this will drastically increase equipment availability and efficiency.

MCLB Albany will conduct Business Case Analysis and Return on Investment studies at the conclusion of the project. The outcome(s) will be provided to MCICOM for determination of solution implementation across the Marine Corp Enterprise. Additionally, the Installation and Environment Division will coordinate with PPA to explore further possibilities for integrating operational equipment into the FRCS program.

MCLB Albany is exploring options for phase II of the FRCS pilot, which will integrate additional facilities and production equipment—such as other PPA paint booths (two) and remaining blast booths (four), Geothermal system, and Methane Landfill Gas generators—and will integrate the call for specific system or component maintenance automatically into the USMCMax Work Order generation system.

These initiatives have proven extremely fruitful so far and are ensuring long-term sustainability while saving resources for other critical warfighting needs. Ensuring that facilities, production equipment, and personnel have a redundant and reliable source of power, and that we are securing this through the use of renewable energy sources will be a model for other DOD installations. Indeed, much of our approach has always been to include scalability in the designs, so that the applications could be shared with other installations, creating additional resiliency, and saving additional resources.

An Untethered MLR

Supporting Stand-in Forces

by Col Omar J. Randall

"Unleash us from the tether of fuel."[1]
—Gen James Mattis, former Secretary of Defense

>Col Randall is currently assigned as the Futures Branch Head at HQMC, DC I&L. He recently completed a tour in Okinawa, Japan, with 3d MEB, 3rd MarDiv, and CLR-37, 3d MLG. This article was written with contributions from the SAFE concept development team and Erik Limpaecher of MIT Lincoln Laboratory and the Marine Corps Krulak Center for Future War.

The 2030 Marine Littoral Regiment (MLR) construct creates an opportunity for the Marine Corps to incorporate alternative energy sources and demand reduction technologies to break the tether of fossil fuels and offer a more sustainable force to the joint and naval commander. The MLR is a future force designed to persist within an adversary's weapons engagement zone to conduct expeditionary advanced base operations in support of fleet and joint operations.[2] As a Stand-in Force, MLRs are envisioned to be mobile, low signature, and relatively easy to maintain and sustain.[3] They embrace demand reduction and sustainment redundancy concepts to mitigate supply line disruption and extend persistence.[4] By design, MLR's can enable aviation operations; however, they do not contain manned aviation organically—eliminating the most demanding consumers of fossil fuels—jets, cargo transports, and tilt/rotary wing aircraft.[5] Moreover, MLRs are planned to be fully operationally capable in 2030 and beyond. This implementation timeline creates sufficient time and decision space to test, evaluate, and integrate alternative energy technologies into the MLR.

The Marine Corps acknowledges this opportunity in their *Concept for Stand-in Forces*,

> Sustainment that does take place inside the contested area requires new approaches to existing techniques and the development of new capabilities, including the following: Demand reduction across the life-cycle of Stand-in Forces, from their design to their employment. For example, including design features like hybrid-electric or fully electric vehicles can reduce future fuel requirements, while focused training on supply discipline best-practices can reduce demand in the near-term.[6]

The Operational Imperative

The *Concept for Stand-in Forces* is prescient in this area. The military must reduce their reliance on fossil fuel to persist in contested spaces against a peer adversary or strategic competitor. The fossil fuel supply chain requires a distribution network of defense fuel supply depots, pipelines, trucks, and tanker ships whose signature creates a lucrative target (Figure 1). Host nation fuel sources are equally vulnerable. Russia's severing of the Ukrainian gas supply in 2009 in retaliation for courting NATO and China's cyberattack on the Indian power grid in 2020 over border clashes should be concerning, given that DOD purchased 48 percent of its fuel from outside the United States in fiscal year 2020.[7] According to a Defense Science Board report on energy systems, "the logistics supply chain to sustain deliveries of energy to remote, forward, and expeditionary sites is an attractive target to an adversary and a burden on our military capabilities to provide effective protection."[8]

The forecasted energy demand of future weapons systems and dispersion of friendly forces will compound this vulnerability. Advanced military platforms tend to drive higher overall energy requirements, which increase demand on the fuel supply chain.[9] A study by the National Academy of Sciences projects that energy requirements

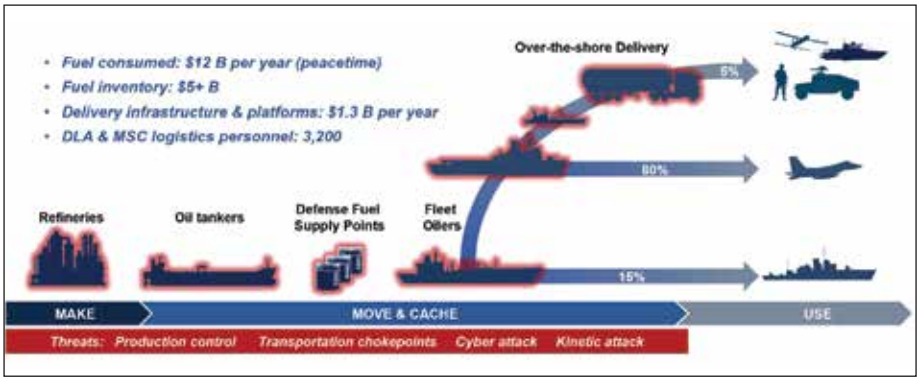


Figure 1. The DOD's global petroleum fuel supply system is expansive and targetable. ***(Figure provided by author.)***

for multi-domain operations will increase 37 percent by 2027.[10] Greater unit dispersion to mitigate adversary targeting also increases fuel distribution requirements because of losses in transportation efficiencies. Given these trends, military forces intended to operate in contested areas must address the fossil fuel tether or risk being the most advanced yet least sustainable force.

Possible MLR Alternative Energy Configurations

Electric Energy. An electric MLR using all battery-electric technology reduces the tactical distribution vulnerabilities created by moving bulk fuel while lowering thermal and acoustic signatures. However, expanding this technology beyond computers and light vehicles presents two significant challenges: recharging power and recharging time. Recharging a battery-electric JLTV in 15 minutes would require a 2.6 MW power source.[11] That is the power consumed by 800 American homes. This type of infrastructure requirement means that battery-electric technology is not practical enough on a large scale in an expeditionary environment and is likely not well suited for a highly mobile force such as an MLR.[12]

A hybrid-electric MLR would be better than all-electric; it captures the fuel and signature reduction benefits of an all-electric approach while avoiding many drawbacks. Hybrid electric technology relies on a fossil fuel powered engine combined with regenerative braking to charge the vehicle's battery. Hybridization obviates the massive recharging requirements found in all battery electric vehicles. Research shows that for both vehicles and command operations centers hybridization can reduce fuel consumption by 40–60 percent.[13] However, hybridization still requires fossil fuel at the tactical edge, which does not entirely untether the MLR from the supply chain.

Go Nuclear

Portable micro nuclear reactors would represent a significant technological leap in sustaining the MLR. Recent developments in nuclear technology have made micro reactor designs much safer and on a smaller scale. Former SpaceX engineers at Radiant raised $1.2 million to develop the first portable nuclear zero-emissions power source. Radiant claims its micro reactor can operate up to eight years without refueling, power the equivalent of 1,000 homes, and fit into a shipping container (Figure 2).[14] NASA's KRUSTY (Kilopower Reactor Using Stirling Technology) micro reactor was designed to power Mars and lunar missions (Figure 3). In 2018, the smaller KRUSTY reactor demonstrated the ability to produce 4kWt in 1.5 hours.[15] While micro rector technology is promising, it becomes limited when applied to environments where the force must be highly mobile and

Figure 2. Information available at radiant.com. *(Figure provided by author.)*

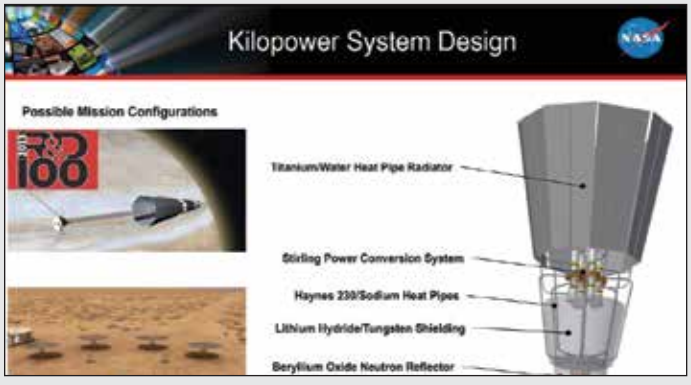


Figure 3. KRUSTY design and mission configuration. (Information available at: https://www.nasa.gov.) *(Figure provided by author.)*

Figure 4. Holos micro reactor onboard a flatbed. The Holos microreactor can be scaled from a minimum of three MWe to a maximum of thirteen MWe for Holos Quad generators and comprised within a single transport container. The Air Force intends to field a similar prototype micro nuclear reactor at Eielson AFB, AK, by 2027 to allow that remote site to reduce reliance on coal.[17] (Information available at Image Forbes.com and holosgen.com.) *(Figure provided by author.)*

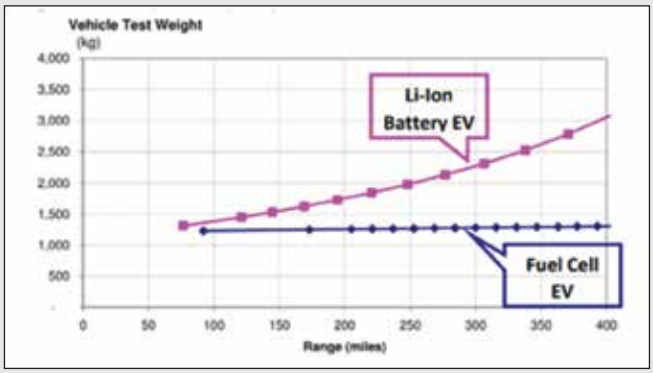


Figure 5. Weight of electric vehicles powered by lithium-ion batteries versus hydrogen tanks and hydrogen fuel cells. (Source: Presentation by Aristeidis Tsakiris Copenhagen Centre on Energy Efficiency [C2E2], available at https://c2e2.unepdtu.org.). (Figure provided by author.)

A MLR equipped with hydrogen-powered platforms could fill the gaps in areas that all-electric, hybrid, and nuclear configurations fall short.

low signature. Designs similar to Radiant and Holos (Figure 4 on previous page) will require some form of material handling equipment, and even at 6.5m tall, NASA's KRUSTY displaced up to 800C of heat.[16]

Enter Hydrogen: Future Fuel Used Successfully in Past Combat Operations

A MLR equipped with hydrogen-powered platforms could fill the gaps in areas that all-electric, hybrid, and nuclear configurations fall short. Hydrogen-powered platforms use electrochemical fuel cells, which convert hydrogen gas and atmospheric oxygen into electric power. Hydrogen's energy density allows it to provide power at ranges comparable to battery-electric without adding more weight (Figure 5). More importantly, hydrogen refueling times are similar to fossil fuel vehicles enabling rapid resupply.[18] Another key advantage of hydrogen is its ability to

Figure 6. The ZH2 is a hydrogen-powered vehicle undergoing user evaluation in Hawaii with 25th Infantry Division. (Information available at https://www.army.mil). (Figure provided by author.)

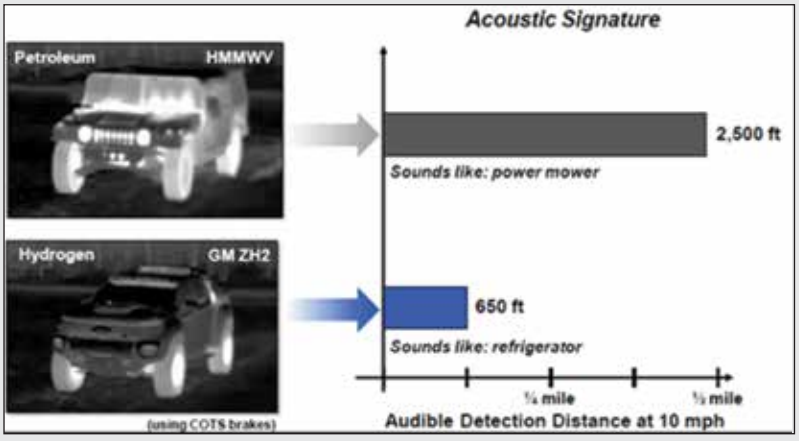


Figure 6.1. Signatures of a combustion engine vs. hydrogen fuel cell vehicle. (Courtesy of MIT Lincoln Laboratory, based on data from Kevin Centeck, Army Ground Vehicle Systems Center.) (Figure provided by author.)

be produced from multiple feedstocks. This advantage creates redundancy for the MLR in sourcing their fuel and improves supply chain resiliency in contested spaces.

Hydrogen use in the military is not new. The Army Air Service used tens of millions of cubic feet of hydrogen fuel safely in aviation operations for artillery spotting and surveillance during the First World War.[19] In the Second World War, the Army produced its hydrogen in the field using small chemical plants on four-wheeled vehicles.[20] In January 2017, the Army began official testing the Chevy Colorado ZH2, a vehicle powered by hydrogen gas; it has a low thermal and acoustic signature, can power a squadron level tactical operations center, and produces potable water as a byproduct of hydrogen production (Figure 6).[21] Today, multiple high endurance unmanned aerial systems use hydrogen, and the Defense Logistics Agency supplies four national stock numbers of hydrogen to the Services.

The primary limitation for hydrogen is that it is bulky to store as a compressed gas and is energy-intensive to produce in the field. Although hydrogen is the most abundant element in the universe, it is rare in its pure form (H_2). It must be separated from other molecules such as water (H_2O), methane (CH_4), or more complex hydrocarbons. Steam methane reforming and electrolysis are the most common means of producing pure hydrogen.[22] The steam methane reforming process is a byproduct of natural gas production, and electrolysis uses an electric current from another energy source to split water into hydrogen and oxygen.[23] The resource intensity needed to produce hydrogen means it is typically done at industrial sites, and it is often compressed or liquefied for transport via pipeline or truck.

MIT's Lincoln Laboratory researchers have developed a methodology to produce hydrogen using scrap aluminum and seawater. They found that by pre-treating the aluminum with gallium and indium, they could create the conditions for the "activated" aluminum to react with water. The reaction rapidly produces large quantities of hydrogen, which can be used on-demand or captured and compressed for use in hydrogen-fueled platforms.[24]

A group of Marine enlisted and officers—infantry, logisticians, and concept developers at MCWL—worked with MIT's Lincoln Laboratory researchers to incorporate this method into their Secure Alternate Fuel Environment (SAFE) concept for operational energy.[25] This concept uses cached activated aluminum by units in highly contested areas to self-supply their hydrogen fuel and proposes using hydrogen procured from regional allies during peacetime and in less-contested areas.[26] The SAFE concept could be a game-changer for Stand-in Forces such as the MLR as it avoids the tactical distribution vulnerabilities of fossil fuels without compromising mobility (Figure 7 on following page).

Field tests with Marines capturing aluminum-derived hydrogen have demonstrated viability in austere environments.[27] By incorporating hydrogen-fueled platforms into the MLR, Marines at expeditionary advance bases throughout the Pacific could produce or receive hydrogen fuel from countless sources: Australian coal gasification, Malaysian natural gas, or aluminum scavenged from a junkyard in the Philippines. Of note, Japan has recently announced its intention to build the world's first full-scale hydrogen supply chain by 2030.[28] Such a diversity of fuel feedstock near

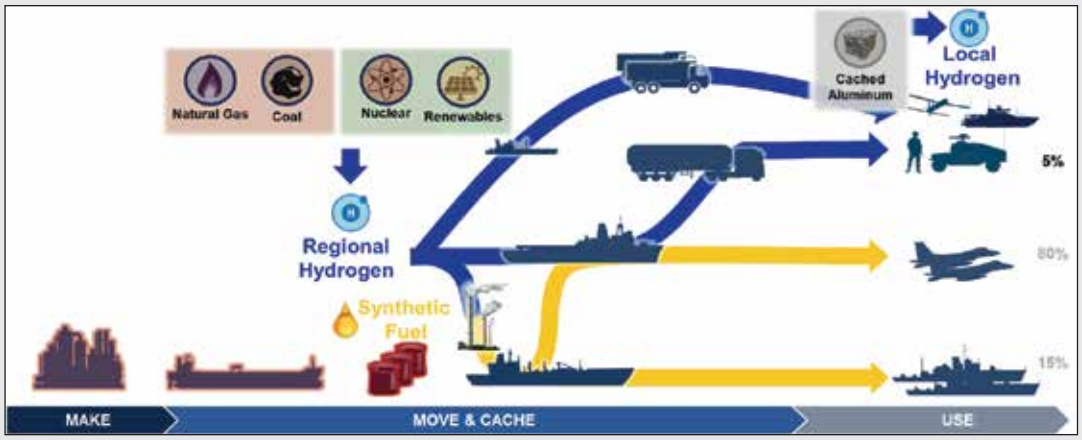


Figure 7. Beyond Tactical Applications: Overview of the Secure Alternate Fuel Environment (SAFE) operational energy concept for DOD contested fuel logistics. *(Figure provided by author.)*

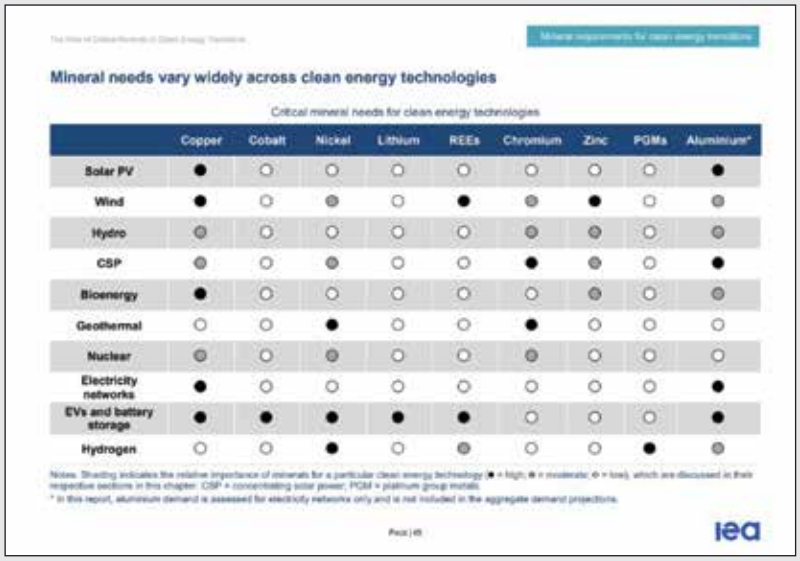


Figure 8. The Role of Critical Minerals in Clean Energy Transitions, IEA, Paris. (Information available at https://www.iea.org.) *(Figure provided by author.)*

their point-of-use would dramatically complicate the targeting of fuel supply lines and create redundancy for the MLR.[29]

Risk Assessment

Military planners must acknowledge near-term strategic logistics risks before adopting alternative energy sources and demand reduction technology. Today, we do not have complete control of the technology's supply chain. Batteries, specifically rechargeable batteries, are vital for most alternative energy technology. According to the International Energy Agency, "China is the world leader for battery manufacturing, accounting for around 70 percent of global capacity, followed by the United States (13 percent), Korea (7 percent), Europe (4 percent) and Japan (3 percent)."[30] Alternate energy technology also requires varying amounts of precious minerals not entirely produced by the United States. (Figure 8, 8.1 on following page). The Nuclear Infrastructure Council has also expressed concerns with obtaining sufficient domestic high assay low enriched uranium to fuel micro nuclear reactors.[31]

These near-term strategic logistics risks should not preclude implementation for a future force. The growing international demand for carbon-reducing technologies combined with Allied efforts to control their supply chains will sufficiently diversify production and prevent a single state monopoly over the next two decades. Nearly 130 countries, including the United States, have set net zero emission targets by 2050.[32] (Figure 8.3 on following page) This global demand will necessitate opening new mines globally and spur supply chain protections. In June 2020, the White House announced that it would leverage $17 billion in loan authority to support the domestic battery supply chain.[33] The Department of Energy and its national labs are already proposing interim means to address the high assay low enriched uranium supply chain by "downblending" used nuclear fuel from government-owned reactors.[34]

Historical precedent supports this assessment. Salt was a strategic mineral before the advent of the refrigerator.[35] Coal was a strategic resource in the era of steamships. As a result of scarcity concerns, world governments took steps to diversify production and protect their supply chains. Today, salt and coal are among the most attainable resources globally.

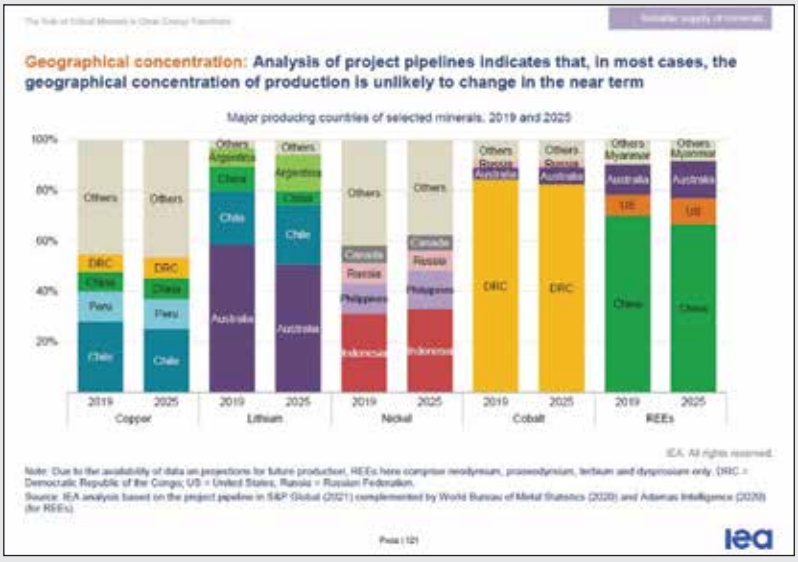


Figure 8.1. The Role of Critical Minerals in Clean Energy Transitions, IEA, Paris. (Information available at https://www.iea.org.) *(Figure provided by author.)*

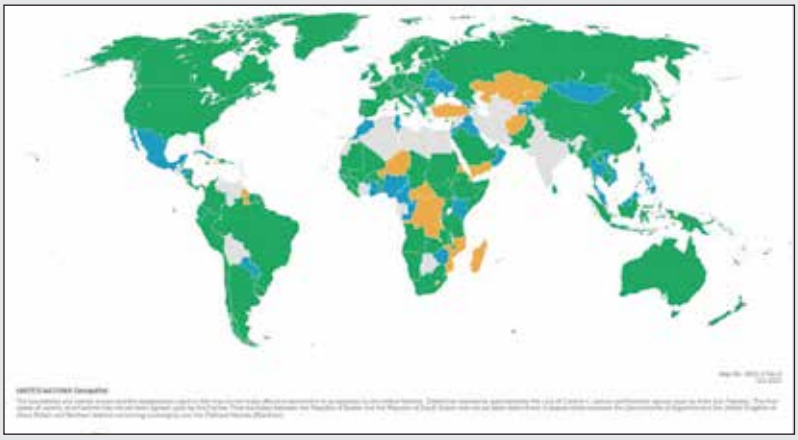


Figure 8.2. Countries with Net Zero Commitments. (Information available at https://www.un.org.) *(Figure provided by author.)*

What Is the Best Choice for the Marine Littoral Regiment?

Diversification. MLRs should employ multiple alternate energy sources to untether from fossil fuel and increase sustainability. MLRs could use electric, hydrogen, and nuclear technologies without compromising mobility, signature, or lethality. Small battery-electric powertrains could power MLR C2 and ultra-light platforms (e.g. sensors and ULTVs) that have reasonable recharging requirements. At the same time, aluminum-reacted hydrogen fuel could be used for medium and heavy platforms that require long endurance, larger payloads, and short refueling times, such as tactical vehicles, generators, heavy equipment, and unmanned aerial systems. As described in the SAFE concept, activated aluminum feedstock could be cached or airdropped to remote EABs to serve as forward fuel. Micro nuclear power may not be a good fit inside the MLR. However, it might be used in a supporting role such as bringing online new advanced naval bases, restarting bases after an attack, or powering mobile electrolysis farms supplying hydrogen or its derived synthetic fuel to the MLR from lesser contested spaces.

The timing is right for the Marine Corps to untether from fossil fuel.

The timing is right for the Marine Corps to untether from fossil fuel. The recent advances in alternative energy sources and demand reduction technology are creating an early window of opportunity for low signature, mobile, non-aviation intensive formations like the MLR. Through continued research and experimentation, the Service should explore incorporating these technologies into the MLR and other Stand-in Forces, knowing that global demand and allied efforts will buy down near-term risks associated with the alternative energy supply chain.

Notes

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3. Gen David H. Berger, "A Concept for Stand-in Forces," *U.S. Naval Institute Proceedings*, (November 2021), available at https://www.usni.org.

4. Department of the Navy, *A Concept for Stand-in Forces*, (Washington DC: December 2021).

5. *Tentative Manual for Expeditionary Advanced Base Operations*.

6. *A Concept for Stand-in Forces.*

7. Donghu Park, Michael Walstrom, "Cyberattack on Critical Infrastructure: Russia and the Ukrainian Power Grid Attacks," University of Washington, (October 2017), available at https://jsis.washington.edu; Inskit Group, "China-Linked Group RedEcho Targets the Indian Power Sector Amid Heightened Border Tensions," *Recorded Future,* (February 2021), available at https://www.recordedfuture.com; and Department of Defense, *FY20 Operational Energy Annual Report*, (Washington, DC: May 2021).

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10. Staff, *Powering the U.S. Army of the Future,* (Washington, DC: National Academies of Sciences, Engineering, and Medicine, 2021).

11. Ibid.

12. Ibid.

13. Staff, *Technical Report TR-1181, Tactical Power Systems Study*, (Hanscom Air Force Base, MA: MIT Lincoln Laboratory, 2014).

14. Information available at https://www.radiantnuclear.com.

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19. Donald Bishop and Dr. Erik Limpaecher, "Looking Back from the Age of ISR: U.S. Observation Balloons in the First World War," *Air Power History*, (Fall 2021), available at https://www.afhistory.org.

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21. Mr. Jerome Aliotta, "U.S. Army TARDEC Demos ZH2 Fuel Cell Vehicle at Schofield with 25th Infantry," U.S. Army, (February 2018), available at https://www.army.mil.

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24. Nancy W. Stauffer, "Using Aluminum and Water to Make Clean Hydrogen Fuel—When and Where It's Needed," *MITEI Energy Futures*, (May 2021), available at https://energy.mit.edu.

25. These "Lethal Luminaries" were key contributors to the SAFE concept: Maj Jake Clayton, Maj Doug Baker, Capt Walker Mills, MGySgt Beau Hornsby, GySgt Justin Leibach, LtCol Nate Knowles, Maj Heather Ichord, Col Matt Swindle, Maj Aaron Stone, Capt David Lorio, Maj Greg Lewis, Capt Matt Evers, LtCol (Ret) Gary Lehmann, Col (Ret) Art Corbett.

26. Walker Mills and Dr. Erik Limpaecher, "Need Fuel? Marines Should Make Moonshine Hydrogen," *U.S. Naval Institute Proceedings*, (November 2021), available at https://www.usni.org; and Dr. Erik Limpaecher, "Fuel for Contested Logistics: Secure Alternate Fuel Environment (SAFE) Concept," (November 2021), available at https://nps.edu.

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Today's Naval Supply Chain

Sourcing and distribution options for near-term conflicts

by Majs Alexander Irion & Robert Callison

Decades of counterinsurgency operations with uncontested air, land, and sea dominance left Marine Corps logistics operations lacking flexible supply chains necessary to counter credible near-term threats within the Indo-Pacific Command (INDOPACOM) Area of Responsibility (AOR). Timeframe analysis of near-term Pacific-theater threats, coupled with recent Chinese "[near-] Sputnik moment" hypersonic weapons tests, emphasize the immediate importance of United States' readiness and posture over robust modernization and changes to force structure and warfighting concepts.[1]

The naval force must continue to analyze and anticipate the future operational environment, but today it must prioritize the restructuring of its existing supply chain architecture. Today's naval supply chain must generate options in sourcing and distribution utilizing existing systems, capabilities, and resources to move needed resources to the point of need in support of joint-driven and threat-informed concepts of logistics.

Coming from the sea removes the luxury of deploying friendly forces from a relatively secure environment. In other words, operations conducted in impermissible environments impact logistical support options provided to joint forcible entry operations. Contested spaces necessitate the establishment of "tail end" supply chains in unestablished and remote locations not controlled by the naval force and not supported by an existing distribution architecture.[2] Current Marine Corps logistics operations are too predictable and vulnerable, and massive ships at anchor will likely be the first targets in a modern or future conflict.[3] As a result, U.S. naval force logistics plans in the INDOPACOM AOR must provide more flexible supply chain optionality, utilizing forward basing and resourcing supported by partnered nations, joint embarked platforms, and friendly bases within the region.

>Maj Irion is the Deputy Officer in Charge of the Field Supply and Maintenance Analysis Office-Western Pacific.

>>Maj Callison is the Deputy Assistant Chief of Staff G-6, 1st MAW.

If the naval force were to face a conflict within the next two years, the challenge becomes posturing existing capabilities that enable sourcing and distribution to the point of need to sustain the fight in an increasingly dispersed and dynamic environment.[4] In a near-term contested and primarily distributed maritime domain, naval logistics support must be capable of interfacing with embarked platforms, established distribution nodes, and remote landbased locations. Success in this environment will require sourcing and distribution methods that enhance existing systems and enable resource utilization within the naval supply chain.

Fortunately, there are three things the Marine Corps can do now to diversify current logistics operations, enhance optionality to the existing supply chain and its capabilities, and counter adversary-imposed disruptions to its sourcing and distribution design. First, the Marine Corps can overcome predictability and enhance optionality in end-to-end supply chain planning through diversified distribution; second, they can optimize the use of existing Global Combat Support Systems-Marine Corps (GCSS-MC) data resources; and third, they can augment traditional procurement methods with non-traditional procurement and requisitioning systems outside GCSS-MC.

Overcoming Predictability Through Diversified Distribution

Success in the near-term environment means taking into account current naval force sourcing logic based on anticipated resource laydown between landbased and embarked platforms. This requires enhancing near-realtime implicit communication—at the point of sale between supporting and supported agencies—to accurately capture the appropriate distribution medium to support transportation of goods from originating destination to the point of need. The Marine Corps' current single-sourcing strategies limit options to support from, and distribute to, established adjacent units and remote locations. Limiting the ability to source from and ship to allied and partnered nations—or to remote and unestablished locations—makes contingent distribution networks difficult to establish and maintain. Studies of global supply chain disruptions emphasize the importance of dual or triple-sourcing strategies when the probability of a disruption in distribution is high, and as of this writing, the likelihood of a disruption to the naval force's distribution design is high.[5]

Analyses of credible threats to U.S. logistics show an aim to disrupt U.S. logistics systems by focusing on

U.S. Transportation Command (USTRANSCOM) capabilities by employing a system called paralysis warfare. Between 2012 and 2013, Chinese military hackers were able to "compromise the networks of a series of TRANSCOM contractors more than [twenty] times."[6] Combined with weaknesses in private sector and commercial U.S. supply chains, this reality highlighted the potential consequences of adversary-induced disruptions to the capabilities of the near-term DOD supply chain: overwhelmed industrial ports, platform vessel congestion, and the impact of natural disasters and pandemics to the movement of goods through a complex international distribution network.[7]

Over the last decade, Chinese realization of weaknesses within their logistics system strengthened their supply chain in the INDOPACOM region while shaping near-term People's Liberation Army (PLA) concepts to disrupt U.S. logistics. Internally, the PLA strengthened logistics base utilization and replenishment from commercial vessels to overcome weaknesses in self-sustainment.[8] Externally, they concentrated on information dominance efforts "focused on attacking C4ISR infrastructure" to emphasize the importance of degrading U.S. networks and supply chain capabilities central to their strategy. Combined, this demonstrates how a conflict in the First Island Chain would complicate U.S. logistics efforts while simplifying China's supply chain, enhancing the tyranny of distance.[9] Moreover, because around 90 percent of TRANSCOM transaction data is open source, this necessitates that the Marine Corps must emphasize flexibility in the near-term to deliberately avoid adversary-imposed choke points while moving supplies from destinations to the point of need.

Deliberately avoiding adversary-imposed choke points in the existing distribution architecture requires a secure and flexible global logistics operating model. This is a tough balancing act when considering that a predictable supply chain is efficient for competition yet weak in rapid transitions to conflict without ballooning resource requirements. From 2020–2021, the 31st MEU conducted embarked experimentation in a theorized global logistics operating model nested in concepts from the *National Defense Strategy's* global operating model. They showed how integrating existing naval procurement and distribution systems with allied and partner systems can be used to support known and contingency sourcing and requisitioning requirements. Capitalizing on approved decision support tools—to include Integrated Data Environment & Global Transportation Network Convergence (IGC), the Navy requisitioning system Relational Supply (R-Supply), and DOD Address Activity Directory (DODAAD)—the 31st MEU created flexibility in how it sourced and distributed high-priority repair parts. As theorized in *Sustaining the Force in the 21st Century,* this demonstrated how the Marine Corps can currently enable global logistics awareness and diversify distribution to create flexibility in disruptive conditions without levying additional coordination requirements outside established supply and distribution networks. To simulate high-priority requisitions in disruptive conditions, the 31st MEU successfully transported materiel from traditional and wholesale sources of supply to non-traditional distribution nodes, Defense Logistics Agency (DLA) distribution nodes, and "ship-to only DODAACs."[10]

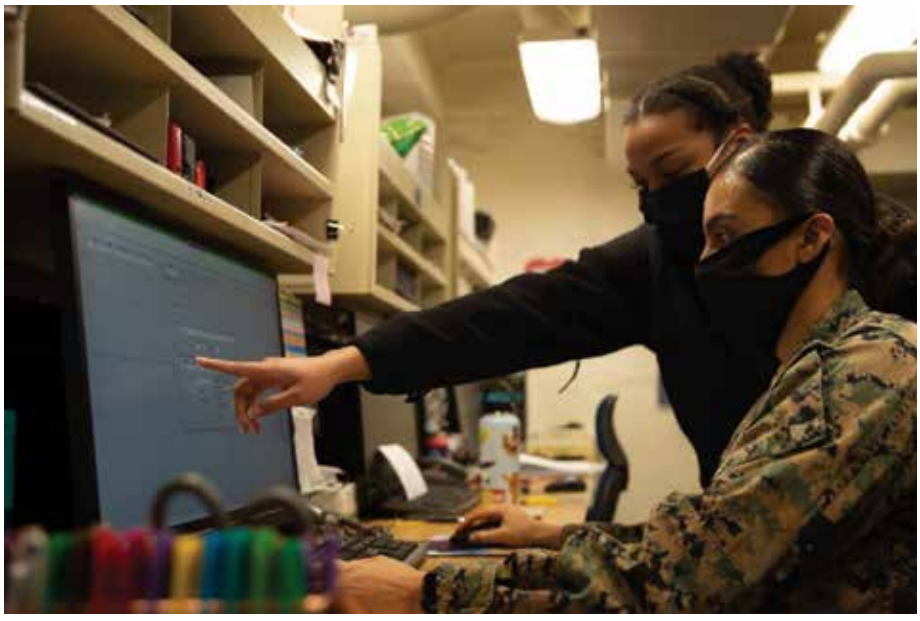
Non-traditional sourcing and distribution methods afforded by existing GCSS-MC functionality can support optionality in how supplies are moved. And using implicit communication resident to existing requisitioning systems allows the Marine Corps to achieve mass in positions not anticipated by the enemy. In its experiments, the 31st MEU integrated existing distribution architecture systems across the Naval Services in coordination with allies and partners, by creating requisitions utilizing signal code J within GCSS-MC.[11]

The GCSS-MC-supported signal code J affords the use of existing in-theater and co-located DOD Activity Address Codes (DODAAC) as non-traditional distribution backboards. Shipments pointed at non-organic destinations is one method to reduce supply chain predictability and expands optionality for how the Marine Corps directs materiel shipments from sources of supply to their final destination. Using non-traditional distribution backboards enabled by standardized signal code J functions augments the Marine Corps' current single-sourcing strategies with a more flexible distribution network. Additionally, it enhances the potential to source from and ship to allied and partner nations without levying additional external coordination requirements, like emails, phone calls, and other means of communication. This makes contingency sourcing and distribution networks easier to establish and maintain while making end-to-end supply chains less predictable and able to anticipate.

Shipments to Non-Traditional Distribution Nodes

In its 2021 experiments, the 31st MEU shipped 40 test requisitions from the 3d MLG Supply Management Unit and DLA to non-traditional distribution nodes, testing implicit communication and functionality between sources of supply and USTRANSCOM distribution assets. The non-traditional distribution nodes were Navy-owned R-DODAACs and Marine Corps-owned "ship-to-only DODAACs," with the desired outcome to evenly ship requisitions to USS AMERICA Amphibious Ready Group platforms. Additionally, they sought to demonstrate how parts can be shipped from retail and wholesale sources of supply to more destinations than the requesting units' aligned shipping address. This will become more important to mitigate systems-external coordination requirements outside GCSS-MC, particularly as units disperse and repair parts are required in multiple locations.

In this test, 30 of the 40 requisitions were physically received on ship and accepted in GCSS-MC without levying additional administrative actions on the requesting unit. Five of the 40 requisitions were created from organic DODAACs and shipped to a "ship-to-freight address" in Iwakuni, and the remaining five items were shipped to a "ship-to-only" DODAAC attached to a 3d MLG Type of Address Code-



As Stand-in Forces disperse and repair parts are required in multiple locations, coordination requirements outside GCSS-MC will grow. *(Photo by Capt Brett Lazaroff.)*

2 address.[12] All 40 requisitions were physically received by the embarked 31st MEU via PMC and RAS, and virtually accepted in GCSS-MC.

As anticipated, requisitions shipped to "ship-to-freight addresses" were successful but were administratively burdensome to the requesting unit. Because the test requisitions used a non-31st MEU Marine DODAAC, the "ship-to" DODAAC's unit was required to accept the requesting unit's items in GCSS-MC. Once received, the "ship-to" DODAAC's unit had to materially redistribute parts to capture proper physical receipting procedures and to support visibility of follow-on maintenance requirements.[13] This administrative step is not required for Marine Corps units shipping GCSS-MC requisitions to Navy DODAACs or Marine Corps "ship-to only" DODAACs.

Requisitions shipped to Navy DODAACs and Marine Corps "ship-to only" DODAACs were successful and did not require additional administrative requirements, as the parts were accepted in GCSS-MC by the requesting unit to support visibility of follow-on maintenance requirements. The Marine Corps can create "ship-to only" DODAACs to create distribution backboards throughout its areas of operations to support known and contingency requirements. This can create redundancy and survivability in the Marine Corps' sourcing methods while supporting flexibility in how deployed units distribute priority material to supported commodities in remote and non-established locations.

DLA Distribution Centers

Predictable end-to-end supply chains, particularly in impermissible environments, can have a negative impact on support to the MAGTF and other force employment options if observed and exploited by adversary forces. Layering redundant distribution architecture on the battlespace by using approved partnered and collocated DODAACs as "ship-to" addresses can be utilized today to mitigate disruptions when the probability of a disruption in distribution is high.

Additional 31st MEU tests to diversify distribution included requisitions created by organic DODAACs, sourced from CONUS and OCONUS DLA nodes, and shipped to DLA Distribution Centers within the INDOPACOM AOR. With coordination through the III MEF Logistics Systems Coordination Office and the GCSS-MC System Integration Team, test documents were created in GCSS-MC by the 31st MEU to validate functionality of DLA distribution hubs as contingent receiving nodes for organic units. Subsequent tests were successful in demonstrating that DLA distribution hubs can be used as in theater backboards to diversify the use of "ship-to" addresses.

To reduce predictability and increase supply chain redundancy, future experimentation should include requisitions sourced from approved Demand Stocked Item (DSI) inventories; requisitions sourced from and shipped to Army, Navy, and Air Force commodities as non-traditional sources of supply and distribution backboards; re-evaluation of requisitions shipped to DLA Distribution Centers and alternate additional non-traditional distribution nodes; and forward positioning of prepositioned stocks using "ship-to-only" DODAACs. Additionally, training on the establishment of contingent supply chains and diversified methods of distribution using existing resources should be a training requirement for supply and distribution Marines—particularly for Marines serving a MEU, SPMAGTF, or intermediate supply activity.

Sourcing Diversification within GCSS-MC

The recently released U.S. Tri-Service Maritime Strategy, *Advantage at Sea*, and Gen Berger's *Commandant's Planning Guidance* orient the naval force toward strategic investments focused on addressing challenges in logistics. Today's naval force must leverage existing systems and tools while reinvigorating America's creativity and innovative spirit. To create an effective disruption-mitigation strategy for a contested logistics model, the Marine Corps must utilize capabilities within GCSS-MC to conduct online sourcing and distribution to counterpart DODAACs with lateral support from NATO and other mutual defense treaty allies.

Sub-optimal sourcing and requisitioning strategies—particularly in disruptive conditions—can negatively impact support to the modern MAGTF and to other future force employment options. With existing naval requisitioning systems, the Marine Corps can

effectively see all available repair parts in DOD-owned sources of supply. However, to create an effective disruption-mitigation strategy for a contested logistics model, the Marine Corps needs the ability to conduct online sourcing and requisitioning from counterpart DODAACs with lateral support from joint Service and other mutual defense treaty allies.

Studies of dynamic sourcing strategies in private sector contingencies show—despite an increase to price and inventory holdings—that availability of multiple suppliers increases potential to satisfy demands during disruptions.[14] While dynamic sourcing strategies may impose additional costs to the naval force, they must be considered because they may be required to support contingency operations during credible disruptions to U.S. logistics in the near-term. Existing systems like Navy Supply Systems Command's One Touch Support (OTS) and R-Supply, USTRANSCOM's IGC program, and DODAAD provide the necessary data to establish and optimize a global logistics operating model capable of supporting sourcing, requisitioning, and distribution of high-priority materiel via dynamic sourcing strategies.

In 2021, the 31st MEU demonstrated the use of non-traditional sourcing with DSIs and U.S. force SOS, testing dual-sourcing concepts to requisition repair parts from adjacent Marine Major Subordinate Command DSI inventories as non-traditional sources of supply through implicit GCSS-MC communication.[15] They also used existing decision support tools and non-traditional U.S. sources of supply to create redundancy to standard requisitioning systems. These efforts ensured options were available to source and requisition priority repair parts, which was demonstrated in the event of a GCSS-MC scheduled intermittent outage.

DSI Inventory

In-storage visibility of materiel by-location allows supported units to identify on-hand availability of contingency maintenance materiel from non-traditional (and geographically co-located) sources of supply, like DSI inventories. The 31st MEU used the USTRANSCOM IGC program to assess notional high-priority materiel total asset visibility and to test functionality of requisitioning process for non-organic DSI inventories within GCSS-MC, as non-traditional sources of supply. A total of five National Item Identification Numbers (NIINs) were sourced from a Marine Corps DODAAC using the "TAVNIIN" tool in IGC.[16] The five NIINs were requisitioned in GCSS-MC, coded for distribution to a Navy-organic supplementary address, and physically shipped to an embarked platform.

This GCSS-MC scheduled outage provided a "real-world" opportunity to experiment ...

The experiment tested the effectiveness of dual-sourcing strategies from Marine Corps DSIs while analyzing existing resources across the naval force. The 31st MEU identified five notional high-priority parts available for issue from traditional sources of supply like DLA and the III MEF Supply Management Unit in addition to a DSI inventory in the vicinity of Okinawa. Utilizing DODAAD, point-of-contact information was obtained for a Marine Corps DODAAC and identified as a non-traditional (and geographically co-located) source of supply for the notional high-priority test NIINs. The five parts were requested by the 31st MEU, virtually shipped in GCSS-MC by the owning unit in one workday, and physically shipped from Okinawa with support from III MEF Distribution Liaison Cells and commercial distribution means. All five parts arrived at a DLA distribution center co-located with the embarked requesting unit and were physically delivered to an embarked naval platform within two weeks from virtual request to physical receipt.

Single-sourcing strategies limit the Marine Corps' ability to construct contingent sourcing and distribution networks. However, existing systems, like the IGC program, provide the necessary data to establish a global logistics operating model capable of supporting sourcing and distribution of high-priority materiel. The 31st MEU's successful requisitioning experimentation from non-organic DSI inventories and non-traditional sources of supply demonstrates that dual and triple sourcing strategies exist within IGC and DODAAD. These options expand lateral support options from in-theater resources and can reduce customer wait time by expediting priority materiel to the point of need from non-traditional (and geographically co-located) sources of supply.

U.S. Forces

The combined use of IGC, DODAAD, and R-Supply enhances GCSS-MC capabilities and offers potential counters to adversary (and systems-outage induced) deterrence efforts by increasing redundancy in sourcing and requisitioning strategies for priority materiel. During a scheduled GCSS-MC outage, the 31st MEU used R-Supply to establish contingency supply chain networks through an adjacent U.S. force unit as a non-traditional source of supply co-located in Guam. This GCSS-MC scheduled outage provided a "real-world" opportunity to experiment with redundancy to standard requisitioning systems.

Priority-02 Supply Management Unit walkthroughs, emailed MILSTRIPs to DLA, and non-traditional U.S. Force sources of supply in Guam countered the aforementioned GCSS-MC outage, demonstrating how non-traditional (and geographically co-located) sources of supply can be used to expedite priority materiel to the point of need—even in the absence of GCSS-MC functionality. The test case of non-traditional sourcing and requisitioning strategies resulted in five days of customer wait time for four deadlining components of a deployed critical firing system chassis while the simultaneous control case used traditional sourcing and requisitioning strategies for the same parts, and the control case parts did not meet

required delivery dates—resulting in 38 days of customer wait time.

Sourcing Outside of GCSS-MC

"Advantage at Sea" provides guidance to the Naval Service to prevail across posited future conflicts in the next decade, highlighting the importance to "sustain forces while under continuous multi-domain attack" by prepositioning, distributing, and capitalizing on DOD budget requests to fund future logistics platforms.[17] While future logistics platforms may not support a near-term threat, augmenting traditional procurement methods with non-traditional procurement and requisitioning systems outside GCSS-MC is supportable by the Marine Corps today.

The publication, "DOD Supply Chain Materiel Management Procedures: Operational Requirements," directs DOD components to conduct demand and supply planning to optimize the use of supply chain resources to meet established support strategies, collaborate between supply support providers and their customers, and minimize total supply chain costs while meeting operational requirements. Demand and supply planning, as identified in the manual, optimizes the use of DOD supply chain resources by encouraging deliberate thought in the conduct of inventory sourcing decisions.

The Marine Corps' default single-sourcing strategies, shaped by DOD acquisitions and supplier management through DLA, make contingent sourcing and distribution networks difficult to establish and maintain. To optimize the use of DOD supply chain resources and diversity distribution, the Marine Corps must encourage deliberate thought in the conduct of inventory sourcing decisions. To support a near-term conflict, this may mean optimizing materiel sourcing performance and sourcing infrastructure management by utilizing systems outside of GCSS-MC, like Maintenance, Repair, and Operations (MRO), embarked naval sources of supply, and unique credit-card and cash capabilities.

MRO is one system available from DLA to augment traditional procurement methods with non-traditional procurement and requisitioning systems outside GCSS-MC. Through DLA Troop Support, MRO can be used as a non-traditional procurement vehicle for Class IV stocks. Marine Corps units with an MRO account can transfer funding via a Military Interdepartmental Purchase Request. In 2021, MRO was used to support the procurement of lumber and construction materials for Pacific-Theater Defense of the Amphibious Task Force construction projects by sourcing required materials, like hardware, paint, lumber, tools, and maintenance equipment, from local vendors in Guam and Hawaii. This augmented traditional procurement methods available with GCSS-MC and the Government Commercial Purchase Card program. Using third-party shipping afforded by the MRO program creates additional opportunity for last-tactical-mile considerations in lieu of unit-owned availability of supporting assets.

Embarked platforms and Navy requisitioning systems provide another means to source materiel using non-traditional Marine Corps means and to provide opportunities to develop demand signals for Marine-specific requirements aboard Navy platforms. The use of Navy requisitioning systems expands lateral support options from in-theater resources, increases redundancy in requisitioning systems during intermittent outages, and reduces customer wait time. The 31st MEU conducted procurement test actions for hundreds of Marine supply requests consisting of nearly 350 unique individual items sourced from Navy-owned stocks aboard embarked platforms. These requests were sourced with naval decision support tools prescribed in the 31st MEU Shipboard Supply Policy and requisitioned by Navy requisitioning systems like R-Supply and OTS, demonstrating how current-day Naval Logistics Integration tools enhance how materiel sourcing is performed. Forecasting to these centers can reduce redundant stockage of Class III, Class IV, and Class IX by utilizing embarked Naval Material Issue Centers as primary sources of supply; minimize customer wait time; and create cost savings to embarked Marine Corps units by reducing second-destination transportation charges. Buy-in from embarked MEUs to source materials from embarked Naval Material Issue Centers, instead of embarking redundant stocks, will relate directly to future Marine Corps cost savings and performance benefits including potentially freeing up organic Marine Corps connectors by having the Navy distribute as many Marine Corps requisitions as possible. By recognizing the Navy and Marine Corps have limited Class IX similarities in common, the naval force can begin to stock Marine Corps-specific equipment sets on Navy embarked platforms.

Further, Navy-owned stocks provide additional means to use serviceable on-hand materiel to the extent practicable, before procuring duplicate materiel through Marine Corps procurement channels. To support daily operations, the 31st MEU used pre-expensed materiel from the USS *AMERICA* Amphibious Ready Group Main Issue Divisions and HAZMAT Divisions, supporting operator-level maintenance. Because materiel was pre-expensed to the Navy, Marine requests for Class III in R-supply were free-issue and supported by Navy HAZMAT minimization centers. Access to and utilization of naval requisitioning systems preserved already-limited embarked container space, reduced redundant stockage of daily operational requirement material by embarked Marines, and generated a demand signal for storage of Marine-specific requirements within the Navy's embarked inventory.

Future experimentation to reduce predictability of the supply chain should include requisitioning supported by OTS and the use of unique credit card and cash capabilities. Foraging for fuel within existing systems like the OCONUS Mastercard Program and Field Ordering Officers can provide over-the-counter purchases in support of mission-essential requirements in austere environments.

Way Forward

During the counter insurgency fight of the last twenty years, the DOD was spoiled in its logistics operations. Units

fell in on existing and mature infrastructures with reliable air and ground capabilities to deliver resources to sustain the force. Even when contingent distribution operations were required, they were conducted without interruption, using a combination of commercial and tactical delivery assets.[18] The Marine Corps took hits, mainly through improvised explosive device attacks on main supply routes, but was consistently able to enable combat operations relatively unimpeded with significant supply deliveries.[19]

Today, and reflective of logistics concerns within the Pacific-theater, America's reliance on standard supply chains was exposed through the COVID-19 pandemic and costly cyberattacks, like the recent pipeline attack. Through the pandemic, it became clear that more than 70 percent of our pharmaceutical manufacturing sites are overseas, with about one third of them being in India and China.[20] These conflicts highlighted impacts of disruptions in distribution and have also exposed the potential for other crises to wreak havoc on the Marine Corps' current supply chain system. Though the Marine Corps does not rely as heavily on overseas sources like China or India, minor disruptions from these countries, another global pandemic, or adversary-induced disruptions could have strategic implications to the naval forces logistics operations.

Near-term support requires diversifying support hubs and analyzing how the Naval Force can jointly base, stage, and move support to the point of need not only to support friendly concepts of operations but also to deny adversary-imposed disruptions to the existing supply chain infrastructure. Furthermore, projecting military power through logistics requires U.S. Services to compile and identify high priority capability gaps in how they generate, maintain, and regenerate the force through deployed support in order to mitigate the risks and surge capabilities to the force. As major distribution disruptions continue to illuminate the need for diverse supply chains, the naval logistics team must continue to emphasize future force development while still maintaining a focus to transform the existing logistics needs of today. This focus should be regional, prioritizing INDOPACOM efforts, and shaping global logistics employment concepts and applying joint-driven and threat-informed concepts of logistics. The Marine Corps already has the ability, systems, and sources of supply to create a flexible and resilient supply chain. The key is to codify best practices, build relationships with joint and combined agencies, and continue to integrate systems to improve organic visibility and sourcing options.

Notes

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9. Patrick Hulme and Erik Gartzke, "The U.S. Military's Real Foe: The Tyranny of Distance," *1945,* (January 2021), available at https://www.19fortyfive.com.

10. Traditional sources of supply were the Supply Management Unit, 3d Supply Battalion. Wholesale sources of Supply were DLA, shipped from CONUS and OCONUS locations

11. A signal code used in GCSS-MC to indicate "bill to requisitioner, ship to supplementary address."

12. A ship-to freight address is equivalent to an adjacent unit's organic DODAAC. The "ship-to only" DODAAC utilized for this task is owned by 3d Supply Battalion with the intent of shipping Meals, Ready to Eat from Rations Platoon to support Okinawa-based Marines in Iwakuni.

13. CLC 36's intermediate Class IX Block is a subordinate element of 3d Supply Battalion.

14. Shanshan Li, Yong He, Li Zhou, "Dynamic Sourcing Strategies for Supply Disruptions under Consumer Stockpiling," *Complex and Intelligent Systems,* (New York, NY: Springer, September 2021); and Chung-Chi Hsieh and Hung-Lin Chang, "Sourcing with Recycled Materials: A Contingent Sourcing Model with Supply Unavailability and Setup Time Uncertainty for Ripple Effect Mitigation," *International Journal of Production Research,* (Milton Park: Taylor and Francis, September 2020).

15. Parts were physically shipped from Okinawa to embarked Naval vessels.

16. The "TAVNIIN" tool within IGC provides DOD-wide in-storage visibility of materiel by location.

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The MSSLG

A hybrid LCE for the future

by Maj Russell W. Parker

The current MLG structure for the MEF is failing to maintain the personnel and equipment readiness necessary to support future Marine Corps operations. The MLG has been effective for the past two decades during both wars in Iraq and Afghanistan. Those wars have since ended and so has the operational commitment, including the applicability of the current MLG structure. The MLG is not capable of sustaining the current Theatre Security Cooperation, Special Purpose MAGTFs (SPMAGTF) missions, MEU deployments, or garrison operations without a great risk to readiness, personnel management, and the success of the MAGTF. BGen Ottignon and Maj Jordan recognize this failure of the current MLG structure in their *Gazette* article "More Tooth, Less Tail," "Force structure decisions over the last 25 years have resulted in a Logistics Combat Element (LCE) with less capacity to meet the needs of an evolving MAGTF."[1] These demands of the evolving MAGTF require an LCE that has a hybrid of Force Service Support Group (FSSG) functionally aligned battalions capable of supporting the current MLG designed combat logistics battalions.

Throughout Operations IRAQI and ENDURING FREEDOM, the MAGTF operated as a MEF with offset deployments between the corresponding units. This MEF construct inevitably brought about the MLG structure that was more effective than the FSSG that was in operation at the onset of the wars. The intent behind a multi-functional Combat Logistics Battalion (CLB) in a direct support (DS) role to an infantry regiment (RCT) was highly effective. However, it was critically flawed with deployment cycles as a CLB deploys for seven months and RCT's for one year. This in turn means that designated command relationships have not lined up across all MEFs with the employment in CLBs providing DS support to their associated RCT while in combat.

>Maj Parker is currently the Site Commander for Site Support Las Vegas. He served in 2d MARDIV and 2D MLG from 2010–2016. He wrote this article while at EWS as a way to begin the conversation for MLG restructuring.

Throughout the past few years, the argument has been made to either keep the MLG in its current structure with minor adjustments or to return to the pre-war FSSG structure. Most notably are the *Gazette* articles by the officers of CLB-2, LtCol Spangenberg, and Capt Patton. In "Functionally Aligned Battalions," the Marines of CLB-2 discuss the MLG returning to functionally aligned units since "[t]he original intent behind the multifunctional CLB's has diminished with constant restructuring efforts."[2] LtCol Spangenberg, in response to the CLB-2 officers, argues that although functionally aligned battalions could be effective, the command and control of the current multifunctional CLBs are required to meet the demands of an effective fighting force.[3] All authors argue toward the issues in the structuring of the MLG failing to meet the requirement of the future MLG. Specifically, the authors are not meeting the requirements to support a MEF with dispersed and disaggregated forces that can rapidly concentrate while being responsive to the smaller size elements that could be required by SPMAGTF elements.[4] Capt Patton states,

> We need to develop a structure, a mission, and a training cycle that builds experience and understanding throughout our community in this critical facet of our jobs so that we can improve our ability to provide the right force, in the right place, at the right time.[5]

She refers to CLBs that are multifunctional and capable of meeting current mission essential tasks associated to current CLBs but, again, does not address how to meet future structural requirements. This article will propose a structure that meets the above requirements and demands by all three authors with functionally aligned battalions that feed into a command and control element capable of providing the right force, at the right place, and at the right time.

The current problems with the MLG are the degradation of equipment and the morale of the Marines from overuse in supporting exercises and operations around the globe. With MEU and SPMAGTF equipment density lists (EDL), there is a constant demand to task organize to a non-standard mission. This requires our forces to piece-meal themselves to further develop the proper force for the mission. Within the MLG, many Marines are pulled out of the DS combat logistics regiment (CLR) and general support CLR pool. The taskers the DS CLR are requested to fulfill extend past the DS role to division, negating its doctrinal mission.

This issue within the DS CLR is the reason why there are personnel issues within the MLG as well. Marines on both the enlisted and officer sides are getting tasked out individually to support various missions, which breaks unit cohesion and continuity amongst staff. This results in platoons without platoon commanders, company commanders who are junior first lieutenants, chief warrant officers serving as commanders instead of subject matter experts,

battalion and above staffs without key billets, and individual units incapable of meeting daily mission requirements without assistance from other units. The process of robbing Peter to pay Paul just to meet manning requirements is the driving issue for low morale being at the junior Marine and officer level.

The same issue encompasses equipment within the MLG. Good equipment gets passed around in support of mission taskings that do not always follow the personnel from the unit being tasked. This results in units providing their best equipment to support others while left with degraded and dead-lined equipment to operate their internal missions. In addition to the personnel taskers taking away the best and brightest to support multiple exercises, there is a lack of knowledge and ability of maintenance shops to keep up with the flow of equipment in maintenance. This degrades maintenance for equipment, morale for Marines, and ultimately readiness of the force.

The proposed way to correct these deficiencies in the MLG is to move away from the multifunctional DS CLR structure to a structure with a mixture of functionally aligned battalions and combat logistics battalions. The combat logistics battalions would not appear like the current structure but would only maintain the command and control function they currently possess. Instead of concentrating on table of organization and equipment, the CLB's would primarily use manning documents and EDLs. Overall, the structure and relationships between units needs to change internally within the LCE.

The top priority to form the Marine Service Support Logistics Group (MSSLG) would be to drop CLR-2 and CLR-25 and make transportation support battalion (TSB), landing support battalion (LSB), engineer support battalion (ESB), maintenance battalion, supply battalion, dental battalion, and medical battalion. All these independent battalions would fall directly under the MSSLG. There will also be a need to implement a headquarters battalion (similar to that of division).

Next is a need to drop all DS CLB's and consolidate the equipment under

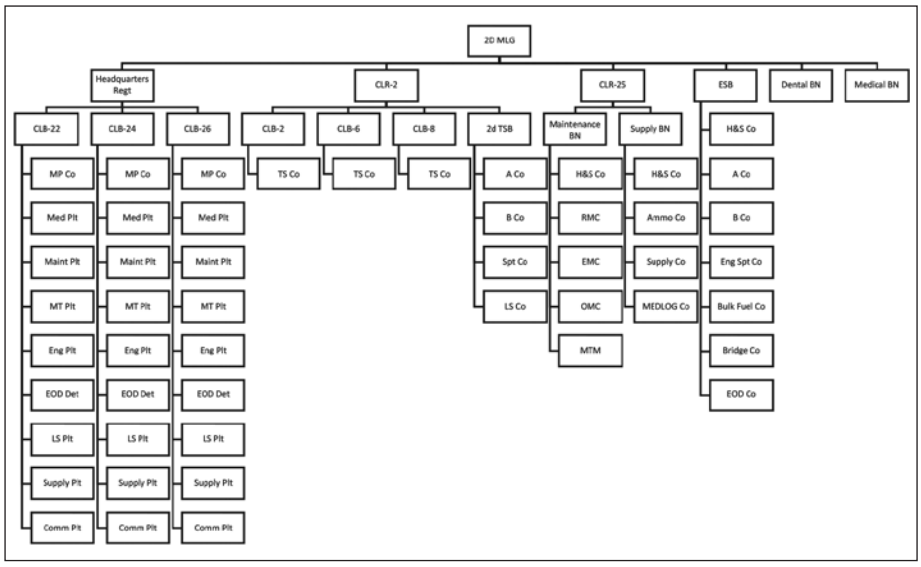

Figure 1. Current MLG Structure within 2d MLG.

TSB, LSB, ESB, maintenance battalion, and supply battalion; thus, there would be CLBs with a minimal table of equipment associated under a support regiment. These CLBs would have a bare minimum table of organization staff to include a battalion commander, executive officer, operations officer, adjutant, intelligence officer, logistics officer, and communication officer with associated officers/enlisted personnel (H&S Co).

The need for this would allow the LCE to have MOS experience within the functional battalions. The consolidation of all equipment and personnel allows for a unit to be dedicated to specific requirements, developments in the occupational field, and training for Marines. Putting all the equipment in one chain of command allows for accountability and maintenance to be consolidated for maximum effort by that single battalion commander. These independent battalions would be primarily non-deployable elements.

The support regiment becomes the new *main effort* of the MSSLG. The battalions within this regiment would have a Table of Organization of the necessary leadership for the battalion. The battalions then are tasked with a mission from the MSSLG for MEUs, SPMAGTFs,

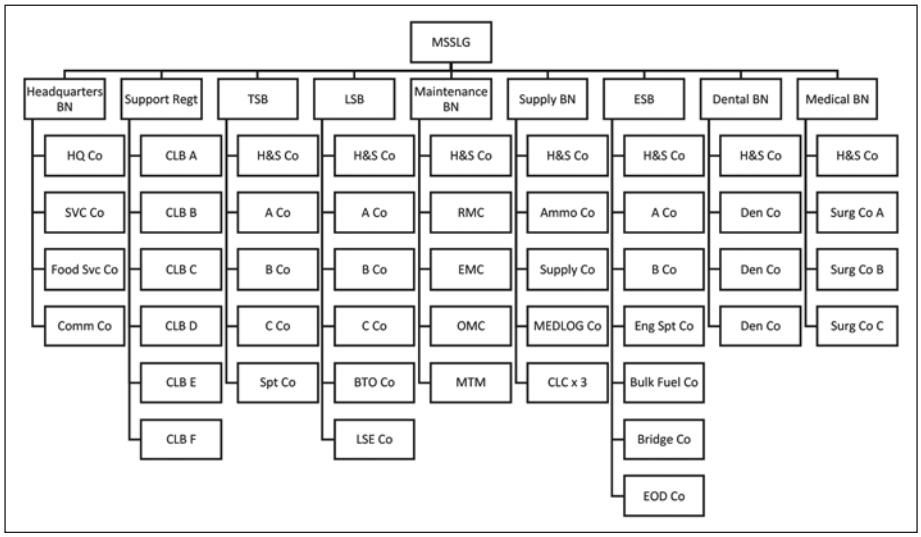

Figure 2. Marine Service Support Logistics Group (MSSLG) proposed structure.

small- and large-scale training exercises, and general support to the MEF. The battalions receive mission directives and then build a manning document and EDL in accordance with the mission. This allows a unit to become specifically tailored to a mission. Manning documents and EDLs would be fulfilled from the independent battalions with the best Marines to support them. As the personnel and equipment move from independent battalion to combat logistics battalion, they would move in full units (squads, platoons, or companies). The support regiment, with its CLB's, would also be the primary deployable unit within the MSSLG if a CLR structure were needed in support of a large-scale deployment such as Operations IRAQI and ENDURING FREEDOM.

It is the relationships that are established throughout the MSSLG that would become critical to the success of the organization. The independent battalions become feeders of equipment and personnel into the supporting battalions. This increases personnel and equipment accountability and maintenance readiness through a standardized support relationship between the functional battalions and the support regiment.

Personnel readiness would increase because of the authorized transfer of personnel from independent battalions to support CLBs and the return of personnel back to independent battalions. The CLBs will not transfer personnel between each other. This would solve an issue with sourcing personnel from across the MLG to conduct training and achieve mission essential training proficiency in garrison.[7] Within the MSSLG structure, every Marine will have orders to a specific unit within the independent battalions (aside from the small staff associated to the support CLBs). When the Marine is tasked to a CLB, they receive temporary duty orders to the battalion for the length of the mission they are executing. Upon the return, the Marine receives any post deployment training/liberty necessary before the CLB is disaggregated back into the small staff, with Marines and equipment going back to a former unit. The CLB is then put back into rotation for follow-on missions and the process is repeated. This brings structure to the tasking process and allows Marines a level of continuity as they move in platoons or companies from the independent battalion to support CLBs. Commanders would get fully functional units to train with instead of the current piece-meal process.

Equipment readiness would increase because of similar reasoning as personnel. As a platoon or company is tasked to support a CLB, they also take the associated equipment. This gives the Marines an incentive to keep it in quality condition. Also, like personnel, it prevents equipment being temporarily loaned to multiple units and operated by personnel who do not have the incentive to care for it. Also, this maintains a level of continuity when it comes to the maintenance cycle of the equipment. The mechanics that transfer the equipment (organizational maintenance) would provide historical knowledge on the individual equipment. Also, the transfer of information/maintenance continuity would be easily facilitated within Global Combat Support System-Marine Corps, when all the same players are involved.

Overall, a positive relationship between the independent battalions and the support CLB exists by the supported (CLBs) and supporting (independent battalions). The independent battalions are responsible for basic skills training, yearly requirements, and equipment readiness that feed into the support of CLBs. The Marine Corps would no longer need to piece-meal from separate units (which degrades morale and equipment survivability). Readiness would increase substantially as a result of continuity and a simplified transfer procedure being conducted. Marines and the institution would be better off and the ability to support would become highly effective and tailorable to current and future demands. This flexibility meets the Marine Corps demands and keeps the logisticians in the Marine Corps capable of maintaining a force sustained and prepared to win the Nation's wars.

The MLG is currently accomplishing the mission in support of the MAGTF, but it is doing it at the peril of the Marines and equipment. This reactive approach is failing the institution as the Marine Corps constantly applies band-aids to the issues when putting together a task organized unit at the last minute.[8] The Marine Corps needs a major overhaul of the structure that allows logisticians the ability to best support current missions while maintaining a high level of readiness for both personnel and equipment. No matter how much innovation and how many improvements are added to the force, it is null and void if there is a poor foundation. The proposed hybrid MSSLG structure is the best course of action to accomplish these tasks, maintain equipment readiness, personnel accountability, and prepare the Marine Corps for future endeavors.

Notes

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Marine Corps Air Station New River

The future of installation innovation and logistics

by LtCols Roger Holliday, Jr., Steven Huls, William Oren & Mr. Kirk Kropinack

>LtCol Holliday is the Director of Installations and Environment, MCASNR.

>>LtCol Steven Huls is the Innovation and Air Station Readiness Model Manager, MCASNR.

>>>LtCol William Oren is the Airfield Operations Officer, MCASNR.

>>>> Mr. Kirk Kropinack is currently serving as the Deputy Director of Installation and Environmental, MCASNR.

Marine Corps Air Station New River continuously works to enhance the readiness and deployability of the Marine Corps. Through multiple innovative models, the Air Station has streamlined the response time on the flightline during extreme weather conditions, created realtime dispatching and tracking of aircraft refueling trucks, and instituted autonomous refueling capabilities for hot refueling, which reduced manned hours. Additionally, the Innovation and Readiness Department created a simulation that demonstrates both negative and positive impacts upon functional areas, which in turn communicates risk for our ability to provide vital services to deploying and non-deploying commands. Furthermore, a planned partnership with the North Carolina Department of Natural Resources will build one large stormwater management device, the first of its kind in North Carolina. The partnership and stormwater management project enhance the mission of the Marine Corps by better enabling the construction of modern facility infrastructure.

Daily fueling operations are key to supporting the OpTempo of the nearly 50 percent of 2d MAW aircraft that are based at MCAS New River. *(Photo by Cpl Christian Ayers.)*

A routine day aboard Marine Corps Air Station (MCAS) New River took a tragic turn on 11 July 2017, when Cpl Skyler James of Marine Medium Tiltrotor squadron 261 lost his life after a lightning strike while performing routine maintenance on an MV-22B Osprey. State-of-the-art weather radars, precise forecasting, and digital notification systems of the 21st century could not overcome the challenge of communicating in the loud, spacious, and demanding work environment indicative of a flight line. Even with the technological advantages known to the modern military, the death of Cpl James highlights a requirement to provide our Marines the ability to stay safe during hazardous weather conditions. While ideas and concepts came forth in the discussions that followed the tragic event, a better method of mitigating risk to hazardous weather and communicating over large distances originated from a Marine officer while staffing a separate infrastructure improvement project.

Upon his assignment as the Director of the MCAS New River Installations and Environmental department in December 2018, LtCol Roger "Doc" Holliday sought to best mitigate future tragedy by developing a cost-effective, timely, and simple method for communicating hazardous conditions to Marines working on the flight line.

This water infiltration basin will provide MCAS New River with 190 acres of impervious area and will be able to handle the first two inches of storm water runoff. This decreases the need for stormwater ponds on the flightline, reducing Bird/Aircraft Strike Hazard (BASH) concerns by eliminating the bird habitat. *(Photo by Cpl Christian Ayers.)*

While collaborating with the Duke Energy Corporation on a runway lights replacement project, an idea came to LtCol Holliday to use a visual system that could notify Marines of hazardous weather conditions. A lightning system of adequate intensity, shared location, and timely activation could provide further risk mitigation to injury or death to all personnel on the flight line from lightning strikes. In partnering with the Duke Energy staff, LtCol Holliday began designing what came to be known as the Lightning Warning System (LWS) in August of 2019. Because of the nature of the concept, readily accessible resources, and availability of expertise, LtCol Holliday went from design, testing, development, procurement, and installation of the first four systems within eight months. This relatively quick timeline and effectiveness are largely because of the simplicity of its design and employment.

The characteristics of the LWS provide a lightweight, visible, and effective notification method by arraying two rows of four blue lights that continually flash during activation. The activation of the LWS begins with MCAS New River Air Traffic Control tower after receiving a lightning strike notification within five nautical miles from MCAS New River Weather. Next, the broadcast of a standard message is given by Marine Corps Base Camp Lejeune Provost Marshals Office through a preexisting Public Announcement device aboard MCAS New River. Then, the lights flash continuously, and the audible message plays once every ten minutes after activation, gaining the attention of everyone aboard the Air Station. The LWS concept is a result of the critical thinking of LtCol Holliday and his efforts to tailor a solution to the problem. LtCol Holliday and his staff's timely actions truly represent the innovative mindset sought after by leadership and executives throughout the DOD and private industry.

In 2019, MCAS New River initiated another project called the Air Station Readiness Model to increase the readiness of its air station units and increase the readiness of the air station's deploying commands while bringing the installation into the modern era and beyond. To accomplish this task, the Air Station created an Innovation and Readiness department. This new, small department can potentially impact not only the air station but also the Marine Corps significantly. The department's first task was to interview personnel across the air station staff that provide aspects and define the services to determine the qualitative and quantitative measures of performance. The goal was to prioritize major readiness inhibitors and identify areas that would improve fastest. Following this prioritization, the team integrated available data sources to develop a predictive model of Air Station functional areas. This model, called the Readiness Network, represents all required functional support areas and their relationships and, through a predictive formula, interdependencies between functional areas based upon preset performance levels. The team is currently utilizing Common Output Levels of Service performance ratings as the preset standard of performance. Additionally, the team can change each functional area's performance independently from any other area. Then, a simulation can be run utilizing a Bayesian formula that incorporates current and past performance data to predict potential second and third order effects to other established Air Station functional areas. This simulation demonstrates both negative and positive impacts upon functional areas, which in turn communicates risk to our ability to provide essential services to deploying and non-deploying commands. Leadership can evaluate these risks to develop resilience plans, assist in limited resource decision making, or as focus areas for innovation.

... the Readiness Network, represents all required functional support areas and their relationships and ... interdependencies between functional areas ...

Through MCAS New River's initial analysis, fuel services were identified as

areas where immediate change could make significant gains. The initial focus was on the general behavior patterns of both refuelers and tenants requesting fuel. During this study, the team determined that some squadrons were repeatedly requesting minute amounts of fuel, resulting in fuel truck delays. The next endeavor was to reduce wait time for refueling aircraft with operating engines, known as "hot refueling." After a review of more than six months of data, an optimal schedule was developed. The new schedule reduced wait times, resulting in less wear-and-tear on aircraft parts, reduced lost man-hour production, and revealed the potential for more than four million dollars in savings when projected across a year. Following the review of hot refueling, efforts transitioned to refueling aircraft with engines off, known as "cold refueling." To further improve efficiency, the air station is exploring innovative solutions that include realtime dispatching and tracking of aircraft refueling trucks and autonomous refueling capabilities for hot refueling.

To further improve efficiency, the air station is exploring innovative solutions that include realtime dispatching and tracking of aircraft refueling trucks …

Once the Readiness Model is further developed and validated, the aim is to ensure the model is scalable for other bases and stations across the Marine Corps. While each installation is unique, the core of the model remains true. Tenant commands depend upon hosting installations to provide essential services to generate readiness, including maintenance of buildings, power, fuel, identification center, operations center, and safety. With moderate tailoring, the MCAS New River's Readiness Model could be developed for any other Marine Corps base or station.

Another example of the innovation aboard MCAS New River is the collaboration for an environmental project. MCAS New River continues to experience significant growth in infrastructure, which has stressed its ability to meet the requirements for stormwater quality and quantity management under current state and federal rules. Currently, MCAS New River operates under a system regulated by the North Carolina Department of Natural Resources (NCDENR) that requires a distinct permit for each new project where new impervious surface is required. This system has resulted in over 60 stormwater permits and multiple stormwater management devices on an installation that is severely constrained for buildable space because of flood plains, wetlands, explosive safety arcs, airfield safety regulations, among other considerations. In most cases, the current stormwater management features are ponds, which happen to provide habitat for water birds—gulls, ducks, geese, egrets, and herons—resulting in an elevated Bird/Aircraft Strike Hazard (BASH) risk. In order to provide flexibility in future infrastructure growth and reduce BASH concerns, MCAS New River has developed a plan with NCDENR to build one large stormwater management device: an infiltration basin that will serve as a "stormwater credit bank."

The infiltration basin is located away from the airfield, adjacent to the installation ammunition supply point, in an area where brick-and-mortar facilities cannot be built due to the associated explosive safety arcs. This location effectively utilizes an unbuildable area, reducing space limitations and places the stormwater management well away from aircraft operations.

The basin will be engineered to manage up to the first two inches of stormwater runoff, as required by NCDENR stormwater rules for coastal counties, and sized to handle 190 acres-worth of impervious area. The basin's engineered infiltration rate prevents standing water for longer than twelve hours; it is absorbed into the ground within that time, minimizing BASH concerns. Once complete, the "credits in the bank" will

The Lightning Warning Panels provide a visual indication to all personnel on the flightline when lightning is detected within five miles of MCAS New River. This provides realtime warnings for observed hazards to protect the Marines, Sailors, and Airmen supporting the ACE mission of II MEF. *(Photo by Cpl Christian Ayers.)*

be managed under one permit by the MCASNR facilities planners in concert with NCDENR. The advantage to NCDENR is a reduced manpower effort in their management (inspections, permit modifications, etc.) of the 60+ permits. Additionally, from an environmental quality standpoint, the basin will capture and treat stormwater from the bulk of MCAS New River's cantonment area. Because of the age of the infrastructure, it is not currently managed in any way. Most of the cantonment area was constructed before the current stormwater regulations; therefore, it was grandfathered with minimal stormwater management required. This new basin results in improved water quality in the surrounding waters not currently attained. Once in place, the stormwater bank can provide flexibility in infrastructure growth in space-constrained areas such as the flightline and can be used to "buy areas" where current stormwater management features are simply taking up space. This project provides an additional tool for the Installation Development Program to meet regulatory requirements, more effectively utilize buildable space, and improve aviation safety. Bottom line: this supports the mission of the Marine Corps by enabling the construction of modern facility infrastructure—the platforms where we train and maintain and from which II MEF forward deploys.

... New River's innovative models demonstrate the station's commitment to the progress ...

MCAS New River's innovative models demonstrate the station's commitment to the progress and process improvements of its capabilities to the tenant commands. These efforts provide aviation support, force protection, infrastructure, and community services to promote the readiness, sustainment, and quality of life for II MEF personnel and their families.

USMC

Unmanned Aerial Vehicles

Application within the Marine Corps supply chain

by 1stLt Dominick Tranfaglia

Historically, the application of unmanned aerial vehicles (UAVs) has been primarily slated for the use of surveillance and intelligence gathering. Originating in the United States as early as the 1950s, UAVs first operated as small radio-controlled aircraft with a small film camera attached. During this time, the UAV was primarily used for intelligence collecting on both China and North Vietnam as a method to avoid risking the lives of pilots or the possible diplomatic consequences that could result if a pilot was captured. At this time, this technology was considered niche as it was unreliable, expensive, and oftentimes pilots had to be in a nearby manned aircraft to control them. As time and technology progressed, the use of UAVs and their practical application to the battlefield advanced. As early as the 1990s, the United States began equipping drones with missiles for use in the Middle East—specifically, in the search for Osama Bin Laden.

The UAV, by definition, is a system that contains the necessary equipment, personnel, and networking capabilities to control an unmanned aircraft. UAVs can be autonomous or radio controlled. While primarily applied to tasks such as surveillance, intelligence gathering, and airstrikes, UAVs can make considerable impacts to the supply chain and logistics field within the Marine Corps if employed properly.

UAV Application

There are several uses for UAV technology within the Marine Corps supply chain and logistics field; for the purpose of this article, we will break them down into external and internal uses.

>1stLt Tranfaglia is currently a 3002 Supply/Fiscal Officer stationed in Okinawa, Japan, serving as the Headquarters Battalion Supply Officer.

Internal uses describe tasks associated with tasks internal to warehouses and within the unit or business-to-business operations. On the other hand, external tasks can be associated with UAV application involving outside the unit transfers or business-to-customer tasks. Business to customer tasks also include the use of UAVs within the unit but outside of warehouse operations, such as the transportation of goods from a supply warehouse to a motor transport maintenance section.

Business to Business

The integration of UAV technology in a business-to-business setting within the Marine Corps has the potential to serve measurable impacts. First, in order to gauge effectiveness and limit risk, UAV technology should be implemented at both intermediate-level and using unit-level warehouse locations such as the Supply Management Unit and unit supply warehouses. UAV applications can allow for accelerated inventories, removing items off location for distribution using optimized paths, and overall

The Marine Corps has been testing and employing logistics UAVs like the Kaman K-MAX Helicopter since 2016. *(Photo: Marine Corps Air Station Yuma, AZ.)*

safety improvements. UAVs can be employed to move small items within the warehouse quickly and effectively allowing for reduced time cutting out forklift use or the need to scale shelving to access a specific part—a concept known as intra-logistics or the movement of transportation within a facility. UAVs are extremely versatile in nature and can perform several tasks simultaneously, giving them an extreme advantage over their human counterpart.

For example, Amazon has been able to effectively employ the use of UAVs and robotics within their warehouse with Kiva Robotics. These UAVs move on a predetermined path with their direction determined by barcode location; they locate and carry racks loaded with goods from their location on the shelf to a single workstation where a worker is located. As a result of this technology, Amazon's fulfillment rates and speed has significantly improved while simultaneously increasing capacity and reducing labor costs. Overall, the implementation of UAVs within their warehouse has reduced Amazon's operating expenses by over 20 percent and improved total process cycle time from over 60 minutes to just 15 minutes.[1] Furthermore, because of the fact that these UAVs can navigate in significantly smaller spaces that workers, Amazon was able to reduce their inventory space by over 49 percent while additionally lowering their energy cost approximately 50 percent because of the fact that these UAVs do not need to operate in well-lit areas.[2]

Business to Customer

Business-to-customer tasks entail delivery tasks—primarily conducted outside of the warehouse—can be increasingly more dynamic, as they are conducted outside of the controlled environment that is typically seen in warehouse operations. The employment of UAVs for delivery within the Marine Corps would serve a measurable impact in the delivery of goods to commodities at the using unit level. Traditionally, Marines must physically go to the warehouse when parts are available for pickup. Using a UAV to deliver goods to sections cut down significantly on the time spent in transit. Unfortunately, at this time, technology only allows for the transportation of smaller weight payloads; however, much of what is placed on order are items such as nuts, bolts, screws, and tool—all items in which would be prime for UAV delivery. Once delivered, the customer or section representative would sign the attached proof of delivery receipt, and the UAV would return to the warehouse where the supply representative would file and upload the document appropriately.

Some possible friction points with this technology include weather limitations, local restrictions, and collision avoidance with other aircraft and limited flight times and distance because of battery life. There is still much work to be done on the business to customer aspect of supply operations using UAVs; however, this technology would be prime for light package and short distance delivery trips given specific conditions.

The Way Ahead

As technology progresses the Marine Corps must adapt in order to maintain the competitive edge over our adversaries. This starts specifically with the way in which we enhance our supply and logistics capabilities. The faster we can get a product out the door and to the Marines at the using unit level and beyond, the quicker Marines can continue the fight. As we look to implement this technology, we should consider a two phased approach; phase one includes the project approval and funding followed by the distribution and employment at intermediate supply accounts such as the Supply Management Unit for a period of twelve months. The application of UAVs by our civilian counterparts allows for immediate assessment of lessons learned and confident employment of this technology. Through time and trial, this technology can then be evaluated, and a determination can be made based on the exhibited performance and benefits. Should this technology provide measurable and substantiated benefits, phase two involves the distribution of this technology to using unit supply accounts throughout the Marine Corps. Implementing this technology in an outside of continental United States or deployed environment may prove to be challenging but not insurmountable. The technology is readily available and is employed within other facets of the Marine Corps. As Marines, we must look to effectively employ this technology sooner rather than later. It should be noted that UAVs are not a replacement for Marines but rather a supplementation and aid to meticulous and arduous tasks.

Conclusion

Driven by cost, safety, and overall efficiency, UAVs play a critical role in overall supply chain operations and can be specifically applied to use within the Marine Corps to expedite the supply chain process while simultaneously improving safety and efficiency. Given their ability to fly autonomously, carry payloads, intelligently analyze surroundings to avoid obstacles both indoors and outdoors, and operate in fleets, UAVs can provide a significant advantage over our adversaries within the field of supply chain and logistics. More importantly, this concept allows us as Marines to operate at a higher level with a smaller footprint. The Marine Corps, as called upon in the *Commandant's Planning Guidance* and *Force Design 2030*, must learn to increase lethality and effectiveness during distributed operations, the employment of UAVs within the supply and logistics field answers that call.[3]

Notes

1. Greg Lamm, "Here's How the $775M Investment in a Robotics Company is Paying off for Amazon," *American City Business Journal*, (June 2016), available at http://www.bizjournals.com

2. Alexis Madrigal, "Autonomous Robots Invade Retail Warehouses," *Wired*, (January 2009), available at http://www.wired.com.

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

Resilient, Efficient, and "Dumb"

An expeditionary rail system for the joint force

by Maj Daniel C. Walker

Future operating environments (FOE) will require the joint force to be increasingly agile and expeditionary to accomplish a wide array of missions across the range of military operations. Given this, forces must be properly equipped to provide responsive transportation and sustainment as a key component of success. Current and future logistical capabilities are largely based on rail and motor transport, with emerging vehicle autonomy offering possibilities for significant developments in the latter. Though they do serve an important role, overreliance on these capabilities will degrade joint force flexibility resulting from three specific platform weaknesses. First, rail transportation is limited to existing infrastructure, most notably the established rail network. Second, traditional motor transportation is inherently inefficient, requiring significant fuel and manpower to operate at scale. Third, the rise of vehicle autonomy is currently limited in its application because of the reliance on technological systems that are vulnerable, costly, and complex in their maintenance requirements. This triad of challenges is significant, yet the development of a new, alternate transportation platform—the expeditionary rail system (ERS)—can overcome these challenges and serve as a low-tech autonomous platform that will address transportation challenges in the near term.

Though traditional rail will continue to play a key role in future operational-level logistics, its inherent limitations are distinct in light of the growing anti-access/area denial (A2/AD) challenge. This is even more true given naval concepts like expeditionary advanced base operations (EABO), which require logistics capabilities to be rapidly deployable and moveable once established. By definition, railways are not expeditionary because a significant amount of time, resources, and manpower are required to establish an operational capability. Viewed through an operational lens, the most significant observation is that the benefits of rail extend only to the last mile of track.

>Maj Walker is a Logistics Officer, China Foreign Area Officer, and MAGTF Planner. He is currently serving as a Regional Planner in the III MEF G-5.

Past this last mile of railroad track, both military and civilian trucking fulfill much of the transportation and distribution requirement. Unfortunately, military trucking requires an inordinate amount of fuel and manpower for large-scale operations. World War II's Red Ball Express serves as a case study for the massive requirements associated with sustained motor transport operations during a high-end conflict.[1] Even if comparable fuel and manpower costs were accepted in a future scenario, it is unclear if such scale would even be feasible given the significant A2/AD capabilities held by U.S. adversaries and the limited resources within the logistics force structure.[2]

To mitigate some of these manpower and fuel inefficiencies, recent progress has been made within both the public and private sectors to partially fulfill transportation requirements with autonomous vehicles. Although autonomous vehicles will surely play a role in the logistical sustainment of tomorrow's force, they also create three significant challenges for that same force. First, the current military experimentation effort is largely focused on a "leader-follower" concept in which numerous autonomous vehicles drive behind a manned vehicle.[3] Although this manned-unmanned teaming (MUM-T) concept does provide some potential benefits, it presents additional force protection concerns that exist with neither a completely unmanned convoy nor a completely manned convoy. Second, whether using MUM-T or a fully autonomous convoy, success requires technological resilience and the ability to operate in a contested information environment. Third, even if dominance in the information environment is gained and maintained, autonomous vehicles remain costly in terms of fuel and technological systems.

While each of these platforms—rail, manned trucks, and autonomous vehicles—have a place in the FOE, each also presents its own challenges. It is at the convergence of these challenges where an opportunity emerges for the ERS to transport supplies in a more efficient and resilient manner than either traditional trucking or autonomous vehicles. It is the ERS's deployable nature, lack of reliance on technology, and modularity that provide its relative advantage to other current transportation platforms.

The ERS: A Vignette

South China Sea. Initial U.S. security forces landed at a remote island a few hours ago to further distribute lethal, landbased capabilities beyond the upper

limit of naval platforms. Given mission requirements, there is no time to waste. The initial forces must quickly prepare the island to serve as an austere and temporary forward mobile base providing essential logistics capability. Given sensitive political considerations and tactical necessity, the force's primary forward arming and refueling point (FARP) must be positioned about three miles from the landing beach. Poorly maintained, fuel-inefficient roads and the lack of a rail network characterize the area between the beach and FARP.

Although the autonomous vehicles previously used by the force would normally save vital manpower, fuel, and time, the adversary has recently begun conducting operations in the information environment throughout this island chain, most significantly electronic warfare against friendly forces. The result is a localized, yet significant, disruption in friendly communications, GPS capability, and other assets requiring positioning, navigation, and timing technology.

Once U.S. forces establish initial command and control (C2) ashore and achieve localized security, a task-organized element departs the beach in a twelve-vehicle mounted patrol. In addition to the standard security vehicles in the front and rear of the mounted patrol, the remaining vehicles are medium- and heavy-lift trucks with modular spools of metal rope on the back of each truck. As the patrol slowly moves from the beach to the FARP site, each of these trucks lays this metal rope—the guide*—along the ground, creating a track from the beach to the FARP. Within mere hours, the ERS has full operational capability.*

The next morning, as additional forces land, vehicles carrying an array of supplies from the beach are driven to the ERS track, where a tow bar-like device—the guide rider*—connects the front of the vehicle to the* guide*. Within minutes, the vehicles then autonomously idle to the FARP. Over the course of the day, more than 100 vehicles successfully travel autonomously to the FARP, creating significant fuel and manpower efficiencies using a new low-tech form of ground vehicle autonomy.*

Operational Applications of the ERS

While the ERS's value is located at the convergence of existing transportation platform limitations, it is important to note that the ERS will replace neither trains nor trucks. However, in certain situations—characterized by a short-duration (90–150 days) and short-distance (2–10 miles) transportation requirement that necessitates many round trips—the ERS will provide a more efficient transportation alternative to both rail and truck.

There are two optimal applications for the ERS: the first is a joint force's reception, staging, onward movement, and integration (RSO&I) into a campaign's theater; the second is a use during EABO. In both scenarios, supplies will travel repeatedly between key locations (e.g., landing beaches, aerial/sea ports of debarkation, combat service support areas, etc.) but only for a short duration, nullifying the value in building long-term infrastructure—especially a railroad. Once the mission has been met, forces and the associated ERS can be quickly removed and reallocated given the system's temporary nature. As the transportation requirement's duration lengthens, the value of the ERS will decrease. This is because in such a scenario the relative value of laying a traditional railroad increases given its expected payoff of high fixed costs. Similarly, if the mission requires fewer trips between two locations, traditional trucking will likely be more desirable given the higher fixed costs of an ERS compared to a traditional motor transport solution.

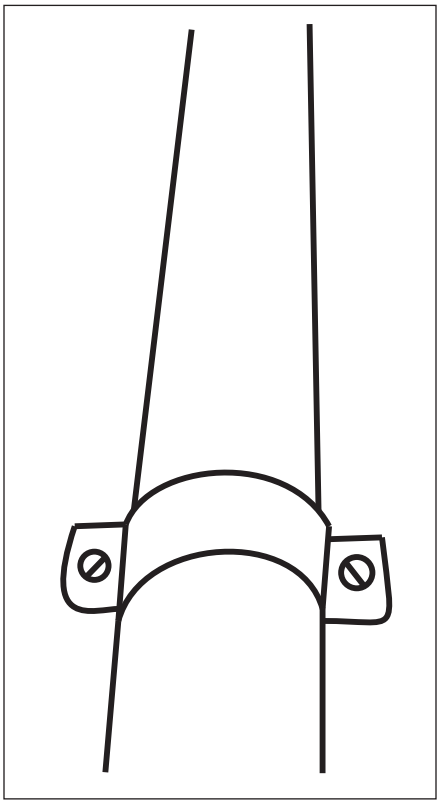

Figure 1. Guide with securing bracket.

Components of the ERS

As defined, the ERS consists of three primary components: the *guide,* which establishes the ERS track; the *guide truck,* which lays the *guide* along the desired route; and the *guide rider,* an attachment which attaches the ERS vehicle to the *guide*.

The Guide: An Overview.

The guide is a non-weight-bearing, surface-laid metal wire rope that spans end-to-end and creates the ERS track. To ensure durability and rigidity in guiding idling vehicles along its path, the guide will be secured to the ground with a bracket and stakes (See Figure 1).

Given various applications and ground surface characteristics, the guide may require differing degrees of rigidity once established; however, this can be managed by adjusting the number of stakes securing it to the ground. By adjusting the guide's tension with the number of stakes, the requirement for a more expensive, thicker, and less expeditionary guide is avoided.

The Guide Truck: An Overview.

To ensure the ERS's advantage over traditional rail transport, the guide must be rapidly deployable. The guide truck provides this capability and will hold one or more spools of guide in a modular attachment on the back of the truck (see Figure 2). Once a desired location for the ERS is determined, the guide truck will simply drive slowly along the desired ERS track and lay the guide. Though manpower will be required to secure the guide at each terminus, once started with the initial anchor end secured, the spool will freely spin to allow for efficient laying of the ERS track. As this guide is laid, it must also be manually secured to the ground

at given intervals. This will both ensure the guide's placement and rigidity required to guide heavy vehicles.

Most critically, the modularity of the guide spool on the back of the truck ensures that any medium or heavy vehicle can transform into a guide truck and perform this critical application. Such a spool module will look similar to Marine Corps' hose reel system which is already used in support of bulk fuel operations.

The Guide Rider: An Overview.

Once the guide is laid and the track established, the ERS is nearly immediately operational. The last required component is the guide rider, which is a modified version of a current military tow bar. This attachment will connect the front of any vehicle to the guide, allowing for autonomous idling along the ERS track (see Figure 3). Because of the simplicity of the ERS concept, numerous vehicles are compatible with the ERS. Given that the guide-rider is a modified tow bar, this single attachment can either attach to the guide directly or attach to the vehicle in front of it, creating an ERS convoy.

The ERS: Flexible, Modular, Scalable

The greatest benefits of the ERS—flexibility, modularity, and scalability—can be seen when contrasted with other transportation platforms. Indeed, the ERS can be adapted to ensure its optimal use in numerous applications.

ERS Compatibility.

Because the vehicle is guided along the track via the guide rider, the only requirement for a vehicle's compatibility with the ERS is its ability to attach a guide rider. Currently, all military vehicles that have organic tow bars will be able to attach the guide rider. This flexibility also enables future contracted or host-nation vehicles to integrate into the ERS, simply requiring the attachment of a guide rider to the front of the vehicle.

ERS Convoy Capability.

Another critical capability of the ERS is the ability for vehicles to operate individually or coupled together to form an ERS convoy (see Figure 4). The ERS provides an analogous capability to the Australian Road Trains in which a tractor-trailer pulls six, eight, or more trailers along the characteristically straight roads of Australia.

If operating as a single vehicle along the ERS, the vehicle simply attaches its guide rider to the guide and moves along the ERS track. When operating as an ERS convoy, the first vehicle's guide rider will attach to the guide, while all other vehicles or trailers simply attach their guide rider as a tow bar to the vehicle or trailer immediately in front of it. Thus, the ERS provides the capability for a heavy-lift military truck (e.g., LVSR) to *autonomously* pull six or more trailers, creating valuable fuel and manpower efficiencies.

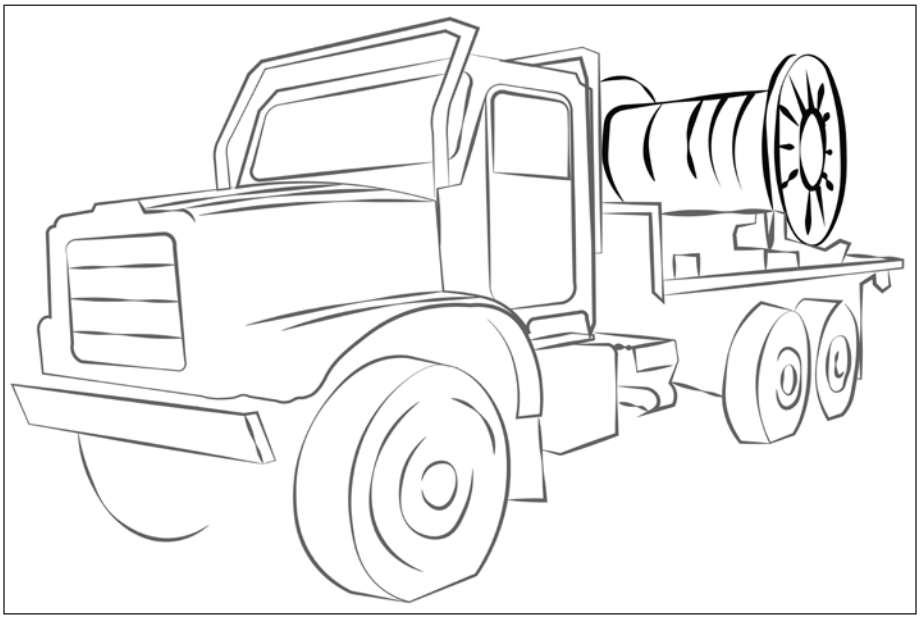

Figure 2. Guide truck. *(Figure by author.)*

ERS Track Scalability.

The ERS also provides the ability to gradually improve its track as resources become available, resulting in scalable fuel efficiency. When initially laying

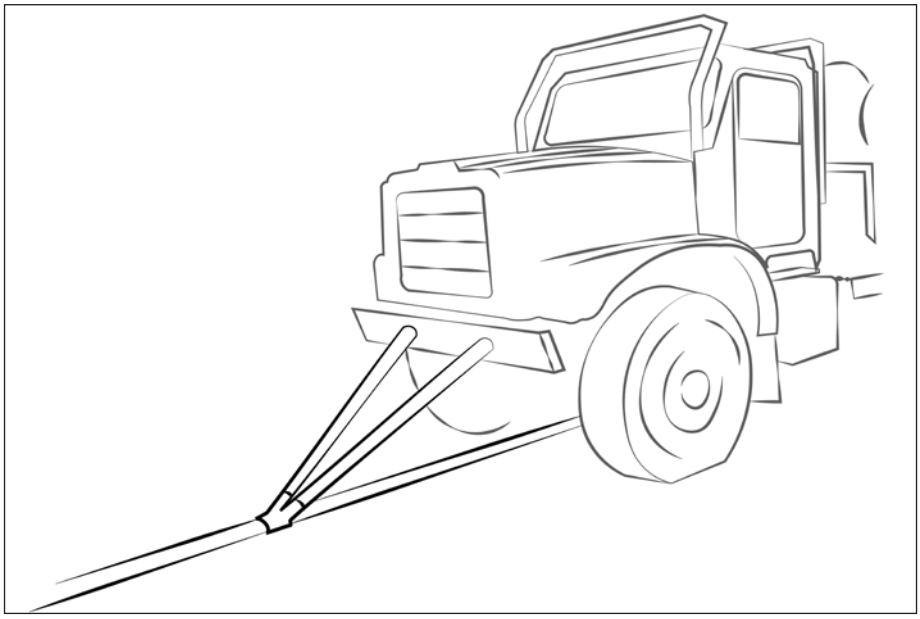

Figure 3. Guide rider. *(Figure by author.)*

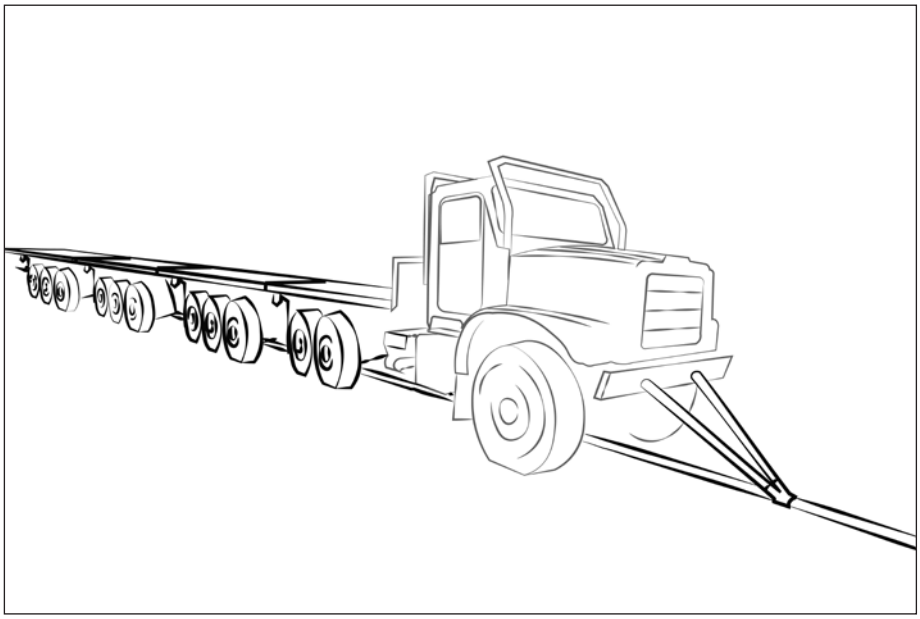

Figure 4. ERS convoy. *(Figure by author.)*

the guide, units will likely lay it on an unimproved ground surface because of time considerations as mentioned in the vignette. Such a method captures the expeditionary benefits of the ERS. However, as time, manpower, and horizontal construction assets become available, the ERS track can be improved in a number of ways to capture fuel efficiencies inherent in the ERS.

First, the ground surface along both sides of the ERS track can be graded and compacted for a more durable, fuel-efficient operating surface. Second, if the ERS will be used for a longer period of time than originally planned and even greater fuel efficiency is desired, a modular rail-mat can be laid down on each side of the guide (see Figure 5).

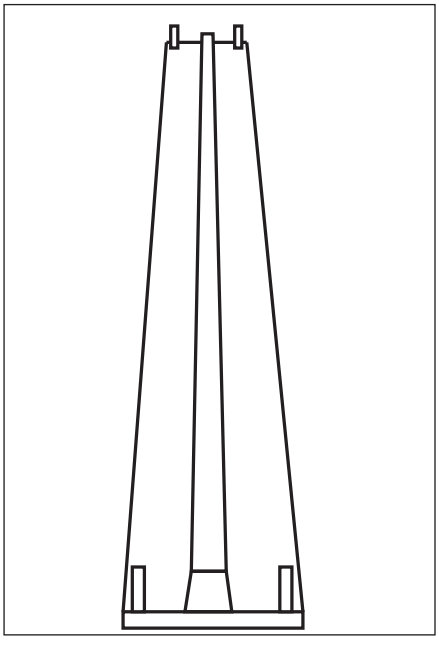

Figure 5. Rail mat. *(Figure by author.)*

This rail-mat would also replace AM2 matting currently used for expeditionary airfields given rail-mat's dual-use as an ERS component and modular airfield matting. If properly engineered, one side of this new rail-mat would continue to be a smooth surface to allow use on airfields and tarmacs. However, on the reverse side, a low-profile track would be engineered in the metal, providing a grove along which a vehicle's tires will travel.

ERS Wheel and Tire Modularity.

Given this new rail-mat, the ERS also allows for a variety of vehicle tire and wheel combinations to improve the stability, cost efficiency, and fuel efficiency of the ERS. If in an expeditionary setting no time is available for the ERS' track to be leveled, graded, or compacted, traditional all-terrain vehicle tires will continue to be used. However, as the surface along the ERS track is improved, a more cost- and fuel-efficient tire can be used on vehicles.

Once the rail mat is laid and the ERS meets a longer-duration requirement, rubber tires can be replaced altogether with railroad-type wheels to ride along the rail mat's low-profile track, further enhancing the fuel efficiency of the ERS and adding to the stability of the vehicles traveling along the track (see Figure 6). Such interoperability between vehicles and railroad tracks has been previously used in both the civilian and military sectors and proven viable.[4]

ERS and Autonomous Vehicle Compatibility.

The final benefit of the ERS is its compatibility within the future vehicle autonomy family of systems. Essentially, the ERS serves as a "bridging platform" between the current traditional motor transportation assets and the fully autonomous convoys of tomorrow. Additionally, the ERS allows for a gradual increase in the amount of autonomy in a given logistics convoy, likely beginning with local, low-cost sensors that aid the ERS vehicles in starting and stopping at each track's terminus.

In the future, if a future transportation requirement is along a complex route in a permissive information environment, such autonomous vehicles can leverage their high-tech autonomous technology. However, if the transportation requirement is a short- or medium-distance movement along a straight route or the information environment is contested, the ERS provides a more resilient capability, presenting commanders with an additional system for risk mitigation—all by simply attaching a guide rider to any vehicle.

Advantages of the ERS

A new concept like the ERS requires significant resources to bring to fruition. Its associated fixed costs are only acceptable if the ERS presents significant benefits compared to available alternatives. Costs and benefits can be analyzed by contrasting this new platform with rail, traditional trucking, and autonomous vehicles. The following five ERS advantages are most relevant in such an analysis.

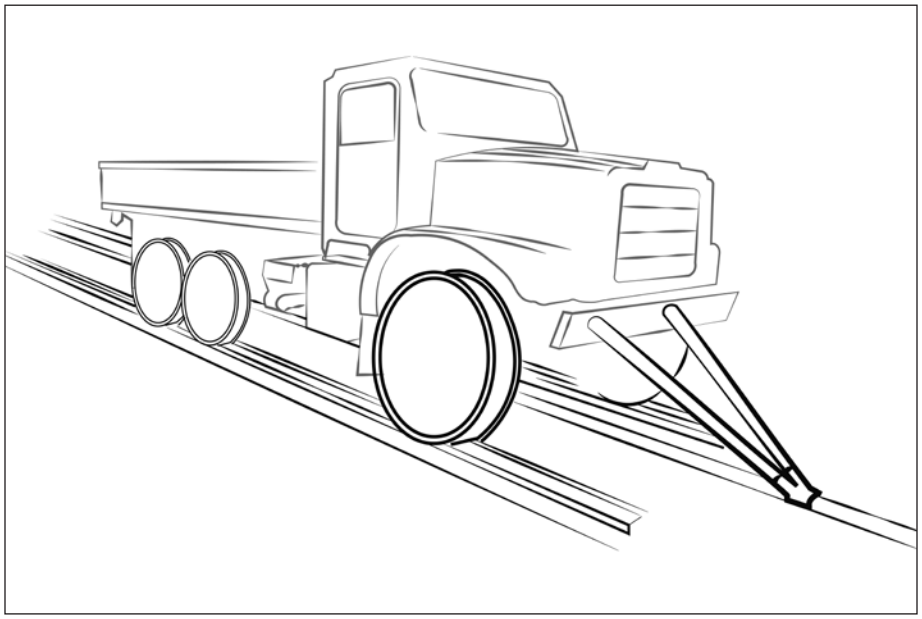

Figure 6. ERS with rail-mat. *(Figure by author.)*

ERS Advantages over Rail.

The ERS's most valuable contribution is that it will be more deployable than traditional rail. While traditional railroads require significant time, manpower, and fixed costs to establish, the ERS track is laid in mere minutes when the guide truck slowly travels along the desired path laying the guide.

Because of its lighter weight and lower cost, the ERS can also be used in many more applications than traditional railroads. Once the ERS requirement has ended, the guide can be rapidly respooled on the guide truck and prepared for its next application. Additionally, because of the specialized nature of locomotives and railcars, they are unable to serve multiple purposes and must be moved into location for operational viability. However, because any military vehicle can be made ERS-compatible by merely attaching the guide rider, significant flexibility is added. Military trucks can be driven across great distances in the absence of established infrastructure when a short-distance ERS track is established and the vehicles are quickly converted to serve as low-tech autonomous vehicles.

ERS Advantages over Motor Transportation.

In the appropriate situations, the ERS will save significant manpower and fuel resources compared to motor transportation. Though manpower will be required to lay the ERS guide, load/unload trucks, and service trucks at each end of the track, ERS autonomy relieves the requirement for vehicle drivers and assistant drivers. This autonomy also minimizes the force protection risk normally associated with drivers and assistant drivers conducting convoy operations across the battlefield. Additionally, because the guide provides the truck a linear path on which the truck will travel, fuel-inefficient lateral movements are reduced. Additional fuel savings are captured by the inherent slow, but continuous speed of the ERS vehicles idling along the track. Though the ERS does not provide the fuel efficiency of traditional rail, it does increase fuel efficiency when compared to traditional trucking.

While traditional railroads require significant time, manpower, and fixed costs to establish, the ERS track is laid in mere minutes ...

ERS Resiliency.

Because the ERS operates with a type of "dumb" autonomy—one in which no navigational technology is required—the ERS is more capable and resilient in an information-degraded environment. While the autonomous vehicle does provide some benefits over the ERS, once its core capability—high-tech autonomy—is degraded by enemy actions or technological failure, it simply becomes another truck that is both fuel and manpower inefficient.

Additionally, the ERS's low-tech requirements present significant benefits and reduced risk when compared to current vehicle autonomy's technology. Autonomous vehicles' robotic applique kits (RAKs [i.e., navigational systems]) are expensive to acquire and maintain.[5] This maintenance includes ensuring systems are properly patched and configured to mitigate any known cyber vulnerabilities[6] As such cyber threats evolve, so must the patching and configuration updates. Because of the ERS's lower-tech solution, such a maintenance requirement is eliminated, further mitigating operational risk and support requirements.

ERS Reduced Signature.

The ERS also has the potential to reduce friendly force signatures within an operational setting. In the FOE, adversaries will use friendly force's signature and emissions to find, track, and target adversarial forces.[7] Viewed through this lens, another potential weakness of future "smart" autonomous systems is their signal emissions. Whether communicating to other vehicles in a MUM-T configuration or using GPS navigational systems, such signals create risks. In contrast, because the ERS executes "dumb" autonomy by merely operating along a fixed track, its autonomy creates no additional signals or emissions for an adversary to detect.

Additionally, in an A2/AD environment, especially while conducting

EABO, once an adversary has taken advantage of a friendly force signature, logistics capabilities must be able to be quickly displaced and moved elsewhere. The ERS provides such a capability in its ability to be moved rapidly, ensuring a distributed net of logistics capability while minimizing friendly force vulnerabilities.

Less Technology=Faster Development.

Though the ERS will require time to further develop and test, its minimal technology requirements will result in expedited testing and fielding as compared to development of fully autonomous convoys. The potential for this more rapid acquisition is a significant benefit to a "low-tech" solution and one that is explicitly supported by current DOD acquisition initiatives.[8] In essence, the ERS provides a "bridging" solution between current transportation platforms and future fully autonomous convoys that are very much in their "operational infancy."[9] The ERS's compatibility with future autonomous vehicles ensures that development of the ERS is not a detriment to the long-term development of autonomous vehicles. Additionally, such a "bridging" solution will not simply serve as a link from current trucks to fully autonomous convoy capabilities; rather, it will serve as a bridge along each iterative enhancement of autonomous capabilities, all the way to fully autonomous convoys.

The ERS's Challenges

As established above, the ERS presents a valuable capability in the FOE. However, in examining the way forward, three notable challenges are quickly evident, all of which must be properly addressed to ensure this project's success. First, the ERS does require some technological and engineering refinement to ensure the system's technological viability. Second, although the ERS will likely be considerably cheaper than both traditional rail components and a fully converted fleet of autonomous vehicles, the ERS will still have significant fixed costs above and beyond additional required experimentation and testing. Third, the ERS program will have impacts across the doctrine, organization, training, materiel, leadership, personnel, and facilities spectrum. Perhaps the most significant of these relates to organization and personnel. If fully fielded, selection of the proper organizations to manage ERS manning, training, and equipment maintenance is vital for its successful future use.[10]

Conclusion

The FOE continues to challenge the joint force as it seeks heightened readiness across the range of military operations. Despite the variety of future mission sets, transportation will be a requirement to ensure flexible sustainment to relevant forces. In this context, the transportation challenges created by the weaknesses of traditional rail, manned trucks, and vehicle autonomy lend themselves to the creation of a new transportation platform: the ERS. Such a system is not only a significant benefit over the long term but also serves as a crucial bridging technology that ensures heightened flexibility over the medium term. With proper advocacy and sponsorship, the ERS can reduce costs, gain manpower and fuel efficiencies, and ensure joint force agility in future operational scenarios.

Notes

1. At its peak, this amalgamated American convoy system employed 132 truck companies, consisted of more than 5,900 tucks, and used more than 300,000 gallons of fuel daily in support of U.S. First and Third Armies in France. See Bradley E. Smith, "The Influence of Railroads upon Campaign Plans," (Master's Thesis, U.S. Army Command and General Staff College, 1989). Additionally, such a significant fuel requirement for operations requires addition transportation assets to move that same fuel. In other words, it takes a significant amount of fuel to move fuel.

2. Joint Staff, *Joint Concept for Logistics*, (Washington, DC: September 2015).

3. Sydney J. Freedberg Jr, "Army Wants 70 Self-Driving Supply Trucks by 2020," *Breaking Defense*, (August 2018), available at https://breakingdefense.com.

4. For historical military applications, see Denis Bishop and W.J.K. Davies, *Railways and War since 1917*, (London, UK: Blandford Press, 1974). For a current civilian application, see HARSCO website available at http://www.harscorail.com.

5. According to the Army Capabilities Integration Center (ARCIC), the upcoming Army RAK testing is scheduled to be completed in 2020 and will cost between $30–$45 million for 150 vehicles. Personal exchange between author and MAJ Todd McMillan, USA, (ARCIC Sustainment Division) on 17 November 2018.

6. Department of Defense, *Unmanned Systems Integrated Roadmap: 2017–2042*, (Washington, DC: 2018).

7. Headquarters Marine Corps, *Marine Corps Operating Concept*, (Washington, DC: 2016).

8. Department of Defense, *A Blueprint for Winning* (Annotated Summary), (Washington, DC: 2017). This document lays out six "tenants for modernization" for ensuring new capabilities are in line with "an operational definition of modernization."

9. Robert O. Work and Shawn Brimley, *20YY: Preparing for War in the Robotic Age,* (Washington, DC: Center for a New American Strategy, 2014). This assessment is shared by MAJ Todd McMillan, ARCIC. Following the leader-follower testing through 2020, those vehicles' operational viability is still "years away." This time would likely be spent refining technology based on testing results and adding similar technology to more of the Army's approximately 30,000 RAK-compatible vehicles. Discussion between author and MAJ Todd McMillan on 17 November 2018.

10. Systems maintenance remains a key consideration for the implementation of any new technology. Given the future operating environment's austere and distributed nature, maintenance planning should account for active duty service members conducting all maintenance. This is a marked difference from the current leader/follower testing which is heavily reliant on contractors for the foreseeable future to ensure RAK maintenance.

Aviation Supply Support

How Marines improved aircraft operations

by Mark Polca, LtCol Ryan Finn, William Munson, Bob Love, Scott McAllister, Doug Blazer, David Fulk, Karen Klinger, Rob Kline, Mel Huryasar & Julie Castilho

Across the DOD, aviation commands face the formidable task of increasing the operational availability of aircraft. As the "First to Fight," readiness is of extraordinary importance to the Marines, who increased aircraft availability through dramatic improvements to supply inventories (spare parts to fix aircraft). The Marines are enjoying optimal supply performance—specifically, historically high planeside consumable material availability rates—among the best rates of any Navy aviation command, past or present. Furthermore, Marine Aviation Groups (MAGs) are enjoying consumable part availability rates on par with the best commercial aviation companies. This change was realized through the formation of a team of subject matter experts, which included Marines, experts in DOD supply modeling, and others from industry and government. Together, the Marines implemented a proven spare parts forecasting model, the Customer Oriented Leveling Technique (COLT), and continually monitored and improved the supply chain process.[1]

A Better Mix of Spare Parts on the Retail Shelf

As with many weapons systems across DOD around 2016–2017, Marine aircraft did not achieve mission capability (MC) goals for either fixed- or rotary-wing aircraft. To identify readiness degradation causes and effective corrective actions, the Deputy Commandant for Aviation commissioned an independent readiness review for the MV-22 Osprey. Consumable supply chain performance—highlighted by planeside availability below plan and long wait time for off-station, high-priority requisitions—was a major contributor to MC below goal. The review recommended implementation of an alternative inventory-level model to

>Mr. Polca is currently the Planning, Readiness, and Performance Lead Commander, Fleet Readiness Centers and a retired Navy Supply Corps Officer.

>>LtCol Finn is Deputy Director of Aviation Operations and Senior Marine at NAVSUP and at HQMC Aviation Supply Officer during COLT implementation.

>>>Mr. Munson is a retired Navy Corps Supply Officer with 41 years of military and private sector supply chain management experience.

>>>>Mr. Love is a Director at LMI, a retired Marine Colonel, and former Chief of Staff to the Secretary of the Navy (Acting).

>>>>>Mr. McAllister is a Project Manager at LMI, has over 35 years' service in Navy/Marine Corps Aviation Logistics and provides technical leadership for Navy COLT/PDL projects.

>>>>>>Dr. Blazer is Operations Research Principal at LMI and a retired Air Force Colonel. For the last 25 years, he has implemented improvements to the Air Force and Marine supply chains.

>>>>>>>Dr. Fulk is a Principal at LMI, a retired Air Force Major, and primary developer of COLT.

>>>>>>>>Mrs. Klinger is a Senior Consultant at LMI, an operations research analyst with 26 years of experience in inventory modeling for the Air Force.

>>>>>>>>>Mr. Kline is a Technical Fellow at LMI with 30-year experience with supply chain modeling across DOD, International Air Forces, and commercial aircraft manufacturers.

>>>>>>>>>>Ms. Huryasar is the Sr. Data Science Consultant at LMI with over fifteen years of experience in supply chain management, computer programming, modeling, and simulation.

>>>>>>>>>>>Mrs. Castilho is a Senior Data Science Consultant at LMI supporting Marine Corps and Air Force supply planning and logistics.

help correct these issues. COLT was the answer. Within two years, the Marines implemented this new supply model and associated processes across the eleven MAG locations. Within a year, the key inventory metric of customer wait time improved by an average of 65 percent.

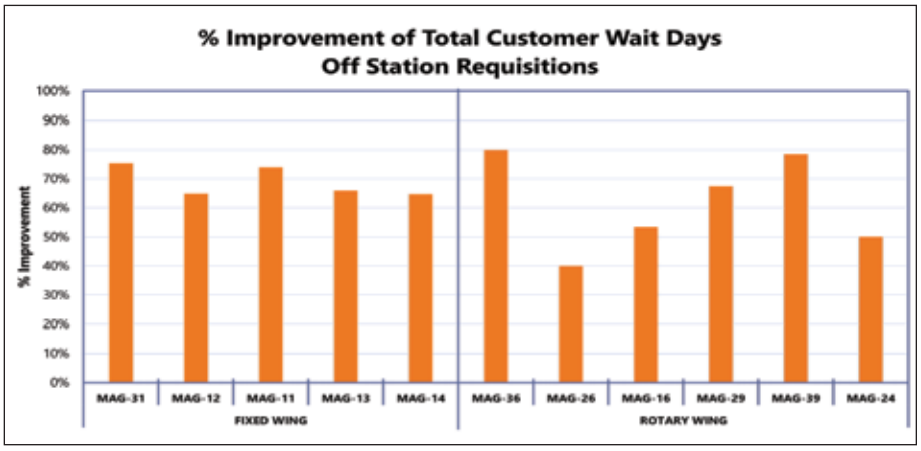

Figure 1. Consumable Requisition Wait Days Improvement by MAG (Off Station). Percent Improvement Customer Wait days period means estimating average wait days nine months before vs nine months after COLT implementation (ending March 2020 to avoid COVID impacts). Requisition Wait Days—off station used since directly correlate with non-mission capable aircraft for supply (NMCS) or Partially MC aircraft for Supply. *(Figure provided by author.)*

Marines brought together: the software the Air Force has used for a decade and a half, self-correcting techniques that adjust to new problem parts, and experienced personnel who understand the processes and data, enabling implementation of good ideas and corrective actions. Too often, software claims are difficult to validate, since they occur in a model lab or dynamic environment, and it may take years to reveal the actual impacts. This project provided a rare opportunity to observe true impacts on a stable part of the supply chain and helped uncover several additional barriers to performance improvement.

How Improved Inventory Levels Translate into Additional Mission Capable Aircraft

The COLT software tool predicts when parts might fail and determines how many parts are needed in the future to cover most of those failures. Unlike other Navy models, COLT examines past problem parts that ground aircraft to determine the future range and depth of inventory (i.e., what and how much to stock). It produces the optimal mix of parts that achieve an aircraft performance for the least cost. COLT focuses on consumable parts, which are far less expensive than repairable parts (the standard focus for supply improvements). Unlike your local superstore, stocking DOD shelves involves many sources of volatility: orders can take months or years to manufacture, suppliers are limited to one or two companies because of proprietary data constraints, and systems need to account for many external factors such as budget cuts or political dynamics.

As COLT was the only major improvement in spares … we hypothesize that the significant parts-level improvements translated to more aircraft flying …

In February 2018, the Marine Corps began implementing COLT at all its MAGs to forecast their spare parts requirements using a more optimal objective for retail stock. For the same investment in spares, COLT was able to produce the following actual inventory and aircraft improvements one year after implementation.

At the Part Level (NIIN)

COLT fills, from retail stock, more critical orders that would ground aircraft (requisitions that make the aircraft NMCS). Metrics such as *total wait days* (total days waiting for all NMCS/ Partially MC aircraft for Supply requisitions received each month) dropped by 65 percent for rotary-wing MAGs and 69 percent for fixed-wing MAGs (see Figure 1); fill rates (the Navy terms *Gross/Net effectiveness for NMCS requisitions)* increased 10–13 percent at each location (MAG). For the month of June 2020, out of the 11 activities, 9 achieved in excess of 95 percent net supply effectiveness. This feat had never been achieved in Marine Corps Aviation history. (Note, one year later during COVID, total wait days improve by an additional four percent for both types of wings plus a 10th MAG achieves 95 percent supply effectiveness.)

At the Aircraft Level

Six of eleven MAGs experienced readiness improvement (MC rates) ranging from five–thirteen percent, driven mostly by the reduction in aircraft down for supply (NMCS). As COLT was the only major improvement in spares during that time, we hypothesize that the significant parts-level improvements translated to more aircraft flying, although there is no one-to-one relationship as many consumable parts may be grounding a single aircraft. MAGs with fixed-wing aircraft highlight that achievement, as shown in Figure 2 on the following page.

Improving wait times by 65 percent translated into 60 more mission capable aircraft. This improvement demonstrates that addressing consumable supply issues reduced one of the barriers to improving aircraft availability. MAGs with rotary-wing aircraft have other barriers that must be removed; our analysis identified retail repairables as the next focus area to improve the rotary-wing MC rates.

The analysis timeframe avoided including the unique conditions caused

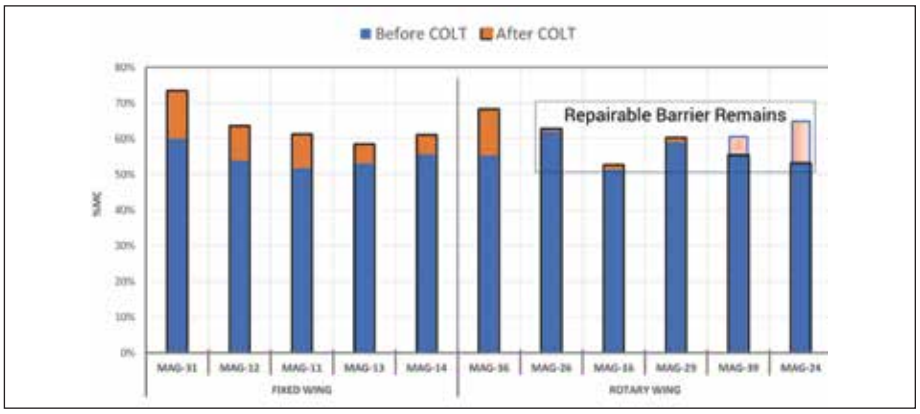

Figure 2. Mission Capability Improvement by MAG. *(Figure provided by author.)*

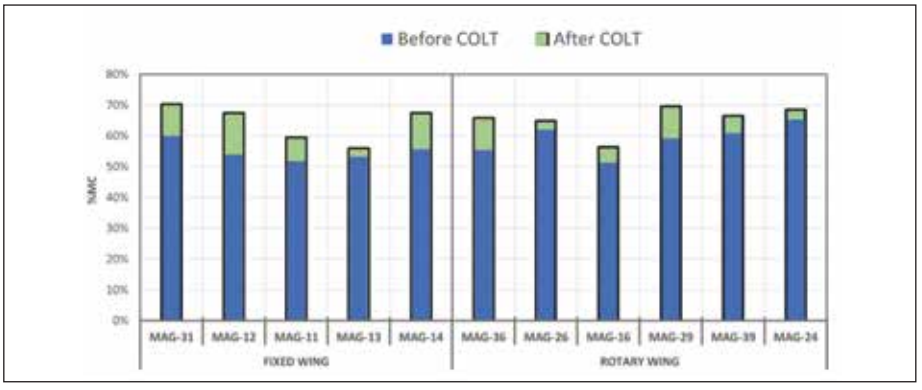

Figure 3. Mission Capable Improvement by MAG (including COVID timeframe). *(Figure provided by author.)*

by COVID concluded with March of 2020. However, if we did include more recent operations (May 2021), the MC rate improved since COLT implementation by eight percent (three percent before COVID and five percent during COVID) averaged across all MAGs (see Figure 3).

The *Commandant's Planning Guidance*, providing metrics for supply chain performance, directs as follows:

> The Marine Corps will be trained and equipped as a naval expeditionary force-in-readiness and prepared to operate inside actively contested maritime spaces in support of fleet operations. In crisis prevention and crisis response, the FMF, acting as an extension of the fleet, will be first on the scene, first to help, first to contain a brewing crisis, and first to fight if required to do so.

A force ready to fight on short notice must receive sustainment that enables maintenance and training, aligned with readiness goals. The Marines' efforts in retail inventory optimization represent an important step toward meeting those goals.

Note

1. COLT is a Government Off the Shelf Supply Model developed and maintained by LMI. The submodule (Proactive Demand Leveling) develops the range of NIINs based upon enterprise requisition. PDL increase in range of parts provides roughly half of the model's benefit so is often referred to as COLT/PDL.

>Author's Note: To learn more about COLT, please reach out to at Polca, Mark A CIV USN COMNAVAIRSYSCOM PAX (USA) mark.polca@navy.mil or Mr. Rob Kline, Senior Fellow at LMI, rkline@lmi.org.

Exploring Context

The origins of maneuver warfare

by Marinus Era Novum

A stated goal of the Maneuverist Papers has been to shed light on the history of the origin of the Marine Corps' maneuver warfare theory. They are accompanied by the thought that many officers today would benefit from the contextual knowledge this provides. The retelling though has been much through the eyes of the victor in regard to the ideas that won. I intend to expand the scope slightly beyond the dichotomy of the intellectual maneuversists and the institutionalized attritionists. To be sure, there was resistance to change—the same as we see today—and it was likely easy to paint this resistance broadly as attritionist. However, there were other ideas about what was (and still is) changing in regard to warfare. If it is important to understand the origins of maneuver warfare, then it is equally important for Marines today to understand the broader strategic and political context in which the ideas have existed. The review offered here is by no means exhaustive; rather, it is an attempt to highlight that there were competing concepts to the modernization of the military in the past several decades and that it was not just an argument of attrition verse maneuver. This article will discuss how this debate and the emerging concepts have become such a focus that they have distracted many leaders and contributed to strategic miscalculation.

The Marine Corps appeared to employ the new maneuver warfare doctrine, which was based on the military reform movement of the 1980s, in the successful Operation Desert Storm. *(Photo by LCpl Alison Dostie.)*

Reform and the Revolution in Military Affairs

The maneuver warfare movement in the Marine Corps fell under the larger umbrella of the military reform movement of the 1980s. The reformers were a group of military and civilian leaders that had concerns about the DOD's reliance on exquisite and overly complex systems, which seemed to dominate much of the focus of the DOD. Prominent leaders of the movement were John Boyd, Pierre Sprey, and Chuck Spinney. The reformers had supporters and advocates at the high levels in the military and government in people like Gen Al Gray and Democratic Senator from Colorado Gary Hart.

John Boyd summarized the three priorities of the reformers in order of importance as:

1. Focus on people—specifically on ensuring the right people are promoted and units can build cohesion before combat. They also highlight the benefits of an all-volunteer force.
2. Then was the importance of ideas. Reformers believed in the importance of intellectual curiosity and the importance of military officers learning history. Chief among the ideas that the reformers promoted was the concept of maneuver warfare.
3. Last on the list of priorities was hardware and weapons. It is not that the reformers thought hardware was unimportant, but it should not be the primary focus of the DOD. They also rejected the notion that American strength lay primarily in technological superiority.[1]

Another concept that was growing alongside that of the reformers was the idea of a revolution in military affairs spurred on by the superior technology of the United States. As a general concept, a revolution in military affairs is some combination of new technology, a set of technologies, or new concepts that emerge which fundamentally alter the character of war.[2] While stemmed by technological or other advances, a revolution in military affairs also generally includes changes in practices, organizational structure, and may require new theory or doctrine to incorporate the technology. There are examples of this throughout history. One such example is the advent of military aviation. Such innovation necessitated new concepts

for employment, which military thinkers like Dohuet turned their attention to create new theories.

The revolution in military affairs referred to in the 1980s was the use of precision strike weapons and information systems to effectively reduce the fog of war for oneself while simultaneously being able to perform strikes with surgical precision. The notion was first conceived of by Soviet analysts and termed Military Technological Revolution. Military Technological Revolution predicted that in the future there would be a reduced need for large ground forces because of advanced weapons technology.[3]

The idea was picked up by some within the U.S. military establishment within the Office of Net Assessment under the leadership of Andrew Marshall.[4] The concept was called a Revolution in Military Affairs (RMA), perhaps confusingly referring to a specific paradigm by the name of the more general concept. Proponents within the DOD saw the possibilities of smaller ground forces able to accomplish more with the aid of precision fires and reduced friction and fog of war as a result of highly capable information systems—thus, changing the fundamental character of war.

The RMA was not the same type of movement as the reform movement. RMA had less of a solid core of believers that was associated with the reformers, particularly in the 1980s. Though it is possible the ideas were more widely spread. It was not until the 1990s that Andrew Marshall pushed for the ideas to be more solidified and connected and the ideas gained more followers from top military leadership.[5]

Reformers and advocates of RMA had key intellectual differences, particularly on the emphasis placed on technology. RMA placed technology at the center of new conceptions of warfare. Reformers acknowledged the advances in technology as important but still valued people and ideas over the pursuit of complex systems. They also believed in maneuver warfare and that this concept was not limited to a particular technological paradigm. Ardent believers in RMA believed that airpower and precision fires could be relied on increasingly more to accomplish goals alone, whereas the maneuver warfare advocates viewed these more as ways to enable the maneuver of ground forces. More important was the idea that information systems could provide near-perfect battlespace awareness to commanders. Maneuverists did not reject improvements in information systems but were skeptical of its actual abilities to reduce the fog and friction of war. This view is highlighted in the opening vignette of *MCDP 6*, *Command and Control*.

Though there were some key areas of overlap, both were used to move away from concepts placing mass and attrition at the center of operational planning. Both have some promise of being able to have an outsized impact with the actions of one's force—one using maneuver and superior decision making and the other through the application of fires with sophisticated weapons.

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The First Gulf War

For most of the 1980s, the primary focus was the Soviet Union, and much attention was paid to responding to Soviet aggression in Europe. However, the George H. W. Bush administration was coming to power under a new global paradigm. One in which every conflict was not some extension of the Cold War. Bush and leaders saw this in grand terms of a new world order.

The 1990 Iraqi invasion of Kuwait was a direct affront to the grand vision of a new world order. The move violated United Nations' mandates and was threatening to U.S. interests in the region. Bush felt a strategy of appeasement would embolden Saddam as well as dictators throughout the world and was reminiscent of allied responses to Hitler's build-up in the Rhineland. He was determined to act.[6]

There were particularly hawkish members of the administration including Secretary of Defense Dick Cheney. In the war, Cheney saw an opportunity to demonstrate the extent of American military superiority. In some ways, the goal of demonstrating the superiority of the U.S. military seemed a goal. This also provided the opportunity for reformers and believers in RMA to demonstrate the superiority of their ideas.

By this time, much of the work of the reformers had had its impact particularly on the doctrine of the Army and the Marine Corps. In the Army, it came in the in the form of AirLand Battle written in *FM 100-5, Operations,* published in 1982, and for the Marine Corps in *FMFM 1, Warfighting* in 1989. Both doctrines were heavily influenced by the reformers and particularly by Boyd's *Patterns of Conflict* and it seemed would be put to the test in the Persian Gulf. There were fewer concrete outcomes of the RMA, but there were many new advanced weapons in which this conflict would be the first wartime test.

Yet, the DOD was not entirely hawkish on Iraq. The Chairman of the Joint Chiefs, GEN Colin Powell, was opposed to entering the war without clearly defined objectives and the presence of overwhelming force to obtain those objectives.[7] These views were formed from Powell's formative experiences during the Vietnam War where he observed the impact of unclear and changing strategy. He was less convinced than others that technological superiority or the use of maneuver or any other operational doctrine was the key to success. He was more focused on ensuring there were well-understood policy objectives and then devising a military strategy to match.

It seems others like Cheney were more willing to jump straight to

military action and leave policy goals open-ended. The policy and strategy goals were outlined in National Security Directive 54, which outlined both the limited war aims of removing the Iraqis from Kuwait and restoring stability to the Persian Gulf but also explicitly mentioned that unlimited war aims of regime change were also on the table. This possibility of regime change was tied to certain red lines but may also have been included as some saw collapsing Saddam's regime as an easy goal to accomplish and would naturally follow after the Iraqis were defeated in Kuwait.

In the end, President Bush called an end to hostilities when the limited war aims were achieved. After six months of build-up, the shooting war was over in 100 hours. While some believed that Saddam should have been removed from power, at the time the war was widely regarded as a large success. Clear political objectives were achieved, and American interests were protected very quickly at a relatively low cost in American lives.

As one might expect after such a success, there was no shortage of people willing to claim their role in the success. Congress, for its part, was eager to understand the source of the success so that it might be duplicated. The House Armed Service Committee held a series of hearings to try to capture lessons learned and ensure continued success. One such hearing took place on 30 April 1991 that was intended to investigate the role of the reform movement in the recent successful operation.[8] The panel was represented by members who were associated with the reform movement, and while not explicitly stated as such, those associated with the technologically driven camp of the RMA. The reformers were represented by then former Senator Gary Hart and John Boyd.

During the hearing, the reformers made bold claims about the role of the reform movement. They attributed the victory primarily to the use of maneuver warfare and the superiority of American commanders. Boyd touted the number of the Army's School of Advanced Military Studies graduates on Schwarzkopf's staff—the school itself a product of the reformers' work. Hart and Boyd downplayed the role of technological superiority as a factor in winning the war. This claim was emphasized to the extent that Senator Hart asserted that because the war only lasted 100 hours we did not have enough time to learn about the effectiveness of the weapons employed and the quick victory was owing to superior leadership of American forces not the weapons employed. He further stated that had the script been flipped and the Iraqis possessed the technological advantage, the Americans would still have won because of their superior leadership. Notably, they offered one exception to the notion that platforms did not have the time to prove themselves, the A-10, which was another product of the reform movement.

Representing the opposing view in this hearing was former Secretary of the Navy John Lehman and former Undersecretary of Defense for Research and Engineering Donald Hicks. These two certainly did not downplay the role of leadership in the victory (this would have been hard as Schwarzkopf was such a popular figure at the time); however, they were unwilling to downplay the role of technological superiority in the victory. They pointed to the ability to gain air superiority, the ability to strike targets as far as Baghdad with relative impunity, advanced command and control, and superior night vision as key components of the swift victory. They even offered that the technological superiority offered the U.S. forces the ability to employ the tenets of maneuver warfare.

It is not apparent to what extent this debate had an impact. Maneuver warfare remained in Army and Marine Corps doctrine, and the DOD at large remained focused on advanced technology. For his part, Cheney later endorsed the role of RMA in the victory in the final report from the DOD to congress.[9] However, in this endorsement there was no rebuke of maneuver warfare, and it is possible in his mind there was not a large distinction as both were juxtaposed with traditional ideas of attrition.

While there was no shortage of people seeking to see themselves in the mirror of success that was Desert Storm, the arguments presented here do not reflect the true nature of the success. The success of war is not measured by operational success or the doctrines and technology employed. Success can only be defined through the achievement of strategic policy objectives. Thus, while both the reformers and proponents of RMA may have things to celebrate in the operational success of Desert Storm, the true success lies in that the stated objectives of the war were achieved. Only by achieving those goals are we then able to further analyze the success in terms of the cost of blood, treasure, and time.

It should be noted that defining these objectives and sticking to them was not a given. The grand visions of a new world order do not lend themselves well to restraint. Some of the hawkish members of the administration seemed willing to dive in headfirst with the belief that advanced technology and operational concepts would ensure swift victory regardless of if the goal was liberating Kuwait or toppling Saddam. The voice of caution came not from civilian members of the administration but rather from GEN Powell.[10]

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Transformation and the Long War

When campaigning for the presidency in 1999, George W. Bush laid

The "long war" that began with Operation ENDURING FREEDOM and Operation IRAQI FREEDOM afforded the "maneuverists" no new successes. *(Photo: II MEF.)*

out his vision for the transformation of the military that he thought was needed for the 21st century. In this speech, he decried the type of long-term commitments in Kosovo and Bosnia that he believed were a drain on American resources and military might. He pointed to the success of DESERT STORM but believed that a six-month-long build-up time was too long for the projection of power. He discussed investment in high-tech weapons and in people.[11] The influence of the RMA and the reformers was present in his speech but given the title of transformation. When Bush was elected, Donald Rumsfeld was tagged with the responsibility of transforming the military as Secretary of Defense—a job that he took to with immense energy and made a priority throughout the DOD.

After the events of 11 September 2001, the United States responded quickly starting military action in Afghanistan on 7 October 2001. The early months of the campaign in Afghanistan would seem to be an endorsement of the views and efforts of Bush and Rumsfeld with ideas of the transformation on display in what appeared to be successful operations. Returning to the Citadel a few months after the start of the war on 11 December 2001, President Bush again made a speech addressing the future of the military. He continued to speak about the need for transformation and praised the early success of operations in Afghanistan. He pointed to the success of small ground forces having large successes with the use of airpower and precision weapons.[12] It appeared that final success in Afghanistan was imminent with the Al Qaeda in hiding and the Taliban removed from power. All of this without the type of long-drawn-out stability operations like those of the Balkans. The type of operations Bush campaigned against and sought to avoid in the transformation.[13] Though, unlike DESERT STORM, in Afghanistan there was no clear and resounding victory defined by objectives achieved, just promising operational success.

With this operational success in hand, the administration made plans to open a second front in the Global War on Terrorism. The focus being to stop the proliferation of weapons of mass destruction and particularly to prevent them from falling into the hands of terrorists. The intelligence failures that lead to this logic are at this point well documented and will not be discussed here.

When it came to planning for Iraq Rumsfeld was an active force, he did not simply pass on policy objectives for uniformed military leaders to devise a military strategy. At the forefront of Rumsfeld's involvement in the planning was the goal of transformation. He was convinced that not only could the United States military overcome Iraqi forces, but it could do so without the months-long buildup of DESERT STORM and with a fraction of the number of troops. As estimates were made by CENTCOM for the operation he continually pressed for fewer troops and even ran direct interference between generals and President Bush when numbers presented were higher than he would have liked.[14]

Unlike Cheney who communicated to the military primarily through the JCS, Rumsfeld dealt directly with combatant commanders. At CENTCOM, GEN Tommy Franks at times pushed back against Rumsfeld but was ultimately amiable to the goals of transformation. Franks even justified the plans with reduced numbers saying, "We are at a crease in history," and this could not be achieved, "[i]f we fought this on an attritional basis." Instead, the plans focused on tenants of maneuver warfare and emphasized capabilities associated with the RMA.[15]

When the plan was carried out in the 2003 invasion of Iraq, all the tenants of maneuver warfare, RMA, and the transformation were on display. Emphasis was placed on defeating the Iraqi system rather than through the attrition of its parts. Precision fires were used to target command and control capabilities and other critical capabilities. Speed of maneuver forces was used to create a rapidly deteriorating situation for conventional Iraqi forces. The ground forces continued to value speed over security even as they encountered an unexpected adversary in the Fedayeen. All this focused on the sources of power of the Saddam regime. As it turned out, the operation set conditions inimical for security and stability in post-Saddam Iraq. The situation quickly fell apart and the United States found itself caught in a situation it was ill-prepared for. As this was happening in Iraq, the early successes in Afghanistan turned into distant memories as it devolved into its own quagmire.

As in the Gulf War, there were many in the establishment that had grand world visions and new operational concepts for a new American military, but this time there was no influence to

temper these views. As CJCS, Powell was able to contain the grand visions and enthusiasm for new concepts. There were some warnings from military leaders. Notably, when asked by congress Army, Chief of Staff GEN Shenseki thought estimates for force levels needed in Iraq were far too low. There was some concern about post-war security. While some offered warnings, there were no military leaders that were able or willing to curb the enthusiasm of Rumsfeld and the Bush administration.

... the focus on the concepts ... cannot ... distract from ... future conflicts in which we will find ourselves.

The Lesson

There was no opportunity for maneuverists, proponents of RMA or transformation to tout their ideas in light of the successes of invasions of Iraq and Afghanistan, as there was no share of laurels to claim. Looking back to the debates after DESERT STORM, we can see that they missed the main reason for America's success and set the stage for the failures of the campaigns of the early 21st century.

The true success of DESERT STORM was in the basic application of strategy. Before the outset of the war, Powell worked to ensure the objectives were clear, understood, and met with the appropriate amount of force. He emphasized the nature of the war in its political roots and objectives and remained focused on them. To be sure, the innovations reformers, maneuver warfare, and technologies associated with RMA all played a role in the success, but the employment of these concepts and technologies did not distract from the true nature of the war. Yet, in investigating the success of the campaign, this was the subject of debate rather than the source of good policy.

As these ideas made it into the next Bush administration in the form of the transformation, we saw that the goal of transformation became an end unto itself. Achieving transformation of the military was a political goal internal to the United States, which should have remained on the fringes of strategic planning. Yet, it became the focus.

In doing so, American leaders at many levels failed at what Clausewitz called, "The first, the supreme, the most far-reaching act of judgment that the statemen and commanded have to make."[16] That judgment "is to establish by that test the kind of war on which they are embarking; neither mistaking it for, nor trying to turn it into something that is alien to its nature."[17]

As we move forward, it is necessary to digest the lessons of the reformers, the RMA, and of the transformation. It will also be necessary to continue to learn and develop new concepts regarding doctrine, operational concepts, and technology. This is especially true now as we move on from recent experiences to conflicts that will likely look vastly different. However, the focus on the concepts themselves cannot be allowed to distract from the nature of the future conflicts in which we will find ourselves. The Marine Corps currently has maneuver warfare as its stated operational doctrine and philosophy. Whether or not that remains the case, we cannot allow the adherence to that doctrine to blind us to the true nature of the conflicts we will find ourselves in.

Notes

1. Summary with some commentary on the part of the author of U.S. Congress, *John Boyd's testimony to House Armed Service Committee on the Role of U.S. Military Reform after Operation DESERT STORM*, (Washington, DC: April 1991).

2. There is some scholarly discussion of the definition of RMA. The definition given here is adapted from: Steven Metz and James Kievit, *Strategy and the Revolution in Military Affairs: From Theory to Policy*, (Carlisle, PA: Strategic Studies Institute, U.S. Army War College, 1995).

3. Ibid.

4. Ibid; and Paul Davis, *Military Transformation? Which Transformation, and What Lies Ahead?* (Santa Monica, CA: RAND, 2010).

5. *Military Transformation? Which Transformation, and What Lies Ahead?*

6. George H.W. Bush and Brent Scowcroft, *A World Transformed,* (New York, NY: Vintage Books: A Division or Random House Inc, 1998).

7. Michael Gordon and Bernard Trainor, *The General's War*, (Boston, MA: Back Bay Books: Little, Brown and Company, 1995).

8. The full hearing can be found at https://www.c-span.org.

9. Department of Defense, *Conduct of the Persian Gulf War, Final Report to Congress*, (Washington DC: U.S. Government Printing Office, 1992).

10. *The General's War*.

11. George W. Bush, "Campaign Speech," (speech, the Citadel, Charleston, SC, September 1999)

12. President George W. Bush, "Speech on Future of the American Military," (speech, the Citadel, Charleston, SC, September 1999).

13. Michael Gordon and Bernard Trainor, *Cobra II: The Inside Story of the Invasion and Occupation of Iraq*, (New York, NY: Vintage Books: A Division of Random House, Inc, 2006).

14. Ibid.

15. Ibid.

16. Carl von Clausewitz, *On War,* translated by Michael Howard and Peter Paret, (Princeton, NJ: Princeton University Press, 1976).

17. Ibid.

Chess vs. Wei-Chi

Why the Chinese will target logistics in the next conflict

by Capt Paul S. Panicacci

>Capt Panicacci is an 0402 Logistics Officer, currently serving as the Logistics Operations Training Section OIC (Coyote 43) at the Tactical Training and Exercise Control Group in MCAGCC Twentynine Palms. Previously, he has served as the Logistics Officer for 3/7 Mar deploying to Marine Rotational Force-Darwin, and the Motor Transportation Officer with CLB 26, deploying on the 26th MEU.

Part 1: High Value Target Lists

In May 2019, I was the new logistics officer for 3/7 Mar. I had been in the seat for a few months when our battalion was selected to fight 2/5 Mar(Rein) during the force-on-force portion of Integrated Training Exercise 3-19, the forerunner to MAGTF Warfighting Exercise (MWX). During an operational planning team for the exercise, our combined anti-armor team (CAAT) platoon commanders came to me with a question: "If you were the S-4 for 2/5, what couldn't you live without?" Put another way, it is a question rarely asked of a battalion logistics officer: "What do you want me to kill?"

I pulled up *MSTP 5-0.3*, the *MAGTF Planner's Reference Guide*, on my laptop. Scrolling down, I showed them the graphics depicted: "This is an LVSR. It carries what is called an FRC, which holds 2,500 gallons of fuel. If you kill one of these, you kill a platoon of tanks 289 miles later." I showed a picture of a MK-31 with a MK-970 trailer: "If you kill one of these, you kill 5,000 more gallons of fuel." I showed them a SIXCON: "Each of these is either 900 gallons of fuel or of water. Kill a truck with three of these, and V25 either doesn't drive or drink water for a day."

Two years later, V37 participated in MWX 3-21. In developing the High Value Target List and Attack Guidance Matrix, we capitalized on the mature staff we had developed over the previous 30 months and incorporated enemy logistics into our targeting guidance. As 1st MarDiv conducted sequential and ultimately futile mechanized assaults through the Quackenbush and Emerson corridors, friendly CAAT, scout sniper teams, and UAS operators systematically dismantled the logistics trains supporting them through an integrated kill chain of direct, indirect, and aviation fires.

The Marine Corps' maneuver warfare doctrine is vicious and lethal. Hard, realistic, combined arms training is extremely effective for conditioning combat arms elements to locate, close with, and destroy the enemy by fire and maneuver. All this is predicated, however, on the ability of logistics units to maintain ground and sea lines of communication forward to fighting units. This should be obvious to most, but in practice, it is often forgotten.

In the next major peer-level conflict, as in MWX, the ability to sustain front line units will be massively tested. The mature battlespaces of Iraq and Afghanistan with berms and HESCO aboard monolithic air bases and well defended forward operating bases afforded logisticians the ability to push mass quantities of supplies as far forward as possible. While they remained vulnerable to attack during transportation in convoys and aircraft, these assets were not at undue risk of annihilation or capture by the enemy while aboard these safe havens.

This immense logistics capability will not be available to the United States in a superpower-level conflict. Precision weapons systems and targeting abilities that have been available for decades will preclude massive, monolithic movements of supplies. The Red Ball Express model from the European Theater of World War II, for example, will not be a viable network of transporting supplies in the next major conflict. In considering the recent conflict between Azerbaijan and Armenia, extremely effective Azeri attacks on Armenian logistics nodes and assets using drone strikes and loitering munitions, we can gain a small perspective into what the future of tactical logistics will look like. In the context of the Chinese People's Liberation Army (PLA), "the use of precision-strike capabilities and intelligent munitions that have reduced the 'concept of distance on the battlefield,' [allow] for target-centric warfare."[1]

Logistics units will not square off against enemy logistics units in the future operating environment. Logistics units will be targeted by combat arms units, guerilla units, and aviation assets, and their survivability should be evaluated in that context. I predict that Chinese tactics in the next conflict will deliberately avoid friendly combat arms units in favor of exploiting logistics units. We should ask ourselves: would our logistics be capable of surviving targeting by our own combat arms?

Inabilities and Incapables

The PLA as well as the PLA Navy's inability to project power through naval means and sustain combat forces in austere conditions will likely lead to their inability to confront American forces in direct sustained combat in any theater outside of the Chinese mainland.[2] By extension, it is plausible that the Chinese military will entirely

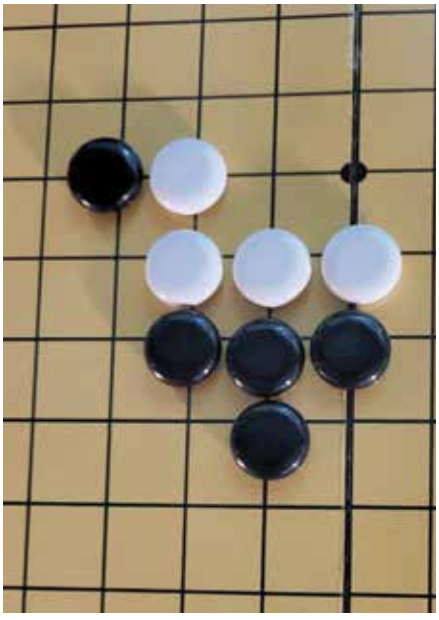
avoid decisive engagement with frontline combat arms units.

The shortcomings of the PLA are known to Chinese Communist Party leadership. Internal reviews of Chinese military capabilities frequently cite the "Two Inabilities" and the "Five Incapables" criticisms of the PLA written by General Secretaries of the Chinese Communist Party. Deng Xiaoping noted as the two inabilities that the PLA is unable to fight a modern war, and "the ability of officers and staffs at all levels to command modern war is insufficient." In the 2015 Five Incapables, Xi Jinping noted that commanders cannot judge the situation, understand the intention of higher authorities, make operational decisions, deploy troops, or deal with unexpected situations.[3] As a result, the Chinese Communist Party assesses that its own PLA will struggle in modern warfare.

Much of this can be attributed to the high level of control that the Chinese Communist Party exercises over the PLA. Their distrust of the armed forces is demonstrated by the fact that political commissars are attached to each commander in the PLA, serving the same purpose that political commissars did in the Soviet Union Red Army. To ensure loyalty, commissars vet all commanders' decisions before promulgation to subordinates and continuously assess commanders' loyalty to the party.[4]

These shortfalls will prevent commanders and decision makers from being able to keep up with the frenetic pace that American, and Marine Corps commanders especially, set when conducting offensive operations. With the rapid pace and tempo that American forces are capable of generating, this will virtually ensure that PLA commanders will not want or be willing to compete in a toe-to-toe match up with combat arms units of the U.S Armed Forces. They will likely prefer to engage with us in indirect ways.

It is important to recognize, however, that the PLA is working to correct these deficiencies with methods that include force-on-force exercises on a scale significantly larger than MWX. The PLA 195th Heavy Combined Arms Brigade, for example, is a standing adversary force that wears desert Marine Pattern uniforms and that is manned and equipped to mirror a U.S. Army Brigade Combat Team.[5]



Wei Chi is based on the objectives of relative advantage and strategic encirclement. *(Photo by C.I.W..)*

Critical Vulnerabilities

Institutional shortfalls and lack of combat experience since the third Vietnam War of 1979 lends itself to the idea that PLA leadership will intentionally skirt all decisive engagement with the lethal combined arms capabilities of the U.S. military. They will avoid surfaces and will choose to exploit gaps, just as American doctrine dictates. Apart from Cyber Warfare, which the Marine Corps is in the process of addressing, I assert that the biggest gaps of the Marine Corps are logistically based.

The objective in chess is total victory through a combination of attrition and maneuver. *(Photo by C.I.W.)*

This critical vulnerability extends all the way from the tactical to the strategic level. The Chinese "Unrestricted Warfare" doctrine will be the avenue through which operational and strategic logistics are targeted. Methods outlined by the authors of the doctrine (PLA colonels, writing in 1999) include targeting the internet, disabling critical infrastructure such as the power grid, water, and water treatment, and sabotaging the American agriculture industry with biological weapons. At the very least, we can expect that supply/maintenance interfaces such as Global Combat Support System-Marine Corps (GCSS-MC) will be taken offline at the outset of a conflict. Supply chains will likely be interrupted by both electronic means and physical countermeasures. However, in order to stay within the intent of this article, we will focus on the tactical level.

At the present moment, tactical logistics is not given adequate attention in the way that the Marine Corps employs maneuver warfare doctrine. As stated previously, the ability of Marine Corps combat arms units to mass fires upon a given frontage and depth, and maneuver on an enemy position is the envy of other military organizations the world around. However, the ability to sustain this violence of action is not paid its due. Consider that among I MEF units in Fiscal Year 2020, 1st MarDiv fired 3,170,927 rounds of machine gun ammunition in training, while the entirety of 1st MLG expended less than 10 percent of that—only 296,888.

Consider also the Table of Organization and Equipment disparity between the GCE and the LCE. While the infantry battalion is capable of talking to every unit in the battlespace, the Combat Logistics Battalion (CLB) struggles to issue radios to every truck in a convoy.

Additionally, despite the fact that a CLB is typically designated as the rear area coordinator for any MAGTF operation, they do not have a fires SME capable of clearing and approving fires, or an Air Officer, FAC, or JTAC capable of controlling aircraft. The CLB has no high explosive solution for an enemy armor problem, unless you count the MK-19, which rarely leaves the armory of a CLB. It has no javelins, SMAWs, AT-4s, LAWs, TOWs, or any Marine even trained to use them. The CLB has no air defense capability and is still issued M16s, ECH cut helmets, PVS-14s, and sometimes even legacy interceptor plate carriers.

Secondly, the current LCE ITX training package reflects unrealistic and inadequate training standards for peer-level conflict. The MOT, MOC, MFME, Advanced, and Enhanced Motorized Operations Course (AMOC/EMOC) are not in depth enough to make convoys survivable in a peer level conflict. They are holdovers from the COIN environments of Iraq and Afghanistan and need to be heavily updated. Logistics units habitually come to ITX categorically unprepared to conduct complex fire and maneuver in training, as tactical training is simply not conducted at home station. This leads to simplified ranges that only stress the most basic tactics, techniques, and procedures (TTPs). Current motor transport tactics do not incorporate tactics developed and proven by mechanized offensive platforms, such as CAAT, Light Armored Reconnaissance, and AAVs. Additionally, the ability of a CLB headquarters to command and control combat operations is limited—to say the least.

This is not necessarily the fault of Tactical Training Exercise Control Group (TTECG) nor that of line units. Clear guidance needs to be promulgated from the highest levels to establish realistic and aggressive LCE training standards. Training and Readiness Standards and Mission Essential Task Lists need to reflect critical tasks in the new operating environment in order to justify supporting arms and ammunition allocations for home station training. Further, Marine Corps Common Standards, such as *MCCS-OFF-2103, Conduct Offensive Operations*, need to be utilized and adhered to rather than taken as a suggestion. This is one reason that I advocate for one or more 0399s to be organic to LCE battalions, but that is another article. According to *MAGTFTC Observations from MWX 2-20*, "A lack of consequences for poor tactical actions relating to resupply performed in an administrative manner has created the set of poor habits ... observed in every iteration of force on force at MCAGCC."[6]

In considering the Chinese perspective on strategic encirclement, we should discuss ... the game of Chinese intellectuals, Wei Chi.

An LCE conducting rear area security is ineffectual if its operations are entirely defensive. Further, a lack of offensive mindset plagues the logistics community in the Marine Corps, as all our training is purely defensive in nature. This critical vulnerability will be at the forefront of the next conflict. In order to understand how the PLA might engage with U.S. forces, specifically logistics, we will next examine their doctrine and relevant cultural idiosyncrasies.

Strategic Encirclement

In considering the Chinese perspective on strategic encirclement, we should discuss what is commonly considered to be the game of Chinese intellectuals, *Wei Chi*. Henry Kissinger, in his book *On China*, describes best the juxtaposition of *Wei Chi* with what is considered the intellectual game in the West—chess:

> China's most enduring game is *Wei Chi*. The board, a grid of nineteen-by-nineteen lines, begins empty. Each player has 180 pieces ... each of equal value with the others. The players take turns placing stones at any point on the board, building up positions of strength while working to encircle and capture the opponent's stones. At the end of a well-played game, the board is filled by partially interlocking areas of strength. The margin of advantage is often slim, and to the untrained eye, the identity of the winner is not always immediately obvious.
>
> Chess, on the other hand, is about total victory. The purpose of the game is checkmate, to put the opposing king into a position where he cannot move without being destroyed. The vast majority of games end in total victory achieved by attrition or, more rarely, a dramatic, skillful maneuver.
>
> If chess is about the decisive battle, W*ei Chi* is about the protracted campaign. The chess player aims for total victory. The *Wei Chi* player seeks relative advantage. In chess, the player always has the capability of the adversary in front of him; all the pieces are always fully deployed ... *Wei Chi* teaches the art of strategic encirclement. Where the skillful chess player aims to eliminate his opponent's pieces in a series of head-on clashes, a talented *Wei Chi* player moves into "empty" spaces on the board, gradually mitigating the strategic potential of this opponent's pieces. Chess produces single-mindedness; W*ei Chi* generates strategic flexibility.[7]

Eastern Deception

I offer that the Chinese perspective on conflict is not the same as that of western civilization. Western military doctrine glorifies Carl von Clausewitz, B. H. Liddell Hart, and Col John Boyd, who preach maneuver warfare, centers of gravity, and critical vulnerabilities. The Chinese take their guiding principles from Sun Tzu, Mao Zedong, and theories of conflict stemming from Marxist-Leninist Dialectical Materialism, all of which value deception, strategic encirclement, and biding time to set conditions for decisive action. In light of this, the Chinese are more likely to

target U.S. logistics units than combat arms units.

While it is particularly un-communist to reference a warring states era strategist, the Chinese incorporate the teachings of Sun Tzu in their training. From the beginning, Chinese Officers are indoctrinated with the importance of victory through deception and unconventional tactics.[8] As well, the concept of deception is understood in a fundamentally different manner in Eastern strategy.

According to *Nuances in Chinese Political Culture,*

> Chinese literature on strategy from Sun Tzu through Mao has emphasized deception more than many military doctrines. Chinese deception is oriented mainly toward inducing the enemy to act inexpediently and less toward protecting the integrity of one's own plans. In other cultures, particularly Western, deception is used primarily with the intention of ensuring that one's own forces can realize their maximum striking potential ... the prevalent payoff of deception for the Chinese is that one does not have to use one's own forces.[9]

In recent years, the PLA has been developing the operational concept of "Informatized Local Warfare," the successor to "Local Wars," which itself succeeded Mao's "People's War." As a means to fight informatized local wars, the PLA has pursued the approach of "system destruction warfare," similar to the network centric warfare that the U.S. practices, but broader. According to system destruction warfare, one side "will be able to attain victory in war without massively annihilating the enemy's vital strengths and will be able to realize the goal of war through controlling and paralyzing enemy systems to make the enemy lose its integrated-whole resistance capabilities." This is done by focused "strikes against targets that are vital to sustaining and supporting the enemy's operational system."[10]

With this enemy-centric focus on deception among Eastern military theorists and the recent advancement of target-centric warfare, I predict that Chinese tacticians and commanders will use this principle to draw in American and Coalition forces to untenable positions, force them to commit to nonviable courses of action, and fix these frontline units. Once this has occurred, the adversary will be free to harass rear area forces, especially logistics trains and combat trains but also air and seaports of embarkation and debarkation. *Threat Brief Charlie*, published by the Marine Corps Tactics and Operations Group (MCTOG), and ATP 7-100.3 support this prediction as well.[11]

I predict that this will be an enduring and defining characteristic of the future conflict, manifesting itself from the tactical level to the strategic. A commander that employs this successfully can simply allow the enemy's fighting force to wither on the vine as ineffectual logistics units are systematically destroyed in rear areas. According to the *Hundred Year Marathon*, "Beijing's strategy is to be like the boxer who uses his knowledge of vital body points to knock out a bigger opponent."[12]

Part 2: What to Do About It

The United States, especially the Marine Corps, is playing chess regarding its logistics organizations. Historically, this has been very effective in conventional conflicts. Deliberate, measured sustainment efforts based on consumption data and projections help to drive down costs while ensuring that front line troops receive what they need. Looking forward, however, it is clear that in a peer-level conflict, it will become a weakness. Large scale, monolithic organizations optimized for efficiency and cost-savings in peacetime will inevitably be inflexible and unresponsive, becoming a liability in wartime.

In the next major conflict, we will not be able to build iron mountains of supplies close to front-line troops, as they were used to great effect during the Global War on Terror conflicts. Doing so invites attack on these depots and will leave critical quantities of food, water, fuel, and ammunition open to destruction or capture. What then can we do to ensure that the flow of supplies continues forward to the frontline troops—even in a denied environment?

In order to maintain reliable ground and sea lines of communication when they are being actively targeted by a peer competitor, there are numerous steps that we must take to revitalize the logistics community in the Marine Corps. Logistics is the warfighting function upon which the successful execution of all the other warfighting functions is predicated, so our logistics units must become more lethal, faster, more maneuverable, and significantly more flexible. We must be able to play both chess and W*ei-Chi* simultaneously.

Staff Training

The first thing that we must do is to train staffs (from battalion to MEF-size) to treat logistics operations in the same manner that we treat maneuver operations. Too often, logistics units are simply left to their own devices or tasked to "provide logistics," with no amplifying guidance or information. This is not necessarily the fault of staffs or commanders, more often it is based on a fundamental miscommunication between the maneuver community and the logistics community. Logistics units are typically unaware of things that maneuver units take for granted, such as the location of IDF agencies, communications re-transmission sites, tasking and availability of friendly aircraft, or the Communications-Electronics Operating Instructions of their supported or adjacent units. According to *MAGTFTC Observations from MWX 2-20*,

> A lack of integrated resupply planning between GCE and LCE or between companies and unit logistics ... has been a trend throughout MWX and its predecessors. This is a direct reflection of the manner in which units generally train across the fleet.[13]

A logistics element with a common operational picture of the battlespace is only possible through close integration with maneuver. Logistics and maneuver subject matter experts are very protective of their own warfighting functions, which often drives a wedge between the communities. This prevents either from learning valuable lessons from each other and seeing the principles that can be applied to their own unit. To quote GEN George S. Patton, "The officer

who doesn't know his communications and supply as well as his tactics is totally useless." The inverse is true as well.

To accomplish this, deliberately planned and executed, logistics-centric wargames must become commonplace in staff training exercises. While MCLOG is pioneering this effort, it is mostly capitalized on only by logistics units. In standard, combined arms wargames, it is important that logistics limitations are not brushed off so as not to impede the kinetics of the exercise. A specific anecdote I offer comes from March 2020 when the staffs of each battalion in 7th Marine Regiment conducted a Kriegsspiel at MCTOG. It featured a scenario in which the blue force, a battalion landing team approximately 200 miles west of MCAGCC was tasked with conducting a mechanized movement to contact against the red force that was establishing a defense in central MCAGCC.

Unfortunately, no conversation was had about the range of each vehicle or of refueling assets, whether by Blue Force or the adjudicators of the exercise. Within the V37 planning space, we had determined that Blue AAVs would run out of gas well before reaching their objective. Nobody, be it Blue Force or MCTOG personnel, discussed what refueling assets a MEU CLB embarks aboard ARG shipping nor discussed the delays that would occur when the movement to contact needed to pause for refueling before pressing into the attack.

This is why we have unrealistic expectations of logistics in the Marine Corps. During an after-action report for that series of Kriegsspiels, the former Commanding General of MAGTF-TC said, "It astounds me the number of times that units run out of fuel on their way to an objective." We do not practice logistics in an academic setting, and only recently with the advent of MWX force-on-force training do we hold units somewhat accountable in the tactical play of a problem for failing to respect and know their logistics.

Logistics Officers Course

Next, the Logistics Officers Course needs to be significantly longer, and its priorities re-evaluated. The amount of information we expect second lieutenants to absorb during the ten-week course is unrealistic. This includes GCSS-MC, the Maintenance Cycle and Maintenance Management, Motor Transport, Landing Support, Air Delivery, Engineer integration, Surface, Ground, Air and Rail Embarkation, Armory operations, Food Service, Health Services, and Supply functions. The colloquialism applied to logisticians, "jack of all trades, master of none," is an effective buzzword until the breadth of required areas of expertise exceeds the scope of knowledge that a logistician can retain, and we simply water down excellence in any one area.

> ***… disaggregated operations need to be taught, and codified in doctrine … iron mountains will be obsolete and highly targetable …***

In order to prepare for a conflict in which logistics trains and nodes will be high value targets for the enemy, we should fill the extra weeks of the Logistics Officer Course (LOC) period of instruction with the following four concepts. First, there needs to be shooting and tactical force-on-force evolutions, of which there are currently none. These need to be both mounted and dismounted as well as offensive and defensive. To simply make all learning electronic, save for a few convoy simulator evolutions at the Combat Convoy Simulator and LOCFEX, is setting up the community for failure.

Second, scouting and patrolling, infiltration, and virtually all offensive operations have atrophied to the point of extinction in the logistics community, and should have special emphasis placed on them during LOC. The logistics community frequently forgets that its core mission is to employ violence on behalf of the United States, not just to drive trucks. Junior officers are mostly cut from the same cloth at The Basic School (TBS), with the individual characteristics of each community becoming prominent somewhere in each MOS pipeline. The lack of lethality in the logistics community is bred somewhere post-TBS and must be corrected.

In order to truly treat logistics operations as maneuver elements, we need to start at the beginning of a logistics officer's career, and practice integrating indirect and aviation fires, especially in convoy settings. Logistics units, based on their relatively small quantity of offensive assets and general restriction to roadways and linear danger areas, need to incorporate external fires in order to maneuver past or onto enemy units in an engagement. A common counterargument to this is that logistics officers are taught basic call for fire techniques at TBS and should have retained those skills. This does not take into account the fact that fires integration is a significantly perishable skill, and LCE units do not practice it.

Third, logistics officers graduating LOC should be required to conduct training in Twentynine Palms, just as officers in Infantry Officer Course conduct PALMFEX. Ideally, these student logistics officers would be required to conduct operations while being actively targeted by the student infantry officers.

Finally, disaggregated operations need to be taught, and codified in doctrine. As stated previously, iron mountains will be obsolete and highly targetable in the next conflict. The hub-and-spoke method of distribution at the tactical level should be considered obsolete. Instead, logistics officers should be taught to employ small boats and small logistics ground vehicles in order to be capable of employing a mesh, or spiderweb network of logistics to replace the traditional hub-and-spoke. By effectively employing communications systems such as MUOS to replace the tired programs of record GCSS-MC,

Common Logistics Command and Control, and Transportation Capacity Planning Tool, we will be able to effectively incorporate small, flexible, and responsive logistics cells capable of mutually supporting each other.

Suppress and Press

Motor Transport standard operating procedures are nearly all defensive in nature. When machine gunnery is employed, it is utilized in order to fix the enemy and allow the bulk of the convoy to maneuver past the enemy. While this was an effective tactic in the mature battlespaces of Iraq and Afghanistan, I argue that it will not be in a conflict with a peer competitor. Logistics units will be fighting professional enemy combat arms units that are actively hunting them and trying to destroy them, not the same threats faced in Iraq and Afghanistan. Responding to an ambush with anything less than overwhelming violence of action and attempting to escape the ambush without decisive kinetic engagement will result in a high likelihood of destruction of the convoy.

To counter this, Motor Transport machine gunnery tactics should be updated to more closely resemble the fighting style of assault amphibian units or CAAT. While the engine compartments of MTVRs are not armored as AAVs are, neither are the JLTVs of CAAT, and the vehicle still serves as a mobile machine gun platform. Rather than automatically ceding the initiative to the enemy upon contact and trying to escape the kill box, motor transport units should train to a plethora of different TTPs. An example is training to bulldog enemy ambushes. That is, to place vehicles online and bound forward, maintaining a base of fire between subsequent bounds. Alternatively, the tactical situation may require a fix-and-flank maneuver, employing the most engaged unit to respond with withering firepower and allowing the least engaged unit to maneuver out of the kill box and strike at the enemy flanks. These tactics should be available to the convoy commander as options in the toolbox to use as the situation dictates but are not currently taught at all. An enemy light infantry force will attack with ATGMs, heavy machine guns, and precision fires, not just RPGs, PKMs, and IEDs.

When logistics units come to ITX, categorically unprepared to conduct the training events outlined in the handbooks that are provided ahead of time, they expect the coyotes to instruct their Marines, leading to a watering down of training events. Take the Motorized Operations Training Section program as an example. It consists of a static machine gun shoot and a live fire bounding exercise as prerequisites for more realistic events. Only after demonstrating sufficient weaponeering ability in these basic events are units allowed to participate in AMOC and EMOC, which incorporate close air support and artillery call for fire procedures, respectively. Such a diluted training package would never be observed among GCE units.

Units should arrive at ITX at the colloquial varsity-level, capable of jumping straight into the AMOC and EMOC, rather than having to be led by the hand to execute 1000 and 2000-level T&R tasks. A discussion that has occurred within the Logistics Training Team at TTECG is reintroducing the Convoy Operations Course, which was a training event at CAX in the early 1990s. It consisted of a convoy staged at the base of Range 410A, at which point an ambush occurred and the Marines were expected to dismount and take down the range. Range 410A is traditionally a live-fire infantry platoon range. Unfortunately, I do not believe that any Motor Transportation platoon in the Marine Corps has the initiative or tactical ability to conduct the same exercise today. In a perfect world, logistics units would conduct challenging tactical training at home station, and the LTT at TTECG could focus on improving the training package to prepare exercise forces to fight a peer competitor, instead of trying to prove that the phrase, "Every Marine a rifleman," is not a simple platitude.

Current TTPs are indicative of a larger problem in the logistics community, the lack of an offensive mindset. For example, the term "blocked ambush" is specific to the logistics community. In the combat arms community, a blocked ambush is simply an ambush. It is a given that an ambush should be blocked. Convoys should be considered large, mobile defenses, two tenets of which are offensive mindset and defense in depth. Neither of these are typically incorporated in convoy SOPs. We can develop the offensive mindset by updating motor transport tactics and develop defense in depth by employing indirect and aviation fires.

Training: Disaggregate

As we discussed briefly in our conversation about LOC, the traditional hub-and-spoke concept of logistics should be considered obsolete. There are too many single points of failure that can be targeted by an enemy force to render the network ineffective. If we expect to be disaggregated in an EAB operation, we should train that way as well. Multi-functional platoon-sized elements and smaller should be established and trained to. Instead of a rigid point-to-point distribution method, we should allow any CSS point to conduct resupply to any using unit requesting support. The network should resemble a mesh, capable of flexing to support any unit on the map, including mutually supporting each other. This more nebulous network will be much more difficult to detect and track by the enemy, as it is not centralized, exploitable, or (as) easily targetable, but the benefits of mass are maintained.

Employing MUOS point-to-net capability at each cell allows for logistics requirements to be registered with the supporting unit and then backfilled. Each logistics cell requires this capability to communicate with higher headquarters, adjacent units, and supported units. Rather than relying on bandwidth heavy programs of record including GCSS-MC, Common Logistics Command and Control, and Transportation Capacity Planning Tool, a simple resupply request can be typed out in the transverse chat box. This is available for all users on the net to observe and action, as appropriate. However, this requires a flat communications architecture and senior logistics leaders to become comfortable with decentralizing their network and ceding

initiative and decision-making authority to subordinates.

A mesh network may be difficult to establish at the outset of a conflict. Loading the box in an expeditionary advanced base operation will likely require a hub-and-spoke approach. However, with emerging capabilities such as autonomous surface craft, submersibles, and joint precision air delivery systems, many classes of supply can be prepositioned for logistics cells to fall in on. Force preservation is obviously a concern for small units operating in contested environments, but if we actively work to improve the lethality of our logistics units in the manners listed above, we simultaneously increase their survivability.

To make any of this possible, the capability disparity between GCE and LCE that we discussed earlier regarding the Table of Organization and Equipment must be closed. In a battlespace without clearly defined front lines, with long range precision fires threatening all actors in the area of operations, the LCE must be able to effectively communicate, command and control, have the ability to control indirect fires, aviation fires, and be capable of employing direct fires effectively.

Conclusion

I teach a class during every ITX called "MWX Logistics Lessons Learned." The class title is fairly self-explanatory, and in it, we discuss after action points from previous iterations of the MAGTF Warfighting Exercise, as they pertain to the function of logistics. The class usually entertains an audience of 40–50 logisticians and other interested parties (executive officers, medical officers, etc.) from both Exercise Force and Adversary Force. I open the class the same way, every ITX: "I love MWX, because I've been saying for years that the Marine Corps needs to fundamentally change the way we employ logistics, or everyone in this room is going to die. MWX shows that to be true in every iteration."

Logistics units will be deliberately targeted by enemy combat arms units or guerilla units, not enemy logistics units. To that end, it is crucial that we train within that paradigm. Improving staff training to increase communication between the maneuver and logistics communities gives a common understanding about realistic capabilities and limitations. Increasing the offensive mindset at LOC and refocusing the scope of training there will revitalize the logistics community. In updating motor transport operations training standards and closing the capability gap of the LCE's Table of Organization and Equipment, we increase survivability and create a culture of excellence in lethality as well as transportation. Finally, we must practice disaggregated logistics. A CLB headquarters should simply facilitate the operations of its logistics cells, as centralization in logistics leads to inefficiency, complacency, and failure.

Through these efforts, we can support *Force Design 2030*. We can counter the strategic encirclement tactics of our adversaries while simultaneously creating a system that is flexible, reliable, and responsive. Logistics alone is insufficient to win wars, but it is the predicate to the successful execution of all other warfighting functions.

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What Are Your Orders, Sir?

How we train versus how we fight

by Mr. Brendan B. McBreen

Every day around the world, Marine leaders issue clear orders. Marine units execute these orders. As professionals, we emphasize correct tactical language and precise communications.

The corporal says: *"We will **search** every vehicle in order to stop any VBIED from getting inside the compound."* The staff sergeant says: *"We need to **block** this intersection in order to protect the airfield from insurgent vehicles."* The lieutenant says: *"1st Platoon will **clear** the west side of the village in order to prevent snipers from firing on the convoys."* The captain says: *"Alpha Company will **seize** the apartment building, objective two-zero, in order to control the downtown avenues of approach."*

These sentences—as well as the deliberate sentences that follow them—are orders. You have heard them, and you have issued your own, in combat, contingencies, deployments, and training. What are *your* most effective orders techniques? Where are they taught? How should Marine leaders best issue orders under pressure, in combat? These are important skills for any military organization, but our actual practices—what we do out there in the dirt—conflict with our doctrine and our training.

Why Is What We Teach So Far Removed from What We Do?

Afghanistan, 2021.

Last month, I talked to a Marine officer, a unit commander, who had issued orders on the tarmac at Kabul airfield during the evacuation. He described his orders process, built on the real-world techniques he had learned and practiced over the years. In a chaotic, rapidly changing situation, with only verbal guidance from his own commander and almost no time for analysis or preparation, he issued verbal orders from outline notes to a mixed unit of Marines and British soldiers—just like he had trained himself to do.[1] He did so by using practical methods he had shared and discussed with leaders across the Marine Corps.[2] However, this was *not* like our schools had trained him to do.

>Mr. McBreen is a former Infantry Officer who retired in 2012 after 25 years of service.

Iraq, 2003.

Two decades ago, our commanders in Iraq said the same thing. After 6 months preparing for the first 24 hours, most leaders were unprepared for the dynamic orders process required during the march up to Baghdad: multiple orders per day, received and issued principally on the radio, and using only hand-written notes. Our schools and our doctrine had *not* prepared them for this. One battalion's Operation IRAQI FREEDOM after-action report observed:

> *"Peacetime ... training ... should move away from a detailed plan that relies on perfect situational awareness and focus on ... a chaotic, information-starved environment."*
>
> *"During training, the issuance of orders, conduct of rehearsal, and receipt of brief-backs should be conducted over the radio. Tactical decision game training for scenarios at the company level ... should require (orders) to be briefed ... over the radio.*[3]

From the beginning to the end of Operation IRAQI FREEDOM and Operation ENDURING FREEDOM, with thousands of orders issued, our combat-

Often in training, we place unrealistic importance on preparing and issuing long and elaborate operations orders. *(Photo by SSgt Jared Becker.)*

experienced leaders have pointed out the same fact: we need more realistic training and doctrine on orders.

What We Teach

Marine Corps training handouts generally recommend throwing everything into an order, as if the order was a soup pot overflowing with a hundred random ingredients. Students are given lists and lists of every possible item that might go into an order and then warned that their orders need to be "complete." Nowhere do we discuss what to leave out. The same is true for our training standards.

The Basic School (TBS) provides baseline orders training for officers of every MOS. These lessons follow Marines throughout their careers, particularly since orders are not emphasized in later schools. However, the current 31-page TBS orders handout is a confusing mishmash of instructions, ill-defined terms, mnemonic acronyms, and lists of mandated items to put into the order.[4] Lieutenants are not provided with any example orders or practical real-world processes.

The orders handouts for the *Staff Non-Commissioned Officer (SNCO) Academy* and *College of Enlisted Military Education* are largely the same, with entire sections copied from the poorly written TBS handouts.

At each *School of Infantry,* the Infantry Small Unit Leaders Course teaches orders to infantry NCOs. Their 32-page student handout for orders is overwhelming—essentially a long checklist of recommended items to pack into a squad-level order. There are no examples and no instructions on what information is needed for what types of missions. The performance checklist is *140 lines*, including 21 lines for the situation paragraph alone.[5]

Earlier this year, a sergeant sent me his final Infantry Small Unit Leaders Course order where he directed a squad to occupy a patrol base. It was ten pages of computer-printed text, an absurd product that could never be produced in the field—and all this for a straightforward task that any experienced NCO would accomplish with a few sentences and a hand gesture.

Marine Corps doctrine regarding combat orders is inconsistent and often conflicting. *(Photo by SSgt Jared Becker.)*

The instructors who put together these student handouts, and the commanders who sign them, are not to blame. They have no useful references. Our curriculum is generated from doctrine, and our doctrine on orders is terrible.

What We Publish

Our orders doctrine is awful. None of our infantry manuals—all updated within the last three years—explain how to issue an actual order:

- NONE includes an *example* of an order.
- NONE includes a single *sentence* of an example.
- NONE specifies *who* does *what* and *when* to produce an order.
- NONE explains parallel planning and the *orders process* between echelons.
- NONE discusses orders for different types of *operations* or different environments.
- NONE includes a realistic, annotated orders *template*.

MCRP 3-10A.2, *Infantry Company Operations,* is the worst of the three. The company commander is a key leader on the battlefield—directing complex tactical evolutions with attached units, indirect fires, and air—yet this manual provides almost nothing on the critical skill of how to produce a company order.[6]

Instead, the manual is infected with operational-level terms and irrelevant Marine Corps Planning Process (MCPP) concepts. The manual directs that company-level OPTs conduct an unexplained "abbreviated version" of MCPP, generating useless LOE, MOP, MOE, COG, COA, and DST. But MCPP does not apply at the company level.[7] OPTs are not a company-level concept.[8] Companies are told to produce battalion-level IPB products.[9] Eight pages discuss *operational design*.

Multiple sentences imply that a published order, with appendices, is expected from the company. This is unrealistic. The manual includes NO guidance on how to conduct a rehearsal, NO appendix with a company orders format, and NO example of a completed company order.

MCIP 3-10A.3i, *Marine Infantry Platoon,* states helpfully that platoon orders are "normally issued verbally" (page 57) but contains NO example orders and NO explanation of the orders process.[10]

MCRP 3-10A.4, Marine Rifle Squad, also provides very little guidance on orders. This omission is especially bad in a manual intended for both infantry

small unit leaders and units serving as provisional infantry. Our junior leaders, with the *least* experience and training, should be getting the *most* guidance and the clearest examples of how to issue orders in combat. In the Figure C-4 template, fully half the entries should *never* be included in a squad, platoon, or company order: references, annexes, distribution lists, official signatures, and time zones.[11]

What Is to Be Done

- The most important step is to rewrite our manuals. Rewrite the orders chapters for the squad, platoon, and company infantry manuals. We need to see example orders: sentences for different types of missions in different types of environments. Recommend techniques for how to copy an order in the field, make an estimate, draw a sketch, and issue an order—using hand-written notes. These pen and paper processes are combat skills that should be explained. Recommend techniques for the orders process, how orders are passed from one echelon to the next, especially when time is short. Our doctrine should focus on the nuts and bolts of the orders process, the actual steps in the field that reflect real-world practices. *The Marine Corps needs better doctrine on orders.*
- Rewrite the T&R standards for orders.[12] An effective order is not the longest order, nor the order that matches an exhaustive checklist of a hundred items. Our standards need to reflect combat scenarios, with time and information limitations: "Given a platoon defensive order, write a squad order, including a CONOPS sketch, using pen and paper, in 30 minutes." *The Marine Corps needs better standards on orders.*
- Rewrite student handouts for orders. Rewrite the exercises and the evaluation criteria to reflect the real world. Forbid computer preparation of orders. Train to the Kabul Airport example—a combat standard, with limited time, limited information, written notes, and verbal orders. Eliminate the concept of a "complete order"—there is no such thing. Assign orders for non-infantry units. Some instructors advocate that we should teach the long, elaborate orders format so that our students can later develop their own shorthand techniques—but we should train like we fight. *The Marine Corps needs better training on orders.*
- Conduct a study on actual orders issued at the company level. Collect examples of company, platoon, and squad orders issued to real Marine units. Observe and record unit leaders in contingencies and combat. What kind of orders are issued? What skills are displayed? What tactics, techniques, and procedures are used? *The Marine Corps needs to capture actual orders practices, so we can train like we fight.*

Our doctrine should focus on the nuts and bolts of the orders process, the actual steps in the field that reflect real-world practices.

The Marine Corps is not a draftee organization desperate for overly detailed directions. As long-service professionals, serving in well-trained, cohesive units, our orders process should reflect our shared doctrine, experience, and understanding of our commander's intent. Why do our orders not reflect our tactical abilities?

Marines need to be taught to issue concise and effective orders. We need to assume competence, trust our subordinates, focus on the essential, and not waste time on the trivial. Our orders in combat—unlike artificial classroom exercises—must be precise, mission-specific, doctrinally-correct, and well-understood. *Precision language is more important that precision weapons.*

Marines should be taught to issue concise orders based on trust tactics and the initiative of subordinates. *(Photo by LCpl Joseph Scanlan.)*

Notes

1. Email to author on 1 October 2021.

2. Brendan McBreen and C. Skaggs, *Orders: A User's Guide*, (The Warfighting Society, 2021). In August, 20021, Chad Skaggs and I published a guidebook of best practices on orders that we collected from three dozen experienced Marine officers and SNCOs.

3. 3/7 Mar, *3/7 Iraqi Freedom Operations and Training After-Action Report,* (Twentynine Palms, CA: 2003).

4. Staff, *Student Handout B2B0287XQ-DM, Combat Orders Foundations*, (Quantico, VA: The Basic School, n.d.). Tactical planning is defined to new lieutenants as "METT-TC → EMLCOA → CG/CV/EXP → SOM → FSP → Tasks." The TBS *Combat Orders STEX Assistant Instructor Guide,* B2B0307D (n.d.), includes no recommendations or standards for how instructors should evaluate the orders briefed by their students.

5. Headquarters Marine Corps, *School of Infantry—East, West, and Det Hawaii*, *Student Outline: Combat Orders,* (Washington, DC: 2018). Commanders Intent is defined (non-doctrinally) as "CG, CV, EX, and FRD"—center of gravity, critical vulnerability, exploitation plan, and final result desired.

6. Headquarters Marine Corps, *MCRP 3-10A.2, Infantry Company Operations*, (Washington, DC: April 2018). LOE is line of effort, MOP is measure of performance, MOE is measure of effectiveness, COG is center of gravity, COA is course of action, and DST is decision support template. *DOD Dictionary*, Aug 2021.

7. Headquarters Marine Corps, *MCWP 5-10*, *Marine Corps Planning Process*, (Washington, DC: August 2020). Chapter 1 clearly describes MCPP as a staff process for battalions and above. Page 1 states, "For Marine ***units with staffs***, the Marine Corps Planning Process (MCPP) ... is a proven ... approach to planning." The troop leading steps apply to units below the battalion.

8. There are no OPTs at the company level. By definition, OPTs are formed by staffs with a future operations section:

> **operational planning team** (OPT): A group built around ***the future operations section*** that integrates the staff representatives and resources. The operational planning team may have representatives or augmentation from each of the standard staff sections, the seven warfighting functions, staff liaisons, and/or subject matter experts.

See Headquarters Marine Corps, *MCRP 1-10.2, Marine Corps Supplement to the DOD Dictionary of Military and Associated Terms*, (Washington, DC: May 2018).

9. Headquarters Marine Corps, *MCRP 2-10B.1, Intelligence Preparation of the of the Battlespace*, (Washington, DC: May 2016). Chapter 1 clearly describes IPB as a staff process for battalions and above conducting the Marine Corps Planning Process. Page 1-1 states, "The G-2/S-2 leads this staff effort."

10. Headquarters Marine Corps, *MCIP 3-10A.3i*, *Marine Infantry Platoon*, (Washington, DC: June 2019).

11. Headquarters Marine Corps, *MCRP 3-10A.4*, *Marine Rifle Squad*, (Washington, DC: August 2020).

12. Headquarters Marine Corps, *NAVMC 3500.44D*, *Infantry Training and Readiness Manual*, (Washington, DC: May 2020). Tasks 0302-C2-1002 for officers and 0369-C2-2002 for SNCOs are different for some reason, but both equally lack substance. There is no attempt to define a standard for an effective order

Reconnaissance in Support of EABO

Quelling thirst

by Maj Corydon S. Cusack

>Maj Cusack is an 0402 Logistics Officer by trade, 0405 Air Delivery Officer, 0477 Expeditionary Logistics Instructor, and 8023 Naval Parachutist. He was previously the Battalion S-4 Logistics Officer for 3d Reconnaissance Battalion and is now serving as the Battalion S-3 Operations Officer for 3d Landing Support Battalion.

How do the Services plan to conduct water resupply to forward littoral raid forces, such as reconnaissance teams, when they are dislocated from rear logistics elements and trying to maintain a low emissions signature in a contested environment in support of (ISO) expeditionary advanced base operations (EABO)?

Current water resupply methods for forward reconnaissance teams are limited or nonexistent. Traditionally, reconnaissance missions are limited to three days (four days maximum) as the amount of water taken must last each individual for the duration of the mission with no planned resupply. The basic fighting load of a reconnaissance Marine consists of only three gallons of potable water—or one gallon per man/per day.

MCRP 3-4, Water Logistics Operations, suggests a drinking water planning factor of 1.5 gallons per day/per man in temperate climates and 3.0 gallons per day/per man in tropical climates. Presently utilized, alternate water resupply methods include purifying freshwater with iodine or small handheld water purification systems, which are constrained by throughput quantity as well as the relative location to—or even the very existence of—a freshwater source. Further, aerial, ground, or maritime resupplies are generally restricted to reduce signature of concealed teams under cover. Additionally, teams forward of rear area logistical capabilities do not have access to a Reverse Osmosis Water Purification Unit or Tactical Water Purification System capable of desalinating saltwater in an EABO environment; thus, if no freshwater source can be located, they are simply limited to their organic water supply and a three-day mission.

Water resupply to forward reconnaissance teams who are dislocated from the main body or rear logistics elements is an ongoing problem, which ultimately limits mission duration to three days with only few existing alternate solutions to remove the constraint. Gen Berger stated in his *Commandant's Planning Guidance* that reconnaissance teams are at the forward tactical edge of the FMF. He later states that they must be enabled by combat service support functions, ultimately to support EABO in exploiting positional advantage and defending key maritime terrain that enables persistent sea control and denial operations forward. The *Littoral Operations in a Contested Environment* 2017 publication notes the need to project littoral raid forces, such as reconnaissance teams, on a long-range, low-signature craft such as the Mk VI patrol boat. Exploring new options to conduct water resupply to reconnaissance teams will not only increase endurance and extend operational reach of friendly forces in training and conflict environments but will also support the Commandant's shift in the Marine Corps' focus toward naval integration and providing a self-sustaining solution to reconnaissance forces at the forward edge defending key maritime terrain ISO EABO.

Atmospheric water generators (AWG) are one of many proposed innovation methods to quelling the water problem to forward reconnaissance teams in support of EABO. The AWG, specifically the Tiffany Model made by RussKap, is procurable through the Defense Logistics Agency. The Tiffany AWG acts much like a dehumidifier, creating up to ten gallons of potable water per machine from excess water in the air. The Tiffany AWG must be energized with 110-volt power; thus, it is recommended for tandem use with an organic reconnaissance asset, the Utility Task Vehicle and its successor the Ultra-Light Tacti-

Current water resupply methods for forward reconnaissance teams are limited or nonexistent. Traditionally, reconnaissance missions are limited to three days (four days maximum) ...

cal Vehicle (ULTV), in concert with a QP-1800 power inverter. Barring the capabilities of the power inverter, two AWGs per ULTV would be capable of creating up to twenty gallons of potable water per day, per asset. The ULTV/AWG combination asset is capable of being inserted aerially with reconnaissance teams via the 10,000-pound Joint Precision Air Drop Parachute System or by maritime insertion via the Mk VI patrol boat during initial insertion.

The ULTV/AWG asset will positively impact the problem of limited water resupply options to forward reconnaissance teams in support of EABO. The ULTV with 2 AWGs is capable of producing up to 20 gallons of potable water per day; thus, 2 ULTVs would provide 40 gallons daily. Currently, a reconnaissance team of six individuals carries three gallons per man, and though below recommend planning factors for drinking water per day, will only sustain them through a three-day mission. Two ULTV/AWG assets providing 40 gallons per day will provide the recommended planning factor for drinking water of three gallons per day, for a six-man reconnaissance team, in perpetuity. The reconnaissance teams ISO EABO would be able to conduct more in-depth missions beyond the previous standard of three days. Further, the ULTV/AWG provides a flexible response sustainment option to reconnaissance teams in that it can be inserted either by maritime means or aerially.

Concept 1. *(Photo provided by author.)*

Therefore, the ULTV/AWG increases the endurance and extends the operational reach of littoral raid forces such as reconnaissance Marines dislocated from rear logistics elements while ISO EABO. Moreover, the ULTV/AWG solution is applicable to other vehicle sets beyond the ULTV, such as the High Mobility Multipurpose Wheeled Vehicle and Joint Light Tactical Vehicle, and may even prove resourceful to units and communities beyond reconnaissance. Finally, the AWG solution may also serve as an interim means of water resupply for units at any stage of the distribution chain, both on the battlefield during EABO as well as in a garrison training environment.

Limitations to the proposed innovation method ULTV/AWG asset are input requirements, size, and conditions. Like many new ideas or solutions, they resemble the double-edged sword with every positive capability contributed there is a large potential

Concept 2. *(Photo provided by author.)*

for negative setback. Input requirements which limit the ULTV/AWG are power and ultimately fuel. In order to solve the electrical requirement to power the AWG, the proposed innovation method suggested coupling the AWG with a power inverter and then ultimately into the NATO slave receptacle of the ULTV. This solves the power problem but generates an increased logistical tail requirement of fuel to power the ULTV. Alternate ways to solve the fuel problem is to bolt on storage carriers to house fuel jerry cans on the sides of the ULTV itself or simply initially insert with more fuel on a Mk VI or Combat Rubberized Raiding Craft as well as Tandem Offset Resupply Delivery Parachute System. Moreover, the sheer size of an AWG is a negative factor when considering embarkation or movement on the battlespace. The size of the Tiffany AWG is largely similarly to your standard home dehumidifier. The size restraint is mitigated when the AWG is utilized in tandem with a ULTV to increase mobility. Finally, the AWG operates at optimum water producing capability when placed in a tropical climate; therefore, production will be limited under arid conditions.

Discussing external solutions and alternate considerations; III MEF recently requisitioned 50 Atmospheric Water Generators, and 3d Reconnaissance Battalion will lead the charge for all reconnaissance battalions in conducting field testing of AWGs. Additionally, as of 2018, the Army is pursuing a man-portable desalinating water purifying option to provide an enduring solution to the limited water problem for forward forces—though nothing has become a program of record for either Service. In November, 2021, 3d Maintenance Battalion began working to turn the concept for an AWG/UTV combination capability into an actual proof of principle. Specifically, 3d Maintenance Battalion ruggedized the AWG itself with reinforcements, bushings, and shock absorbers while also fitting it to the UTV by way of hitch attachment. They also identified the best way forward for power generation from the UTV to the AWG. While research and field testing with AWGs are ongoing, applicable units can open purchase commercial off-the-shelf options for water purification capabilities that fit their mission.

Innovative combat service support solutions must extend operational reach and provide freedom of maneuver during EABO and specifically increase the endurance of reconnaissance teams at the forward tactical edge of the FMF. A single ULTV/AWG asset provides up to twenty gallons of potable water per day in a tropical environment and is capable of aerial insertion by way of Joint Precision Air Drop Parachute System parachute system or maritime insertion from the Mk VI or larger platforms. Ultimately, though not free of limitations, the ULTV/AWG asset combination is capable of quelling the water sustainment problem to increase reconnaissance-specific mission duration, providing a key link in support to Naval and Marine forces during EABO in a contested environment.

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Commandant's Planning Guidance Leadership Model

Propensity/potential, opportunity, engagement (POE)

by LtCol Mandy M.H. Brannon, USMCR

>LtCol Brannon has served as an enlisted Communications Strategy Marine and a Logistics Officer who served in the GCE and LCE as well as in the FMF and Supporting Establishment including Operation Iraqi Freedom. She currently serves as the Gender Integration Portfolio Manager at Manpower and Reserve Affairs.

There is no greater time to investigate the strategic imperative of understanding holistic human talent and diversity. The Interim National Strategic Strategy directs creative approaches that draw on all sources of national power, preceding with "diversity" and specifically leveraging "diversity of talents" in modernizing national security institutions and processes to address tomorrow's complex challenges.[1] Our national values foster a creative advantage among peer adversaries. Cultivating sovereign and individual creative thought protected by the Amendments of the United States Constitution, absent from authoritarian influence, creates a distinct strategic advantage in innovative potential of the United States but denied to the people of authoritarian regimes like China, Russia, North Korea, and others. The Commandant specifically aligns our Service identity to a "historical record of innovation and adaptation" in forecasting maritime reconnaissance and counter-reconnaissance as a major role in countering pacing threats. He concludes that we must retain innovative flexibility to the demands of today and the future operating environments.[2] Simply, more creative approaches are required, partnered with a deeper investment to understand the human talents that lay within.

Since antiquity, humankind was unable to prove the theory of a spherical Earth until someone actually traveled around the world. This shifted humankind's greater understanding of what our world is—round. Humankind's understanding of truth shifted. Plato's Cave Allegory symbolism of the cave represents superficial physical reality or perception—inferring one must leave the cave, enter the light, and investigate real truth. Likewise, when Ferdinand Magellan and Juan Sebastian Elcano proved a round earth through circumnavigation, humankind could not go back into the cave and believe with absolute certainty that a ship might fall off the edge of the Earth if they go too far.

... we must retain innovative flexibility ...

The same approach can be made when investigating how we understand and measure diversity. Leveraging contemporary human resource analytical methodology can be the parallel circumnavigation maritime technology that allows us to visualize skills or talent diversity—more than just skin deep. The tacit knowledge or understanding of how your most accomplished unit performed in terms of human abilities and the social vehicles that enabled their talents' contribution to the mission recognizes a holistic approach to diversity and the underlying human condition. Effective leadership animates this holistic diversity by affecting the collective human will within the team. Animating will is rooted in our doctrine: "Human will, instilled through leadership, is the driving force of all action in war, as the Marines themselves impose their will on the enemy."[3] *Therefore, effective leadership transforms human will and individual abilities into constructive and positive engagement contributing to performance lethality.*

Investigating Career Viability of Female Ground Combat Arms Marines Led Us to This Approach

Gender integration began in 2012 with the Secretary of Defense rescinding the 1994 Direct Ground Combat Definition and Assignment Rule. The Marine Corps Force Integration Plan (MCFIP) was implemented in 2016, integrating female Marines and maximizing all Marines' talents and skills in sustaining the most combat effective force by capitalizing on the knowledge, skills, abilities, demonstrated performance, and full potential of every Marine.[4] Annex C of the MCFIP, Marine Corps Integration Implementation Plan

(MCIIP), specifies that viable career paths and an assessment of integration success endures. The Gender Integration section of Manpower Policy (MPO-I) assesses the MCFIP. This undertaking is two-fold: adherence to law and policy, and how the policy affects the Marines' career viability.

career patterns and the contributing factors (either positive or negative) for any Marine is required to create context for career milestones that animate career viability. Considering this holistic approach, the qualitative assessment includes female Marines, ground combat arms MOS Marines, their respective

Understanding the interplay of multifaceted variables contributing to a Marine's career is crucial.

The Service adheres to MCIIP law and policy, and subsequently many female Marines have achieved significant milestones over the past five years. Nearly 500 female Marines have earned a ground combat arms MOS, with the greatest propensity in Infantry, Artillery, and Assault Amphibian Vehicles. Also, over 1,200 total female service members serve in ground combat arms units across the FMF. The MCIIP directs an assessment along three lenses: combat effectiveness, health and welfare, and talent management. After careful and deliberate thought in assessing the MCFIP through these three lenses, we argue talent management is central to combat effectiveness as well as the health and welfare of Marines. Talent management occurs at all levels and is fueled by effective human engagement among all Marines. Combat effectiveness is enabled by holistic talent management to which we assume enables *career viability* and ultimately builds comprehensive manpower readiness into the future.

Assessing female ground combat arms MOS Marine career viability is more complex and will take time—perhaps years and decades if solely determined on statistically significant career outcome data, such as reenlistment rates or promotion rates. Degradation of bias for (any) policy action aside, this creates a myopic information channel for the decision maker. A data-driven approach omits contextual understanding provided in data-informed decisions, which contributes meaning to the greater goal of wisdom.[5] Understanding qualitative

MOS male Marine cohorts, and female Marine cohorts to build context of their career viability and more accurately inform progress toward acculturation.

A Marine's career is a complex system. Understanding the interplay of multifaceted variables contributing to a Marine's career is crucial. It requires a holistic understanding of how Marine engagement manifests through periods of time, which builds into a credible observation period for performance reporting that compiles into review for promotion and competitive assignments across a range of opportunities. Marine engagement *enables* not only today's mission but ultimately matures into cumulative career performance and achieves our desired end-state of *lethality*: elite warriors with physical and mental toughness, tenacity, initiative, and aggressiveness to innovate, adapt, and win in a rapidly changing operating environment.[6]

MPO-I developed the propensity/potential (P), opportunity (O), and engagement (E) (POE model) to investigate career viability of female ground combat arms Marines, with realistic actions for all stakeholders in maximizing Marine engagement, leading to trust, team cohesion, speed and performance lethality. P (Propensity/Potential) represents the interplay of mental, moral, physical, economic, environmental, and social/cultural domains; being either centers of gravity or critical vulnerabilities of a person. A variety of sub-P values can carry greater weight in the sum of a person's P, observing an open, complex system. O (Opportunity) is

the lens that either sharpens, diffuses, or neutralizes the P either by structural or social influences perceived and/or granted by and to the individual. E (Engagement) relates to the full expression of a Marine's mental, moral, and physical talents to their service, manifested in effort, involvement, flow, mindfulness and intrinsic motivation. Consequently, MPO-I's POE prototype model investigates and organizes the interplay and uncertainty of Marine talents and situational variables related to interpersonal and intra-personal interactions of the Marine and their environment—with an actionable understanding of Marine engagement. A POE cycle occurs in varying frequency within the spectrum of a Marine's military service and career lifecycle. Studying the objective sub elements of a Marine's P (mental, moral, and physical talents, and situational environmental, economic, social/cultural elements), and the varying interplay and uncertainty is the first task. The second is a study of the O (structural/social/subjective) opportunity the Marine inhabits. Optimizing Marine engagement contributes to performance—which is perceived and acted upon in varying degrees.[7] Cumulative positive performance concludes with the Junior Enlisted Performance Evaluation System and the Performance Evaluation System markings affecting reenlistment and career designation competitiveness, which in turn affects positive career outcomes. The inverse is also plausible, with a variety of career patterns spanning to the left and right lateral limits of career targeting.

This is the work of MPO-I and will be the means to understand the aggregate behavior of acculturation and socialization that affects career viability of all Marines subject to the MCIIP and its desired end state. Understanding the cause and interplay among propensity/potential, opportunity, and engagement requires time, resourcing and partnering with experts in behavioral science, and an investment of innovative technological resources and capabilities. Yet, the reward is uncovering ways to transform, adjust, and maintain career viability for all Marines that builds, nurtures, and retains talent. This evolved approach

ultimately led us to understand talent management is an equalizing partnership between Marine and Service by offering practical methods to harmonize the Marine engagement to Service task.

Study The Temporary Constellation of Marines Within Your Unit.

Upon a quick glance, one can overlook the double stars in the constellation of Ursa Major. Yet, a trained eye can identify Alcor from the brighter Mizar of the double-star appearance in the handle of the Big Dipper. Modern human resource tools are like a telescope—they improve the resolution of each Marine star. However, the leader must enable all the factors among the constellation to illuminate contextual understanding of nascent and present talents among all stars of the constellation and make stronger connection of talents to the mission. Solely relying on technology chills the humanity of the relationship yet offers honesty granted by objective data.

Reflect on the variety of units and how relationships were managed to draw out talent constellations through your career. What were the human strengths and abilities that made that unit successful? Consider the categories of problem solving, creativity, communication, empathy, physical strength, cultural awareness, or systems thinking. These skill and talent categories made the unit strong—or the absence of some, weak. Now, reflect on how these talents emerged. How were these skills and talents developed with the aid of a mentor, or fortified by enemy fire? What was the socialized environment? How engaging was the environment that encouraged your Marines to trust and share their talents with the unit that led to success? In the military these diverse human skills, animated through socialization, give cause to look past visible diversity and see each other for our own humanity.

Assignments vary in duration and stymie efforts to develop a deep and contextual understanding among both Marines—leader and led. However optimal and long suggested, knee-cap-to-knee-cap discussions cannot always take place. This results in a summary understanding of the Marine's short-term talents and abilities by the leader and a desire to be seen as a contributing member rooted in their talents and abilities by the Marine. Optimizing human engagement and collective unit performance requires a deeper and contextual understanding among both leader and led, to which modern human resource data analytics can inform talent diversity among your team. To achieve engagement, a focus should be made to understand and animate Marine's diverse talents and skills and maximize their opportunity to practice and perform. This is basic leadership: transforming human will and individual abilities into constructive and positive engagement contributing to performance lethality.

Barring gender or MOS, optimal unit cohesion is the result of effective socialization.

Example

A highly organized, intelligent, and diligent lance corporal infantryman is selected to be the battalion's armorer. He is selected because of his mental and moral skills, crucial to accountability of assets and risk mitigation. Now, let us understand the opportunity this Marine is given. This is a billet of great responsibility and a higher paygrade (sergeant). The lance corporal has a great opportunity to allow his mental and moral skills to shine as well as develop a greater sense of belonging and trust per his contributions and reliability. At first, he may show positive behavioral signs (all-star). Yet, over time, these signs wane. Using the POE prototype model, his P (propensity/potential) social/cultural sub-value drops because he misses his platoon, and he wants to get out in the field with his fellow Marines and continue to hone his craft. His POE O (opportunity) value drops because he is constrained in his billet; however, he is given public recognition for his continued contributions, and his Junior Enlisted Performance Evaluation System scores reflect his skills and proficiency. Our armorer longs to rejoin his platoon. He deeply desires to hone his occupational skills and remain proficient and competitive with his peers. In addition, he feels disconnected with his peers, and longs for his platoon's camaraderie. His work in the armory becomes nearly automated and his intrinsic motivation fades. He is disengaged. Ultimately, the lance corporal chooses to simply end his active duty service and investigate college or post-service opportunities. Did the lance corporal vocalize his desire to return to the platoon? Did he feel that he might let down those who continued to laud praises on his performance in the armory? How could the unit leader uncover his intentions or desires? Does his unit culture encourage or inhibit his professional growth?

Genius of Including Socialization and Acculturation in the MCIIP: Sense of Belonging, Socialization, Trust, Performance Lethality

MPO-I investigates methods to understand the socialization and acculturation process triggered by the Direct Ground Combat Definition and Assignment Rule rescission. Socialization enables engagement, which enables viable career paths for all Marines, and achieves our desired end-state of *lethality*.[8] We argue socialization is a process whereby a Marine acquires an identity within our organization and adopts the norms, values, behavior, and skills in order to achieve acceptance within the greater whole. Effective socialization illuminates diversity value based on a range of backgrounds, experience, and perspectives. Barring gender or MOS, optimal unit cohesion is the result of effective socialization. All members of the team have acculturated into the group as well as a collective shared learning process through trials, with an accumulated group common understanding of how to think and behave.[9] Cultivated trust and shared understanding optimizes this cohesion, producing a heightened speed and focus on the collective human capabilities (independent of de-

mographics) that increases the Service's lethality. The MCFIP authors' wisdom of specifically directing socialization and acculturation goals as an integration outcome emphasize the criticality of a cohesive team. The responsibility of socializing all Marines lies among the leaders and led in an intrapersonal and interpersonal investigation of how to approach this lofty, yet critical, goal.

This is the Marine Corps' trade. A leader's hand can sift out talent from all grades and occupational specialties in asymmetric team building approach to create a team of talents to match the mission and apply a rudder-steer as connections grow and develop over time. Skills such as creativity, collaboration, and adapting in a complex environment are the non-technical skills that complete the professional skills required in our profession.[10] These skills affect growth and a personal and deliberate quality of engagement among Marines.[11] Yet, we cannot simply rely on the accumulation and progression of technical skills alone, nor can we rely on one "all-star" Marine to bear the lion share of the work. Marines need to wholly understand each other. Connecting each Marine-star among the unit-constellation repeatedly through training and shared experiences reinforces the social bonds of the unit. For every overlap and social re-tracing of the lines, trust and learning are reinforced among the unit. Ultimately, a deep investigation of Marines' micro-talents—combined with personal and meaningful mentoring and coaching—unlocks socialization among the units, thus enabling fidelity and flexibility within the unit.

Take Marines for Who They Are, and Lead Them To Be Who They Can Be

Opportunity

Holistic investigation of the mental, moral, and physical attributes developed through an accumulation of Service and personal life experiences is required to understand the facets of our Marines. Armed with this information and guided with mentors and leaders, Marines create a compass to navigate along a dynamic career road-map with greater personal agency, incorporating military life, combat experiences, and niche military interest. Marines with greater leadership and interpersonal social skills have a greater sense of belonging among their brothers and sisters, which improves our Service culture and unit cohesion. Investing in human resource technology enables improved human resource information, with greater methods for all Marines to understand their own personal career indicators. Used in aggregate, this objective data grants greater Service visibility and actionable methods to contribute to a sound manpower investment among all stakeholders affecting recruitment, career viability, strategic talent management, and ultimately retention of our most talented Marines in defense of our Nation.

How can Marines and the commanders better understand their unique Marine Corps "constellation? *(Photo by SSgt Donald Holbert.)*

Risk

Neglecting this impedes efforts to develop and mature a larger Subsequent Term Alignment Plan (STAP) force, and overlooks the attitudes and desired for those who have a propensity for military service. Joint Advertising Market Research and Studies (JAMRS) informs Marine Corps Recruiting Command with detailed information and trends of the recruiting landscape. JAMRS cautions all Services in predicting a more challenging recruiting environment in the near future in that there is a lesser degree of connection among American youth to the military and a greater interest in choosing college after high school graduation.[12] So for those who *do join*, let us cultivate their human abilities and interests into enduring skills, and integrate them into the fold of our inclusive Service culture through socialized leadership.

Female Marines serving in ground combat arms occupations stretches into all segments of talent across the FMF. Through Manpower Modernization efforts, MPO-I develops a prototype of the POE model to investigate career viability with context for female ground combat arms MOSs Marines and their cohorts. Applying the POE prototype model to the MCIIP assessment uncovers an opportunity for the Service to develop stronger understanding of Marine engagement, cultivate talent, and retain a more cohesive force with a greater sense of belonging among all Marines. Together, we can all improve career viability and positively affect engagement and strategic talent management outcomes to meet the Commandant's direction, strategic imperatives, and the individual Marine's needs. The POE prototype model is a creative approach to leadership and enables a deeper understanding of diversity rooted in human talents of potential and the socialization required to maximize opportunity. Engagement of these two powerful factors connects lethal Marine performance to meet the demands of today and tomorrow's operating environments. What is the shape of your Marine constellation, and how do you investigate the real truth of your unit's diverse and lethal talent?

… for those who do join, let us cultivate their human abilities and interests … and integrate them into … of our inclusive Service culture …

Notes

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2. Gen David H. Berger, "Preparing for the Future: Marine Corps Support to Joint Operations in Contested Littorals," *Military Review*, (April 2012), available at https://www.armyupress.army.mil.

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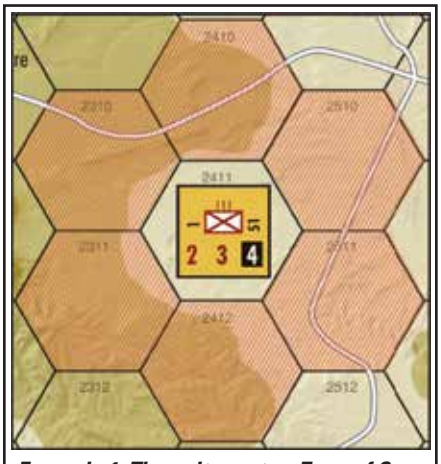
Zones of Control

A design element in board wargames

by Dr. Christopher R. Cummins, Publisher, Decision Games

After writing last month's column on movement in board gaming, I got into a discussion about the variety of zone of control rules that have appeared as wargame design evolved and progressed. Because this element is central to most wargames, and lies between movement and combat, I decided to cover it in this column before moving on to combat.

Zone of Control (ZOC) is used in wargames to represent the sub-units, mobility, or weapon reach that occurred in the situation being modeled in a simple, abstract way.



Example 1. The unit exerts a Zone of Control into each of the shaded hexes.

Effects on Movement

In most wargames, units exert some influence on enemy movement in the hexes adjacent to the hex they occupy; this is ZOC. This influence takes the form of either stopping movement altogether or costing movement points. In most classic wargames, there are no additional costs to move into a ZOC, but the unit can move no further in that turn.

Once in an enemy unit's ZOC (abbreviated to EZOC in most wargame rules), getting out can be easy or difficult. This often correlates to the era or period of the conflict as well as the unit scale, formations, and maneuverability. For example, in games on ancient/pre-gunpowder battles, individual units generally represent tens to hundreds of men in tight formations wielding swords or pikes at close range. These situations usually involve "locking" ZOCs, meaning once a unit is adjacent to an enemy unit, it cannot leave that ZOC by movement. The ZOC can only be removed by a combat result such as elimination or retreat (and no other enemy unit adjacent or moving into ZOC in the next movement phase).

A variant on locking ZOCs was originally termed "rigid." With rigid ZOCs, units must stop when they move adjacent but are able to leave an EZOC at the beginning of their movement. This type of ZOC is often used in the 20th-century operational level where individual units are often battalions, regiments, or brigades. For earlier battles, for example the American Civil War, the rigid ZOC rules added a requirement for one unit to remain in the adjacent hex while others could leave (simulating rear guards or covering fire). There is also a variant where a unit could move from EZOC to EZOC, usually termed "infiltration." This is often limited to one hex per turn.

As wargame design evolved, another type of zone of control emerged termed "elastic" or "sticky." With this ZOC type, it costs movement points to enter or leave an EZOC. Thus, it might be possible for a unit to enter an EZOC, move from an EZOC to another EZOC, and then leave an EZOC all in one turn (presuming the unit has enough movement points).

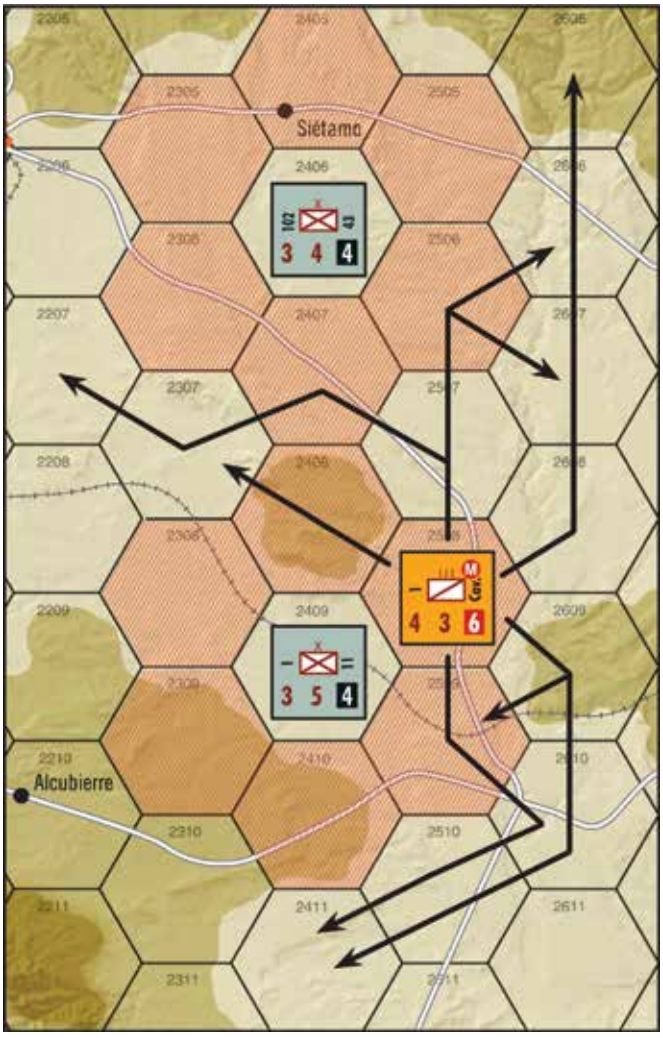
Most games simulating World War II or later conflicts have little or no movement cost to leave an EZOC (disengage), reflecting not only mobility but longer-range fire. In the modern era, there may be differences between mechanized units and leg units such that some units have no ZOC (leg) while others have ZOCs (mechanized). Some games have nuanced ZOC rules where certain specialized units may ignore ZOCs or pay fewer movement points.

In addition, ZOCs may interact with terrain such that ZOCs do not extend into some terrain. For example, ZOCs frequently do not extend across major rivers or into fortifications in 20th-century games and sometimes not into wooded or forest hexes in games on 19th century or earlier eras. Also, some games feature situations where one side was historically road-bound and thus their ZOCs do not extend into hexes without roads.

Effects on Combat

Another interesting element of ZOC rules is how ZOCs influence combat. In most classic wargames, all enemy units exerting a ZOC on a friendly unit must be attacked during the friendly combat phase ("active ZOCs"). This leads to considering the trade-off to enter an EZOC or not. Move adjacent, attack,

>Dr. Cummins, PhD, MBA, is the publisher of* Strategy & Tactics Press *and CEO of* Decision Games. *He has led a team in publishing over 400 board wargames and 600 magazine issues over the past 32 years. He is a former Army psychologist and continues to practice part-time specializing in assessing, testing, and treating individuals with stress disorders.



Example 2. The orange cavalry unit with its M (Mobile) designation is able to enter one EZOC per movement phase. The arrows show some of the possible movement routes it could take. Note the infiltration move to 2207 (the leftmost arrowhead) is possible because even though the grey units' zones of control meet to form a defensive line, being three hexes apart gives the orange unit an opportunity to slip through. If the topmost grey infantry unit was one hex lower, the advancing cavalry unit would be unable to penetrate beyond the grey unit defensive line because it could not enter a second EZOC in 2307 or 2308.

and potentially eliminate the defender, or at least put the defending unit in a ZOC where it may be forced to attack at poor odds or retreat out of the ZOC giving up the defensive position. The dilemma may also be there for the defending side. Put attacking units in ZOCs to limit their movement or force them to attack at poor odds.

In some games, ZOCs do not require attacks ("inactive ZOCs"). An interesting twist on ZOCs and combat is to allow unattacked units an opportunity to counterattack with an advantage. This works well in gunpowder-era games or games with interactive sequences of play.

Effects on Retreat

Most wargames using ZOC rules do not allow units to retreat after combat into a hex in an EZOC (they are eliminated, lose a step, or suffer otherwise adverse results). This was originally termed "interdicting." So one of the goals of wargame play is surrounding enemy units with friendly units and their ZOCs to create these kill zones. Defenders need to create defensive positions that ensure there are retreat routes or that retreats will not allow attackers to advance and cut off other units being attacked later in that combat phase.

Some wargames provide that if there is a friendly unit in the hex, it negates the EZOC for retreat purposes (covering fire of sorts). This was originally termed "suppressive." In these games, defenders will utilize friendly units to create retreat paths or will retreat units into positions where they support other defenders who might retreat later in that combat phase.

Along with effects on retreat, these effects usually apply to lines of supply. If a game has rules for supply, one often traces supply at the beginning of the movement and again at the moment of combat. That means that getting a ZOC on a defender's supply line negates his supply and usually halves his combat strength or other fairly negative effects. As in retreat, many designs allow units to trace supply into and through an EZOC if the hex in question is occupied by a friendly unit.

Application

ZOCs are an important element to understand when starting a new game. Look at the terrain on the game map and consider where the fast routes are and the bottlenecks. As the defender you are looking for positions with terrain that stop or slow the attacker, provide bonuses to defense (rough, woods, etc.), and are mutually supporting (avoid being surrounded during the attacker's movement). The basics of this last point are simple. You are seeking to place strong stacks of defenders every second or third hex so the units and their ZOCs provide a continuous line that prevents the attacker from slipping through the line without moving adjacent to any defenders and allows for defenders to retreat or reposition easily to maintain or adjust a strong, continuous defense line.

Summary

Zone of control is a wargame element that is used to simulate the effect of units on opposing units by denying or limiting movement, retreat, and supply. It simulates sub-units, patrols, ranged weapons, and mobility that extend a unit's influence into the area around the unit.

The Institutional Impact of Maneuver Warfare

Maneuverist Paper No. 18

by Marinus

The Maneuverists understood early on that it was not sufficient merely to change warfighting doctrine, although doctrinal reform was central. They understood that meaningful change required institutional reform as well. Based on the premise that anything that was not the actual conduct of war constituted preparation for war, they believed that the way the Marine Corps functioned institutionally must be made to support and reinforce the way it intended to fight. In retrospect, the Maneuverists were more successful in some areas than in others in accomplishing the goals they set out for themselves.

Doctrine

There is no question that doctrinal reform—at least in terms of formal, written doctrine—was a lasting success of the maneuver warfare movement. This is understandable, as doctrinal reform was Commandant Gen Alfred M. Gray's focus of effort. *FMFM 1*, *Warfighting*, was published in 1989, followed by *FMFM 1-1, Campaigning*, in 1990, and *FMFM 1-3*, *Tactics*, in 1991. Those manuals were revised as Marine Corps Doctrinal Publications (MCDPs), and the entire series of nine MCDPs was completed in 1998. The maneuver warfare doctrine they espouse remains in effect and unchanged today.

That high-level philosophy, however, did not always carry through to the follow-on warfighting, tactical, and reference publications that are meant to translate that philosophy into tactics, techniques, and procedures. Many of those manuals continued to describe a methodical approach to warfare. In that sense, the maneuver warfare reform of formal doctrine lacked depth and was not completed.

The even greater issue is the question of how thoroughly, widely, and lastingly that doctrine has been put into practice by the operating forces. Opinions vary greatly. Some argue that the Marine Corps never succeeded in adopting maneuver warfare in any meaningful way at the Corps-wide level. Others have argued that the Marine Corps did successfully adopt maneuver warfare in the 1990s but has since backslid as a result of various internal and external pressures. Still others argue that the Marine Corps continued to practice maneuver warfare effectively throughout the wars in Iraq and Afghanistan. From our observation, evidence could be cited

The Marine "Maneuverists" gained mixed results in the effort to institutionalize Maneuver Warfare across the entire Marine Corps enterprise. (Photo by LCpl Jackson Dukes.)

supporting each of those opinions at different times, places, and echelons. Clearly, maneuver warfare was not implemented uniformly and irreversibly throughout the Corps. Had it been, there would be no need for the Maneuverist Papers. There was always resistance, especially in quarters dedicated to promoting the procedural, methodical approach to warfare. In some cases in which maneuver warfare was adopted, there just as clearly has been backsliding. In both instances, some of the resistance was deliberate and principled, but much was based simply on a failure to understand that certain practices were antithetical to maneuver warfare. This said, we have talked to Marines who make the credible argument that maneuver warfare was practiced in Afghanistan and Iraq under individual commanders personally committed to its practice.

Professional Military Education

Educational reform unquestionably was an enduring and extensive consequence of the maneuver warfare movement—arguably even more significant than doctrinal reform. Professional military education under Gen Gray underwent a true transformation. From *MCDP 1:*

> *As military professionals charged with the defense of the Nation, Marine leaders must be true experts in the conduct of war.* They must be individuals both of action and intellect, skilled at "getting things done" while at the same time conversant in the military art.
>
> The military profession is a thinking profession. Every Marine is expected to be a student of the art and science of war. Officers especially are expected to have a solid foundation in military theory and a knowledge of military history and the timeless lessons to be gained from it.[1]

Key developments included the establishment of the Marine Corps University (1989), the creation of the School for Advanced Warfighting (1990), and the formation of the Marine Corps War College (1991). The Command and Staff College was transformed from essentially a field-grade staff training program to a true educational experience. The intermediate-level Amphibious Warfare School became the Expeditionary Warfare School consistent with Gen Gray's emphasis on expeditionary operations. The change was more than semantic, as the curriculum incorporated more wargaming, outside lecturers, battle studies, staff rides, and so on. Similar innovations were implemented for enlisted education.

The Alfred M. Gray Research Center opened in 1993, providing what was at the time a groundbreaking capability for online research. Moreover, the center provided an environment conducive to study and research. It increased its holdings over time, to include John Boyd's papers, and it made the Marine Corps Archives more accessible.

These educational reforms coincided with an increased assignment of Marine Corps officers to joint billets, and the improved educational experience contributed to the preparation of those officers for those assignments. Today, the Marine Corps boasts a professional military educational system at least on a par with the other Services and some would argue superior in many respects. That system is a direct outgrowth of the maneuver warfare movement.

Weapons Systems

The Army's development of AirLand Battle doctrine, which occurred roughly coincidentally with the Marine Corps' development of maneuver warfare, explicitly involved the development of upgraded weapons systems. The fielding of the so-called "Big 5"—the M1 Abrams tank, the M2 Bradley fighting vehicle, the Apache and Blackhawk helicopters, and the Patriot air defense system—was considered essential to being able to fully execute AirLand Battle as described in *FM 100-5*, *Operations*.

In contrast, the development of maneuver warfare was not explicitly tied to specific weapons systems. This was largely because AirLand Battle envisioned a specific conflict—a Soviet invasion of Central Europe—and that specificity of enemy and terrain allowed for a similarly specific identification of required weapons capabilities. Reflecting the Marine Corps' role as the Nation's force-in-readiness, maneuver warfare was a more generic solution to a broader range of challenges. It is more accurate to say that the Maneuverists found ways to incorporate technology systems that were already in the pipeline as general upgrades. That said, a couple of key programs that developed contemporaneously with maneuver warfare came to be associated with the new operating doctrine because of the operational mobility they offered.

The MV-22 Osprey program began in 1982 not as a Marine Corps program at all but as a joint NASA-Army program that later became a DOD program. The Army dropped out, leaving the Marine Corps as the lead Service, with Department of the Navy funding. The years 1989-1992, the heyday of the maneuver warfare reforms, were critical to the MV-22, as Defense Secretary Richard Cheney sought to cancel the program on the grounds of affordability. Only strong Marine Corps advocacy saved the Osprey, which entered operational service in 2006 and has been a workhorse ever since.[2]

The light armored vehicle (LAV) entered service in the mid-1980s with the formation of LAV battalions at Camp Lejeune,

The Marine Corps never had the requirements to develop unique material solutions specifically based on our warfighting philosophy and doctrine. ***(Photo by Cpl Orlando Perez.)***

Twentynine Palms, and Camp Pendleton.[3] The introduction of light armor to 2nd MarDiv during the formative years of maneuver warfare certainly helped to strengthen the association between the two. Gen Gray and Bill Lind were both known to be strong proponents of the LAV program. While light armor in fact proved to be a good fit with the emerging doctrine because of its exceptional operational mobility, the requirement for light armor did not arise out of maneuver warfare theory. Rather, it arose out of an earlier initiative to improve the mobility of the Marine division.

Likewise, the Pioneer remotely piloted vehicle, the Landing Craft Air Cushion, the Advanced Assault Amphibian Vehicle/Expeditionary Fighting Vehicle (which never survived to production), and the M198 towed howitzer were all products of a general effort to exploit technological advances rather than a response to the requirements of maneuver warfare theory.

Training

The most important training innovation of the maneuver warfare movement was the insistence on free-play, force-on-force exercises, as embodied in the annual Fort Pickett exercises by 2nd MarDiv in the 1980s. This insistence stemmed from the Maneuverists' belief in the *Zweikampf* as the essential dynamic of war. (For a discussion, see Maneuverist No. 2, "The *Zweikampf* Dynamic," *MCG*, Oct20.) From *Warfighting*:

> Exercises should approximate the conditions of war as much as possible; that is, they should introduce friction in the form of uncertainty, stress, disorder, and opposing wills. This last characteristic is most important; only in opposed, free-play exercises can we practice the art of war. Dictated or "canned" scenarios eliminate the element of independent, opposing wills that is the essence of war.[4]

The emphasis on free-play, force-on-force exercises seems to have waned significantly from 2003 to 2016, largely because of the limited field training time available given the high rotational tempo created by two simultaneous wars. What training time was available came to be largely taken up by certifying units for deployment.

The trend is not universal, however. As an example, starting in 2016, the Marine Corps Tactics and Operations Group at the Marine Corps Air Ground Combat Center undertook an effort to return to free-play exercises. The MAGTF Training Command's Commanding General at the time, MajGen. William F. Mullen III, directed the creation of the MAGTF Warfighting Exercise, a large-scale force-on-force exercise against a live adversary force, with both sides able to leverage all MAGTF capabilities. Similarly, 2nd MarDiv has created the Adversary Force Company, a dedicated opposing force for free-play training purposes. Such isolated efforts are swimming against the current, however, in the face of increased requirements for procedural and technical certification and the established existence of organizations long dedicated to training a methodical, procedural approach.

It is important to recognize the important difference between training and evaluation. Training is intended to improve readiness, evaluation to test it. While the two may use the same methods—namely exercises—they create entirely different incentives. Training encourages learning and experimentation, while evaluation encourages the avoidance of mistakes. The reality is that what is evaluated gets emphasized, and what is easily measured gets evaluated. As a result, procedural and technical skills, which are easily measured, tend to receive the highest emphasis, while tactical judgment, which is extremely difficult to measure, gets underemphasized. Procedures and techniques are not easily evaluated through free-play exercises, which introduce too many variables and too much unpredictability. They are more easily evaluated through canned scenarios, and so free-play exercises have decreased in frequency from the formative maneuver warfare years.

The implementation of force-on-force "free-play" training has been one of the most successful applications of Maneuver Warfare. *(Photo by LCpl Robin Lewis.)*

This is not to argue that there is no place for evaluating combat readiness. Although that said, the Maneuverists would argue that professionally competent officers should be trusted to prepare their units for deployment without the need for an onerous, centralized evaluation system that leaves too little time for actual training.

Based on the above, one would have to assess the impact of the maneuver warfare reforms on training to be a mixed result at best.

Personnel Management

It is safe to say that the maneuver warfare reforms have had little impact on the personnel management system. The Maneuverists had two main goals. The first was to assign and promote Marines based more on individual proficiency and temperament and less on standardized career path requirements—that is to manage Marines as individuals rather than interchangeable pieces. The second was to promote unit cohesion through personnel stability in the form of longer tours with one unit. Though some efforts were made to accomplish these two goals, they were unsuccessful.

Command selection was the one important change that seemed to be at least partly associated with the maneuver warfare movement. Promotion boards seemed to recognize operational competence more than in the 1970s, when administrative and management success appeared to weigh more heavily in promotion and assignment decisions.

Broadly, the Maneuverists called for the institution to be more flexible and less bureaucratic, which was always going to be a daunting task. But daunting or not, reforming the personnel management system arguably was the Maneuverists' greatest institutional failure.

Culture

Management guru Peter Drucker famously said, "Culture eats strategy for breakfast." This was not meant to convey that having a plan did not matter but rather that a strong culture is the surest path to organizational success. This has always been a strength of the Marine Corps given its emphasis on ethos. The challenge for the Maneuverists was to influence Marine Corps culture in a way that supported maneuver warfare without undermining existing cultural strengths.

... the effort to institutionalize maneuver warfare produced a mixed result in terms of breadth, depth, and durability .

The single greatest cultural impact of the maneuver warfare movement was to add a strong intellectual component to the image of what it meant to be an officer of Marines. Hard as it may be to imagine today, intellect was not considered an important quality in a Marine officer in the 1970s and early 1980s. In fact, an anti-intellectual undercurrent ran through the officer corps in the immediate post-Vietnam War years.[5] Not only were officers not expected to read professionally, they were looked at askance if they did. Officers were expected to be physically fit, physically and morally courageous, and technically proficient, but they decidedly were not expected to be students of the art of war. They trained hard, they partied hard, but they were not expected to study hard. That was the culture.

That changed with maneuver warfare. The fundamental understanding of war as described in *Warfighting* dictated it:

> It is critical to keep in mind that the enemy is not an inanimate object to be acted upon but an independent and animate force with its own objectives and plans. While we try to impose our will on the enemy, he resists us and seeks to impose his own will on us.[6]

There was therefore an element of a chess match to warfare, a requirement to outthink the enemy as well as to outfight him. Also from *Warfighting*:

> War also involves a significant mental, or intellectual, component. Mental forces provide the ability to grasp complex battlefield situations; to make effective estimates, calculations, and decisions; to devise tactics and strategies; and to develop plans.[7]

Gen Gray modeled the well-read leader. The Commandant's Professional Reading List made self-study a responsibility for all Marines. The reforms in the schools demonstrated the value that the institution put on education. The emphasis on free-play training exercises highlighted the essential requirement to outthink the enemy. Today, a strong and trained intellect is considered an intrinsic attribute of a Marine leader. We suggest that is largely a cultural consequence of the maneuver warfare movement.

Conclusion

In conclusion, the effort to institutionalize maneuver warfare produced a mixed result in terms of breadth, depth, and durability. The Maneuverists succeeded in some areas, achieved partial or temporary success in others, and mostly failed in at least one. In other words, the maneuver warfare revolution was incomplete. The questions we need to ask ourselves today are: should the Marine Corps undertake to complete the task given the effort required? Is maneuver warfare the right warfighting doctrine for the present and future, especially given the new operating concept of Expeditionary Advanced Base Operations? And if yes, how do we do it given the mixed results of the initial effort?

Notes

1. Headquarters Marine Corps, *MCDP 1, Warfighting,* (Washington, DC: 1997).

2. Staff, "V-22 Osprey Tilt-Rotor Aircraft," *Naval History and Heritage Command*, (n.d.), available at https://www.history.navy.mil.

3. Redesignated as Light Armored Infantry in 1988 and then as Light Armored Reconnaissance 1994.

4. *Warfighting.*

5. We recall the story recounted by a field-grade colleague who asked his commanding officer for an endorsement to his application for Georgetown University's National Security Studies master's program. The commanding officer strongly discouraged him, telling him he could be a Marine or he could be a defense expert, but he could not be both. This attitude was not uncommon.

6. *MCDP 1, Warfighting.*

7. Ibid.

Infantrymen as Terminal Attack Controllers

by Sgt McLennan S. Janes

>Sgt Janes is an 0352 and JFO, currently serving as a Combined Anti-Armor Team (CAAT) Platoon Sergeant in Weapons Company, 1st Battalion, 3rd Marines.

Of the seven warfighting functions detailed within the Marine Corps' philosophy, the two most prevalent in the employment of close air support are *fires* and *maneuver*. *Fires* are the means used to delay, disrupt, degrade, or destroy the enemy, while *maneuver* is the movement of forces for the purpose of gaining an advantage over the enemy. Although these functions are by no means mutually inclusive, an axiom frequently expressed in the infantry community may come to mind regarding these two concepts: "Fire without maneuver is a waste of ammunition, and maneuver without fire is suicide." This phrase displays the union in which fire and maneuver has existed for well beyond a century. While close air support is a relatively new arrival to the host of fire support platforms the Marine Corps employs, its capabilities have become the preferred method for getting ground forces out of a pinch. With precision-guided munitions, reduced collateral damage, and far-reaching delivery methods, most surface-to-surface firing platforms have trouble keeping up with the technological power curve. One limitation of close air support is the degree of technical and tactical proficiency required to successfully and safely employ ordinance in conjunction with maneuver. Close air support is defined as: "air action by fixed and rotary-wing aircraft against hostile targets that are in close proximity to friendly forces and require detailed integration of each air mission with the fire and movement of those forces." Currently, the Marine Corps has two classifications for ground-based personnel who are deemed capable of terminal attack control: joint terminal attack controllers (JTACs) and forward air controllers (FAC). The JTAC and the FAC are both developed by attending the Tactical Air Control Party course hosted by the Expeditionary Warfare Training Group. While the prerequisites do not explicitly state it, school seats and funding approval is generally confined to Marines from the artillery community, air and naval gunfire liaison companies, and Marine aviators preparing for their tours as air officers or forward-air controllers—with few outliers. While all these personnel already have an expanded knowledge base in the employment of *fires,* few have first-hand experience with the conduct of *maneuver.* The definition of close air support raises an issue with this self-imposed constraint on the engendering of terminal attack controllers. How can "detailed integration of each air mission with the fire and movement of those forces" occur when most of our terminal attack controllers are limited to the fire support community? The answer the Marine Corps has provided to this issue is to assign liaisons or attachments to the maneuver elements who—in a perfect world—are included into maneuver-based exercises prior to an individual units' deployment rotation. Conceptually, this allows the attachments ample time to understand fire support necessities when integrated into a ground scheme of maneuver. However, the reality presents a palpably different product. Whether it is an issue tied to manpower or a problem concerning budgetary constraints, these JTACs and FACs frequently are late arrivals to units—often not being fully integrated until the actual deployment occurs.

The JTAC and the FAC are both developed by attending the Tactical Air Control Party course hosted by the Expeditionary Warfare Training Group.

The result is an underdeveloped relationship between both entities at arguably the most crucial time for any unit. With several billets in the infantry battalion serving as a layer of redundancy and the already developed skill set of fire support integration amongst infantry small unit leaders, it is the purpose of this article to argue that the time has come to send infantrymen to become joint terminal attack controllers. With that, through the removal of live fire training and readiness (T&R) standards constraining JTAC and FAC development, the Marine Corps will be capable of meeting the increased demand for terminal attack controllers throughout the fleet, reducing the interdependence between units and

their supporting agencies while fostering more independent and decentralized actors within the battlespace.

The counterargument commonly expressed against making infantrymen JTACs is that it does not fall in line with their job. A squad leader should not have to deal with the routing and safety of aircraft and employ his squad in combat at the same time. While these challenges are valid, squad leaders and assistant squad leaders are already being driven to become Joint Fires Observers (JFOs). Arguably, the only key differences between a JFO and a JTAC is that the JTAC has authority to clear an aircraft for weapons release and the ability to provide routing instructions into and out of a battlespace. Regardless of whether or not it is too much on one person's plate, most infantrymen can expect to be somewhat versed in the utilization of air- and surface-fire support within their first enlistment. Should these JFO qualified squad leaders remain in the infantry, they will eventually become platoon sergeants. The platoon sergeant is, by nature, a layer of redundancy in leadership within the platoon. Most platoon sergeants are tasked with the administrative workload in garrison and the tactical advisory role to the platoon commander operationally. While in combat, most platoon sergeants may be tasked elsewhere and unavailable to control aircraft, one specific platoon sergeant is not. In every rifle company, there exists a weapons platoon. The weapons platoon consists of a mortar section, assault section, and a medium machine gun section. In combat, or operationally—all these sections are generally assigned to one of the three platoons within the company, consequently reducing the administrative or logistical burden of the weapons platoon sergeant. Operationally, the weapons platoon sergeant has flexibility; whether he wants to help the weapons platoon commander in the fire support team or wants to confirm gun data with the mortar fire direction center, he generally does not have a specified role in combat. While this has yet to be recognized, the weapons platoon sergeant is the perfect candidate to become a JTAC. Typically, he will already have a developed knowledge base for *Fires* and *Maneuver* through his several years of service; more importantly, this will provide every infantry company in the Marine Corps with their own JTAC. Rather than scrambling for attachments or remaining at the whim of adjacent units, the infantry company reduces its reliance on outside agencies—becoming a more capable and independent force. This will facilitate the disaggregation of the infantry battalion in operations requiring several small entities operating autonomously and thus living up to our doctrinal concept of decentralization.

To have this proficiency centralized to one career path goes against all doctrine and limits the lethality of all ground forces—not just the infantry battalion.

With the implementation of JTACs within the infantry, there will be a corresponding increase in demand for school seats at the Tactical Air Control Party course; so how does the Marine Corps facilitate a sudden spike in training requirements? Many of the T&R codes associated with making a JTAC or FAC require live fire execution (i.e. dropping live ordinance from a real aircraft). In its current state, the JTAC's T&R Manual would impede the Marine Corps' ability to develop infantrymen as JTAC's because of the logistical and planning requirements associated with integrating aircraft into training. An easy and arguably more financially feasible solution is to remove the live fire training requirements within the JTAC's T&R codes. This will allow the Marine Corps to develop and maintain its JTACs and FACs through simulated close air support, reducing the overall cost of training these Marines. While there is little comparison between live fire and simulated exercises, live fire training should only be a confirmation of skill sets, not a proverbial measuring stick for which we determine one's capability.

To have this proficiency centralized to one career path goes against all doctrine and limits the lethality of all ground forces—not just the infantry battalion. As a force, the Marine Corps expects its Marines to expand upon their knowledge base—often encouraging them to venture outside of their military occupational specialty. The organization therefore has an obligation to provide these Marines with the necessary tools to capitalize off this new information rather than just a pat on the back for having good initiative. By creating JTACs that are already organic to an infantry battalion, we sharpen the lines of communication from commander to subordinate and create an environment where everyone speaks the same language, limiting the potential for misinterpretation of the commander's intent.

USMC

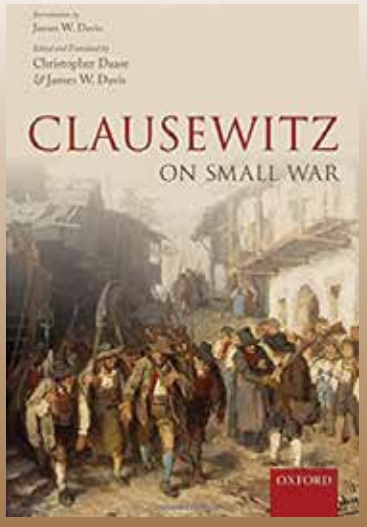
Quote to Ponder:

"To get harmony in battle, each weapon must support the other. Team play wins. You musicians of Mars ... Must come into the concert at the proper place and at the proper time."

—GEN George S. Patton

Clausewitz on Small War

reviewed by Maj Charles D. Melson



CLAUSEWITZ ON SMALL WAR. By Christopher Daase and James W. Davis. Oxford: Oxford University Press, 2015. ISBN 9780198737131, 251 pp.

Christopher Daase is a professor at the Goethe University Frankfurt, while James Davis is a professor at the University of St. Gallen. The present volume consists of Prussian military philosopher, historian, and general Carl von Clausewitz's "My Lectures on Small War, held at the War College," "Testimonial," "On the political advantage and disadvantages of the Prussian Institution of the Landwehr," and "Arming the People." These were the products of expanded translation of Clausewitz's works presented at a workshop at the Nitze School of Advanced International Studies in Washington, DC, and one of a series of Oxford University publications on Clausewitz. An introduction, bibliography, and index are provided to help readers through the disparate writings.

These selections were offered at several levels: as works of translation from German to English, as historical documents from a specific time and place, and whether they continued to be relevant at present as broader considerations of conflict or war. The editors concluded that these works were significant in the development of Clausewitz's theory of war. They also felt that he was an early theorist of insurgency and asymmetric warfare with insights that are still applicable today. The publisher, Oxford University, stated Davis and Daase showed "that asymmetric warfare is not a historical development that can be termed pre- or post-Clausewitzian as many contemporary scholars of war and military strategy argue."

***>Maj Melson (Ret) is the former Chief Historian, History Division, HQMC and Marine Corps University. He is the author of* Fighting for Time and Vietnam 1972: Quang Tri.**

Clausewitz himself defined "little" or "small" wars (*Kleiner Kreig*) in terms of the magnitude of the units involved (squad to battalion-size) and if these were not employed as part of a larger engagement or battle. Distinctions between tactics, strategy, and policy were also provided. This collection was presented in the chronological order they were written from 1810 through 1831. The main article was Clausewitz's war academy lecture notes that dealt primarily with the tactics and techniques of outposts, reconnaissance, security, and patrolling. At the time, this was meant to promote a transition from linear to open tactics during the reform period. The latter selections introduced concepts of partisan support to larger formations by regular forces, organized militias (*Landwehr*), and un-organized militias (*Landsturm*). The final piece from *On War* went on at length with the concept of the nation in arms. All were short of addressing anything like civil or revolutionary war notions of guerilla conflict. Very little was found that resembled modern concepts of insurgency and its counter, although topics for additional research were established.

The editors concluded that these works were significant … They also felt that he was an early theorist of insurgency and asymmetric warfare …

My own work with two German insurgency classics (*Kleinkrieg*, Casemate, 2016) started with a consideration of what Clausewitz had written on the subject. This was from his "The People in Arms" and supported by academic papers on the subject. In 2005, Professor Daase presented a paper at Oxford University on small wars in which he posited Clausewitz's superior conceptualization of political violence, the utility of the concepts of offense and defense, and explanations why big states often lose small wars.[1] Another paper was presented in 2010 by Professor Peter Paret at Humboldt University. Paret paraphrased Clausewitz's teachings on small war from 1810–1811 at the Berlin War Academy. He concluded, "The lectures, strictly pragmatic, oriented towards

issues of the day, are today read primarily by military historians."[2]

The Daase and Davis publication takes up where Paret left off, including an introductory essay by Professor Davis. This was augmented by the historical examples of wars or campaigns cited: Franco-Dutch War (1672–1678), Seven Years War (1756–1763), American Revolution (1775–1789), French Revolutionary Wars (1792–1802), War of the First Coalition (1792–1798), Vendee (1793–1796), War of the Second Coalition (1798–1802), Prussia (1806, 1813), Spanish War of Independence (1808–1814), and Tyrol (1809). Clausewitz's lesson plans included a selection of further reading about these conflicts for his students with the counsel, "not to read much theory about Little War, but to devote their time instead to military history."[3]

Current American military command and staff or war college-level students might not find much here that is prescriptive or applicable to current events. In fact, these writings might be considered antiquarian material. But as an example of Clausewitz's thought, it provides a focus in contrast to his major works and is worthy of consideration in a broader sense. Much of Clausewitz's extensive writing remains in the German language, limiting the access of Anglo-Saxon scholars. Like others, I have had to rely on translations of Clausewitz, which now include this work, along with *On War*, *Principles of War*, and accounts of the 1812 campaign in Russia and the Battle of Waterloo. This situation continues, but efforts like this publication help make great books available to a broader audience. As such, it should be read by Marines to expand their intellectual perspective.

Notes

1. Christopher Daase, "Clausewitz and Small Wars," Clausewitz.com (n.d.), available at www.clausewitz.com.

2. Peter Paret, "Clausewitz: 'Half Against My Will, I Have Become a Professor,'" *The Journal of Military History*, (Lexington, VA: Society for Military History, April 2011).

3. Ibid.

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.

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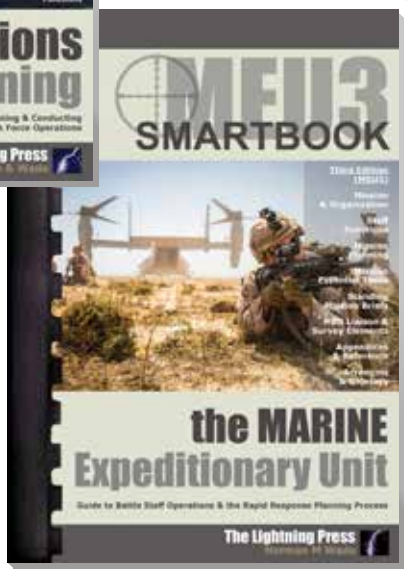

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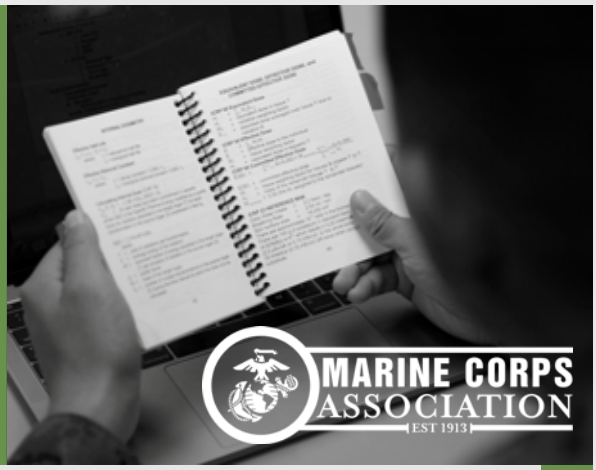

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