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18 Cover Article
Engineer capabilities are limited.
(Photo provided by Sgt Miguel Rosales.)

DEPARTMENTS

IDEAS AND ISSUES

Installations & Logistics

Aviation

Engineer

Behavioral Health

MCISRE

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MARINE CORPS Gazette
Professional Journal of U.S. Marines

MARCH 2019

Editorial: Logistics, Sustainment and Installations

Careful readers of the *Gazette* might notice that we have not published a Logistics focus edition since October of 2017. This hiatus has allowed us to coordinate better support for DC I&L, the Deputy Commandant for Installations and Logistics, by aligning the content of the professional journal with I&L's advocacy and advisory functions, and the annual logistics community's excellence awards program. The annual Logistics edition returns this month with a series of sixteen articles in print. Readers will find additional articles on our website. Our content this month covers a wide range of ideas and issues across both the logistics enterprise and installation functions.

Setting the tone of much of this content, we present a letter on page 8 from DC I&L, LtGen Charles G. Chiarotti, and "An Operational Concept for Future Logistics Development" by the I&L Vision and Strategy Group on page 9. These pieces outline the current state of MAGTF logistics and provide a forward look at logistics innovation. An aspect of innovation in logistics and sustainment involves the potential military applications of "artificial intelligence," or more accurately "machine learning," and heuristic algorithms. However, the effectiveness of these potential applications is always dependent on the accuracy, completeness, and interoperability of the data that the system is built upon. Challenges and opportunities in this area are discussed in "You Need Clean Data" by Maj Amber Coleman on page 12 and "Data-Driven Logistics" by LtCol Kirk Spangenberg et al., on page 19.

Since the establishment of Marine Corps Installation Command (MCICOM) in 2011, the Corps has adopted the concept of installations (bases and stations) as platforms for sustaining and deploying operational forces. "Installation—neXt" by Col A. Ché Bolden on page 60 analyzes the future of this approach. A critical vulnerability of our installations is explored on page 66 in "The Mission Criticality of Energy Resilience" by Randy J. Monahan.

In addition to the extensive discussion of logistics, we also present on page 72, GySgt Alfred Negron II's article, "The Castle Must Fall," a critical analysis of the organization of combat engineers and recommendations to improve engineering capabilities in the GCE.

Last month, MCA&F's new website, including an improved *Gazette* homepage, went online at www.mca-marines.org. Features of the *Gazette*'s page include a more reader-friendly "flip-book" version of the monthly magazine and a group of web-extra articles. We also included a comments forum for readers to respond to articles and provide us with their constructive criticism. This month we will also launch the *Gazette* blog: a forum for warfighters to discuss professional reading and other self-education endeavors. As the Corps' professional journal, we embrace our responsibility to the Service as a whole and provide several free resources to non-members including the Maneuver Warfare and TDG collections and our set of MCPP references. This support to the wider Marine Corps is made possible because of the willingness of you—the members of the MCA&F who participate in our professional association and engage on the important issues facing our Corps today.

Christopher Woodbridge

General Officer Announcements

On 16 January 2019, the Acting Secretary of Defense, Patrick M. Shanahan, announced that President Donald J. Trump made the following nominations.

BGen Julian D. Alford has been nominated for appointment to the rank of major general. Gen Alford is currently serving as the Commander, Task Force Southwest-Afghanistan.

BGen Michael S. Cederholm has been nominated for appointment to the rank of major general. Gen Cederholm is currently serving as the Deputy Commander, U.S. Marine Corps Forces Command, Norfolk, VA.

BGen Dennis A. Crall has been nominated for appointment to the rank of major general. Gen Crall is currently serving as the Senior Military Advisor for Cyber to the Under Secretary of Defense–Policy, Washington, DC.

BGen Karsten S. Heckl has been nominated for appointment to the rank of major general. Gen Heckl is currently serving as the Commanding General, 2d Marine Aircraft Wing, Cherry Point, NC.

BGen William M. Jurney has been nominated for appointment to the rank of major general. Gen Jurney is currently serving as the Commanding General, 3d Marine Division, Okinawa, Japan.

BGen Tracy W. King has been nominated for appointment to the rank of major general. Gen King is currently serving as the Director, J-5, Politico–Military Affairs (Asia), Joint Staff, Washington, DC.

BGen Christopher J. Mahoney has been nominated for appointment to the rank of major general. Gen Mahoney is currently serving as the Deputy Commander, U.S. Forces Japan, Yokota, Japan.

BGen Gregory L. Masiello has been nominated for appointment to the rank of major general. Gen Masiello is currently serving as the Program Executive Officer, Air Anti–Submarine Warfare, Assault, and Special Mission, Naval Air Systems Command, Patuxent River, MD.

BGen Stephen M. Neary has been nominated for appointment to the rank of major general. Gen Neary is currently serving as the Deputy Commanding General, II Marine Expeditionary Force; and Commanding General, 2d Marine Expeditionary Brigade, Camp Lejeune, NC.

BGen Austin E. Renforth has been nominated for appointment to the rank of major general. Gen Renforth is currently serving as the Director, Joint Operations Center-Baghdad, Iraq.

BGen Paul J. Rock Jr. has been nominated for appointment to the rank of major general. Gen Rock is currently serving as the Commanding General, Marine Corps Installations–Pacific, Okinawa, Japan.

BGen Joseph F. Shrader has been nominated for appointment to the rank of major general. Gen Shrader is currently serving as the Commanding General, U.S. Marine Corps Logistics Command, Albany, GA.

BGen Stephen D. Sklenka has been nominated for appointment to the rank of major general. Gen Sklenka is currently serving as the Commanding General, 1st Marine Logistics Group, Camp Pendleton, CA.

Col Marcus B. Annibale has been nominated for appointment to the rank of brigadier general. Col Annibale is currently serving as the Head, Aviation Weapons and Programs F-35 Branch, Department of Aviation, Headquarters, U.S. Marine Corps, Washington, DC.

Col Melvin G. Carter has been nominated for appointment to the rank of brigadier general. Col Carter is currently serving as the Director J-2, Joint Task Force, Marine Corps Augmentation and Training Support Unit, Fort Bragg, NC.

Col Robert C. Fulford has been nominated for appointment to the rank of brigadier general. Col Fulford is currently serving as Director, Expeditionary Warfare School, Marine Corps University, Marine Corps Base, Quantico, VA.

Col Daniel Q. Greenwood has been nominated for appointment to the rank of brigadier general. Col Greenwood is currently serving as Deputy Assistant to the President of the United States, Deputy Director for the White House Office of Legislative Affairs, Washington, DC.

Col Joseph A. Matos III has been nominated for appointment to the rank of brigadier general. Col Matos is currently serving as the Assistant Chief of Staff, Information Environment division, U.S. Marine Corps Forces Pacific, Camp Smith, HI.

Col Jason L. Morris has been nominated for appointment to the rank of brigadier general. Col Morris is currently serving as the Assistant Chief of Staff, G-3, I Marine Expeditionary Force, Camp Pendleton, CA.

Col David Nathanson has been nominated for appointment to the rank of brigadier general. Col Nathanson is currently serving as the Assistant Chief of Staff, G-4, I Marine Expeditionary Force, Camp Pendleton, CA.

Col Thomas B. Savage has been nominated for appointment to the rank of brigadier general. Col Savage is currently serving as the Executive Assistant to the Deputy Commandant for Plans, Policies, and Operations Directorate, Headquarters, U.S. Marine Corps, Washington, DC.

Col Daniel L. Shipley has been nominated for appointment to the rank of brigadier general. Col Shipley is currently serving as the Deputy Director, Program Analysis and Evaluation, Department of Programs and Resources, Headquarters, U.S. Marine Corps, Washington, DC.

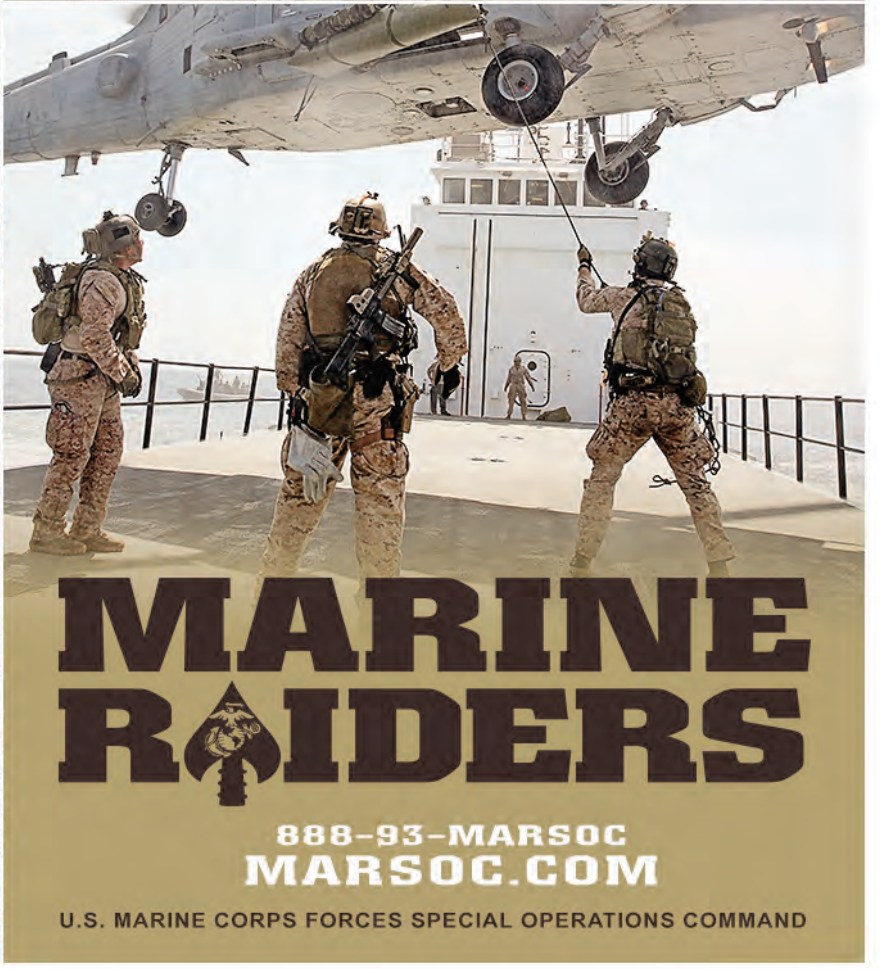
Col James B. Wellons has been nominated for appointment to the rank of brigadier general. Col Wellons is currently serving as the Head, Weapons Requirements Branch, Department of Aviation, Headquarters, U.S. Marine Corps, Washington, DC.

Col Brian N. Wolford has been nominated for appointment to the rank of brigadier general. Col Wolford is currently serving as the Chief of Staff, II Marine Expeditionary Force, Camp Lejeune, NC.

Marine Corps Reserve Col Leonard F. Anderson IV has been nominated for appointment to the rank of brigadier general. Col Anderson is currently serving as the Assistant Wing Commander, 4th Marine Aircraft Wing, U.S. Marine Corps Forces Reserve, New Orleans, LA.

Marine Corps Reserve Col William E. Souza III has been nominated for appointment to the rank of brigadier general. Col Souza is currently serving as the Deputy Commander, Headquarters and Service Company, 23d Marine Regiment, 4th Marine Division, San Bruno, CA.

Spiritus Invictus



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Gender Neutral Pronouns

First, I would like to thank the *Gazette* for publishing my article on pilot retention (*MCG*, Jan19) and helping further the discussion of this issue across Marine aviation. That said, after reading the print version of the article, I noticed that the gender neutral pronouns I had originally written were changed to male pronouns. While I understand these changes were in line with the *Chicago Manual of Style*, I find them problematic primarily for their lack of inclusivity. In a time when the Marine Corps is struggling to retain its female pilots, the use of male pronouns serves to not only exclude them but also sends women the incorrect message that they do not belong, have no place in Marine aviation, and are not a part of the critical pool of pilots the Marine Corps absolutely must retain. Of note, the Marine Corps has fully embraced a written gender-neutral policy and has changed male pronouns in its orders and publications to Marines, SNM [subject named Marine], or something else that is gender neutral. I know there was no malicious intent behind the changes made and I am grateful to the *Gazette* for taking corrective actions and reverting the online version of the article to gender-neutral pronouns. I greatly appreciate the important work everyone at the *Gazette* does in providing a space for the sharing and discussion of ideas and issues across the Marine Corps. I thank you again for the time and the opportunity to share my thoughts.

LtCol Janine "ATIS" Garner

>*Editor's Reply: As the professional journal of the Corps, the* Gazette *will continue to use the accepted guidelines for formal writing as published in the* Chicago Manual of Style. *We will also continue to work closely with all of our Marine authors throughout the editorial process. When a deviation from the norms of formal writing—such as the use of gender-neutral pronouns—is important to conveying an author's message and reaching the broadest audience of Marines, we will always endeavor to support our contributing authors.*

Paid in Full

In reference to my letter, "UAS Commanders as FACS," (*MCG*, Jul17) where I bet my next Reserve paycheck that MAWTS-1 Air Officer Department would agree with my position, The Air Officer Department's response in the January 2018 issue, "UAS as FACs," disagreed with my argument. I paid up on my bet and donated my Reserve paycheck to the Wingman Foundation.

Maj Trent "LOP" Emeneker

Special Notices (continued)

Reunions

Org: Donald E. Davis Squadron
Dates: 21–24 March 2019
Place: Pensacola, FL (Marine Corps Aviation Association hosting)
POC: Wayne Miller
973-441-3636
millerwayne559@gmail.com

Org: Hotel 2/7 Vietnam Veterans Reunion (1965-1970)
Dates: June 20-24, 2019
Place: Holiday Inn San Diego Bayside
San Diego, CA 92106
POC: Dan Steiner
618-567-4077
dsteiner49@yahoo.com

Org: 531 Gray Ghost Squadron
Dates: 27–29 June 2019
Place: Crossroads Inn, Quantico VA
POC: Roman Makuch
347-886-0962
Ray Holmes
732-267-0518
rayholmessr@yahoo.com

Correction

In the January 2019 issue of the *Gazette*, p. 60, Dr. Paolo Tripodi's name was inadvertently left out of the photo of the members of Col Brian Kerl's Dissertation Committee. Dr. Tripodi is the gentleman on the far right hand side of the photo.

Request for Research Assistance

Author Leo J. Daugherty III is looking for Marines who have information on or served with the late MajGen Oscar F. Peatross, USMC (Deceased), in order to gain a better insight on his life and career. Gen Peatross won the Navy Cross for his actions during the Makin Raid by Carlson's Raiders, as CO, Co B, 2d Marine Raider Battalion, and later during Operation STARLITE as CO, 7thMar. He finished his career as CG, MCRD, Parris Island, SC, from 1968–1970. If you knew or served with Gen Peatross and would like to contribute to Daugherty's research, contact him at 145 Waterfowl Loop, Rineyville, KY 40162; 503-624-1501; or 270-360-9689.

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 3 months after the article appeared.

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

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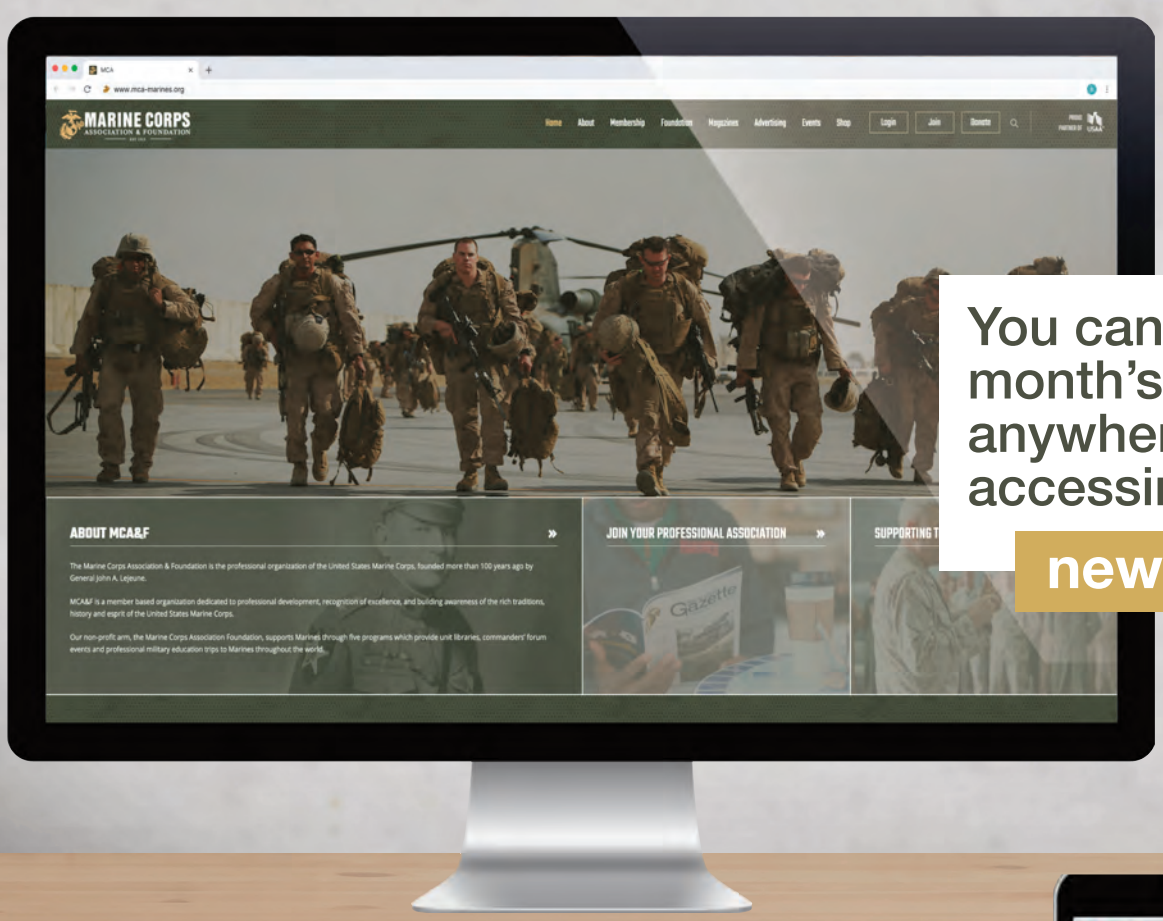

You can read this month's *Gazette* anywhere by accessing it on the

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Faster, easier to navigate, and more secure, the new MCA&F website enhances our support to members, donors, shoppers, guests at our events, and any one who wants to connect to the professional association of the Corps.

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21 December 2018

The present and enduring requirement of the Marine Corps Logistics Enterprise is to enable the lethality of the MAGTF. This focus never changes, even as the fight evolves into different domains and locations. And it is undeniable that the fight is changing. Last year, the National Defense Strategy (NDS) reoriented our military posture for the first time in over a decade, from a focus on low end conflict in the counter-insurgency and counter-terrorism realms, to a focus on high end near peer/peer competitor competition. For Marine Corps logisticians, applying the NDS will require a significant and rapid evolution of the enterprise to avoid any deterioration in the quality of support available to the warfighter. Instead, our objective is to increase and enable the lethality of the MAGTF through the application of innovative, responsive, and resilient logistics capabilities. To be effective, this transformation will have to include the accounting for all existing inventory, sustaining valuable legacy equipment, enhancing close partnerships with industry, academia, allies and partners, and innovating successful best practices and technology.

The changing strategic objectives within the NDS make the precise outcome of the Logistics Enterprise transformation challenging and complex. Our ability to shape the future will depend on a deep understanding of the threat and alignment of our resources, which are vital to sustaining current capabilities while developing new ones. Success will depend on our ability to recognize and accept risk, understanding the adverse outcomes of resource shortfalls and working to mitigate or accept these risks where we can. This is our challenge and should not be viewed as insurmountable—we can and will scale this "Everest."

We must aim our efforts precisely so we do not delay our transformation. As the Marine Corps embarks towards the visions outlined in Force 2025, the Marine Operating Concept (MOC), and emerging concepts like Expeditionary Advanced Base Operations (EABO), our application of logistics must be consistent with the principles of logistics: responsiveness, simplicity, flexibility, economy, attainability, sustainability, and survivability. Our ability to call upon a menu of capabilities tailor-made to meet the tactical demands of the fight will be the difference. These capabilities will be based on networked, autonomous, and data-driven technologies. The speed of understanding and the selection of capabilities to answer the demand will be facilitated by the assistance of artificial intelligence (AI)—speed of decision and swift action is what we will strive for.

To answer the challenges of tomorrow, we are publishing a **Sustaining the Force** concept for the logistics community. This concept serves as an aiming point to support innovation, align efforts, and ensure timely application of resources to achieve our desired endstate: *a Marine Corps Logistics Enterprise capable of generating and sustaining combat power in contested environments across the warfighting functions*. The Sustaining the Force framework drives progress through four lines of effort all directed at increasing the lethality MAGTF: Global Logistics Awareness, Diversified Distribution, Improved Sustainment, and Optimized Installations to Support Sustained Operations. Your close scrutiny and thoughtful engagement on this concept will prepare us to face the challenges ahead. I invite your comments and input on the concept outlined in the next article.

Semper Fidelis,

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

An Operational Concept for Future Logistics Development

The call to modernize

by HQMC I&L Vision and Strategy Branch

As described by the Deputy Commandant for Installations and Logistics, recent strategic objectives within the National Defense Strategy (NDS) resulted in sweeping changes in the way the military will prosecute warfare in the coming decades. The NDS provides clear direction on how the DOD intends to curtail our diminishing military overmatch and deal with the rise of "revisionist powers." It expands the battlespace to include rear area and noncombat operations, incorporating them into four layers of steady-state competition with our adversaries. In doing so, the NDS highlights the shortcomings of the current force and the need for significant and rapid modernization, which is reflected in Secretary James N. Mattis' direction to "foster a culture of experimentation and calculated risk-taking."

Our intent is to provide support to sustain our forces. *(Photo by Sgt Katelyn Hunter.)*

Significant change to the logistics enterprise must begin immediately to support this reorientation and continuously ensure the lethality of the MAGTF. This headquarters is already busy innovating and developing new ways to modernize a rapidly aging logistics enterprise, using guidance such as the hybrid logistics vision and the still developing expeditionary advance based operations (EABO) concept as points of reference. The Next Generation Logistics (NexLog) team continues to carry out our Commandant's mandate to "innovate to stay ahead of our adversaries." Using a mix of crowd sourcing and private industry partnerships, they actively explore and exploit new ideas and technologies. In conjunction with the Marine Corps Warfighting Laboratory (MCWL), they made significant strides in developing ways to employ pre-existing and emerging technologies like additive manufacturing (AM); unmanned logistics systems, air (ULS-A); and ground (ULS-G). Our wargaming and experimentation cell is also involved with tangibly measuring the effectiveness of new technologies through ensuring their integration into Phase II of the SEA DRAGON experimentation plan. Simultaneously, we are leveraging the ground logistics advocacy program to look at ways to accomplish the specified logistics tasks in the *Marine Corps Operating Concept* (Washington, DC: HQMC, September 2016) and mitigate shortfalls identified in the Marine Corps Gap List (MCGL).

The *Sustaining the Force in the 21st Century* concept (Washington, DC: HQMC, January 2018), which we will refer to as *Sustaining the Force* for short, is meant to synergize the current efforts of the logistics enterprise by articulating an aim point for the future of Marine Corps logistics and provide direction for how we will get there. It is a descriptive, vice prescriptive, document serving to guide resource alignment in the future. The concept will also assist in capability development and integration with the Deputy Commandant, Combat Development & Integration.

As depicted in Figure 1, *Sustaining the Force* introduces four lines of effort (LOEs) that we will use to organize our endeavors to continuously support the lethality of an evolving MAGTF. These lines of effort describe, in the broadest terms, what we must do to generate and sustain combat power in future contested environments.

The first line of effort, Enable Global Logistics Awareness, is required to lay the foundation for the largely data-driven operating environment of the future in order to rapidly gain and maintain situational awareness. This means that before arrival into a theater, we must be aware of available resources, including those present in both the joint force and within the area of operations. We will also require the ability to assess friendly force posture and accurately identify warfighter requirements throughout a given operation. Actions along this line of effort will allow us to leverage a very mature, yet still rapidly developing, field of technology to maximize our responsiveness to the demands of the force.

The Diversify Distribution line of effort addresses the need to capitalize on both legacy and emerging distribution capabilities to support geographically dispersed forces throughout a highly contested operating environment in multiple warfighting domains. We must maintain the ability to re-aggregate and mass sustainment whenever distributed operations are either impractical or inhibited altogether, but massed sustainment becomes a vulnerability in distributed operations (e.g., EABO). Improvements within this line of effort should result in distribution methods that are unpredictable, resilient, and enable the highest degree of precision delivery to maximize the MAGTF's speed, agility, and reliability.

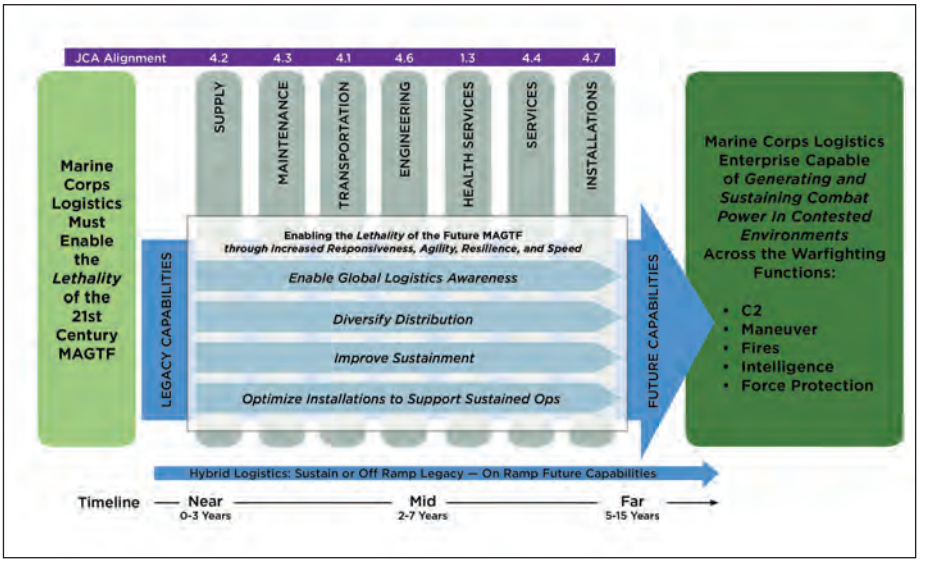

Figure 1. Sustaining the force in the 21st century.

The Improve Sustainment line of effort is, perhaps, the most comprehensive in that it becomes completely realized once actions within the previous two LOEs are achieved. It includes advances that reduce demand on the distribution network by expanding and integrating sources of supply. This will involve leveraging joint, interagency, and coalition support capabilities at the operational level as much as it will involve providing capabilities to our most forward maneuver and logistics units at the tactical level. Actions along this line of effort will enable sustainment over extended lines of communications, reduce overall demand on the supply chain, and enable independent operations for longer periods of time; thereby, maximizing both the efficiency and effectiveness of the support we provide.

Sustaining the Force
... what we must do to generate and sustain combat power in future contested environments.

The final LOE, Optimize Installations to Support Sustained Operations, is integrated with the other three LOEs. Today, our bases, stations, and depots are operationalized more than ever. Their primary mission is to generate and sustain combat power. Specifically, in the *Sustaining the Force* concept, this LOE addresses the requirement in the NDS to support operations at every level of the global operating model. Our installations are the start point for force generation and are key nodes in a distribution network that begins at the industrial base and extends deep into forward areas of operation. In the present global operating environment, our installations are under constant threat of attack both at home and abroad. Actions along this line of effort will require continued resourcing to support installation modernization efforts while strengthening the ties between the Supporting Establishment and the Operating Forces.

Applying the Concept

The LOEs in the *Sustaining the Force* concept follow a natural progression that should help to prioritize and contextualize our efforts. Enabling Global Logistics Awareness will be our main effort in 2019 as it establishes the con-

ditions for success in the other LOEs. As we begin to make progress along these LOEs, we expect the main effort to shift with the direction of the Deputy Commandant.

Regardless of the LOE, we will approach capability development through seven lines of operation which are aligned to the six traditional functions of logistics and installations. In this way, *Sustaining the Force* leverages our current advocacy process, which is functionally aligned and incorporates input from the Operating Forces and the Service staff. It will also serve as a forcing function to coordinate subject matter experts and communities of interest actions in support of these LOEs—perhaps leading to a re-alignment of many of our logistics operational advisory groups sometime in the future.

There are many ways to improve logistics support to the warfighter that can be applied through changing the way that we organize, train, and employ the logistics force. Simple changes to the way we do business (e.g., doctrine and policy) will have a lasting and impactful effect beyond their apparent scope. Successful application of this concept is only possible when we leverage the collective experience and brainpower of every Marine and civilian Marine in the logistics enterprise. Future capability development will be aligned to the LOEs and this concept will serve as the logistics capability roadmap for the next fifteen years or more. Detailed capability requirements will be identified and a full doctrine, organization, training, materiel, leadership and education, personnel, facility, and policy assessment will be completed by the operational advisory groups to support the Martine Corps capability-based assessment process.

Conclusion

The *Sustaining the Force* concept does not replace hybrid logistics. Rather, it reinforces and moves the hybrid logistics vision into execution. The lethality of the MAGTF is increased when the logistics enterprise is fully responsive. Ultimately, the logistics enterprise must extend the operational reach and enable improved response time and maneuverability of the MAGTF, while remaining integrated within the Naval and Joint Logistics enterprise. The end state is a logistics enterprise that will be able to sustain the 21st century force, providing a diverse mission set that enables distributed MAGTF operations in any environment with the ability to aggregate for the high-end fight, or provide support in lower spectrum operations. This article is a starting point to initiate and continue purposeful discussion and debate as emerging concepts and plans are solidified.

You Need Clean Data

Higher data quality standards are needed to improve Marine Corps decision making

by Maj Amber Coleman

The Marine Corps collects and maintains a significant amount of maintenance data, including the daily usage at using units as well as annual depot maintenance repair costs. However, data quality issues result in analysts spending almost 80 percent of their time cleaning and preparing data sets for analysis instead of transforming that data into actionable intelligence.[1] The time-consuming requirement of cleaning data is costly and is caused by the poor quality control of data going into Marine Corps data collection systems. Decision makers, analysts, and managers at all levels must adapt to accommodate this extra time in their everyday work.[2] If one month is required to develop a working model, an analyst could spend an average of four months cleaning and preparing that data, and there is no guarantee that the analyst will remove all of the erroneous entries.[3] This is the equivalent to spending 80 percent of your time arranging your rifle cleaning gear and only 20 percent actually disassembling, cleaning, and reassembling your weapon. While arranging your cleaning gear is necessary, it should only be a small part of the process compared to the time spent scrubbing and cleaning your weapon to ensure it functions properly. Poor data quality is an analyst's worst enemy[4] as it continues to prevent the Marine Corps from gleaning actionable information from our maintenance data.

In 2014, the Marine Corps Operations Analysis Directorate attempted to study the feasibility of creating a maintenance data collection MOS similar to the aircraft maintenance administration specialist MOS 6046. Ultimately, the MOS was not created, and the Marine Corps chose to simply document the effort to collect maintenance data. The M1A1 and the Medium Tactical Vehicle Replacement (MTVR) were used as test cases. Timelines to collect data varied; while some data was available within days, other data sets never materialized. Of the data collected, approximately one-third was unusable because one of three key fields—serial number, date opened, and defect code—was missing from maintenance documentation. Additionally, there were 397 M1A1s reflected on Marine Corps supply records at the time; however, 1,224 serial numbers appeared in this data set.[5] There were approximately 2,900 MTVRs on the supply records, yet over 6,800 appeared in the data sets provided.[6] Accurate serial number reporting and accountability is the minimum requirement in this effort. Without it, there is no way to tie maintenance actions to specific assets and, therefore, no way to uncover information from that data to identify usage patterns that may lead to predictive maintenance capabilities. It is as if both the maintenance action and the effort to document that maintenance action never happened. Imagine spending hours cleaning your weapon only to find that the armory did not maintain accurate serial number accountability so there was no record of your efforts. Even worse, there might be no record of your weapon being in the armory at all.

The M1A1 was used to collect maintenance data. *(Photo by Cpl Kevin Payne.)*

Marine Corps Logistics Command conducted a study to calculate the maintenance costs to the Operating Forces for each year the Marine Corps deferred AAV depot-level maintenance.[7] The analysts found that six years is the optimal depot maintenance interval, which analytically validated the current AAV depot maintenance strategy. However, attempts to apply the same analysis to other vehicle types were unsuccessful primarily because vehicle serial numbers did not match across various data systems. In 2016, Program Analysis and Evaluation, Programs and Resources,

>Maj Coleman is assigned to Combat Logistics Battalion 6.

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EST 1913

HQMC conducted a study to determine the divestment criteria for HMMWVs.[8] Their study revealed patterns between usage data and maintenance histories, but this was based on only 58 percent of the available data. Because of mismatched serial numbers between Global Combat Support System Marine Corps and Transportation Capacity Planning Tool, 42 percent of the data was unusable. This is a critical issue because this missing data might hold key information and contain trends that are absent in the usable data. We can only expose these trends through the data itself, and as of now, there is not enough information to provide accurate predictions.

In 2015, a Naval Postgraduate School student, Maj Adam Foley, attempted to analyze MTVR maintenance trends, but instead found that over 50 percent of the available data was unusable because of missing mileage.[9] Mileage, hours, and any other type of Equipment Operating Time Code (EOTC) data provide a means to determine the age of an item. Without usage data, it is impossible to accurately determine how aged the item really is; thus, there is no way to associate maintenance occurrences with usage trends.

Fortunately, the Marine Corps is not alone. Industries worldwide are attempting to gain further insight from their data, and many suffer from the same problems. One study suggests that only three percent of businesses have acceptable data quality levels.[10] IBM estimates that poor data quality cost businesses over $3.1 trillion in 2016 alone.[11] The best way to improve data is to prevent errors from ever entering the system to begin with.

Data Quality Is Every Marine's Job

Data quality begins at the point of entry—the Marine on the shop floor. These Marines must understand that keeping this data accurate and clean is equally as important as keeping your weapon clean. It consumes no extra resources other than the few seconds it takes to ensure we capture information accurately. This effort will enable the Marine Corps to provide quantifiable and defendable data to support requirements at all levels. Regardless of the systems the Marine Corps chooses to record and archive this data, every Marine has a responsibility to input quality information and work with the tools we have.

Marine Corps analysts currently leverage machine-learning techniques using automated processes to sort through large data sets to find patterns and connect that data with predictable outcomes.[12] Essentially, the machine learns the behavior of your process to provide useful insights and predictions. Based on historical data, analysts may also build mathematical models to calculate risk; regardless, the data is the foundation of this capability. For example, a squad preparing for a patrol could select vehicles and weapons based on the probability of breakdown for each item to increase the overall probability of mission success. Incorporating a feedback loop at the conclusion of each mission provides additional data and enhances this capability since analysts may iteratively improve their models over time as more data and outcomes are collected.

Many of these models, once developed, can run on government networks using open-source software, and the Marine Corps already employs active duty and civilian analysts capable of developing these models at no additional cost to the government. Reducing the confounding "hidden data factory"[13] that constantly operates to link and clean disparate, dirty data will result in more of these analytical resources being available to focus on machine learning and predictive analytics leading to actionable insights. This work will ultimately enhance our understanding of the capabilities and limitations of our equipment before they are needed in combat.

Equipment operating codes are critical to maintaining equipment at a high level of readiness.
(Photo by LCpl Isabella Ortega.)

You Can Do Your Part

The data creation and upkeep is not the sole responsibility of the Marines on the shop floor or the data analysts. Leadership at all levels has the responsibility to maintain data quality through regular data audits. Begin with focusing on just a few data fields such as serial numbers, EOTC data, defect codes, and dates opened and closed. These fields are the most vital to maintenance data and without them data entries are useless. To maintain an understanding of your unit's data quality score, conduct regular in-house data assessments which is much easier than you think.

Managers at all levels could implement the Friday afternoon measurement method.[14] Pull your last 100 maintenance and supply transactions, gather two or three subject matter experts on a Friday afternoon to review each transaction and mark obvious errors.[15] For example, highlight serial numbers from

We have to pay attention to what is happening now, so that we will be prepared for the future.
(Photo by LCpl Isabella Ortega.)

maintenance transactions that do not match your supply records, empty or illogical EOTCs (look for mileage entries such as 12,345 or 99,999), missing defect codes, and empty or illogical dates. Then count the number of errors in each category of data and subtract that from 100. This provides a data quality score for each data element. If scores are high using these variables, begin including more data fields to further increase data fidelity. This methodology is simple and tailorable to any size or type unit within the Marine Corps, making it a low-cost tool that you may periodically employ, ensuring your unit is paying attention to data quality. Conducting this process during Friday afternoons prevents interference with other battle rhythm events throughout the week.

High operational tempo compels us to pay attention to what is happening in the present rather than thinking about how our actions (or inaction) will impact operations in the future. As a result, commanders and leaders at all levels must espouse the importance of data quality just as they underscore the importance of clean weapons. Clean data may not immediately keep you out of danger, but when appropriately leveraged, it could keep you from breaking down in harm's way and potentially save the Marine Corps millions of dollars.

The Marine Corps cannot continue to grow and innovate without keeping better data and ensuring that data works for the institution in a low cost and efficient manner. This effort does not necessarily require more funding. It simply requires education, diligence, and organizational discipline ranging from the shop floor to all levels of leadership. Everyone needs to understand the relationship between the data they are recording and the capability that accurate data may one day provide.

Several civilian and government agencies already capitalize on detailed analysis of maintenance and cost data. They are able to accurately break down costs, requirements, or other data points to provide detailed predictions that justify future requirements and may eventually result in greater profits. Advanced information technology systems could help, but only after we implement the proper education and processes to support accurate data collection.

If we want to be an innovative and advanced fighting force, we must embrace big data and start enforcing data quality standards throughout the Marine Corps. Our data must be as clean as our weapons.

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15 "Assess Whether You Have a Data Quality Problem."

A Data-Driven Organization

Developing data and information competency

by Maj Scott A. Humr

The Marine Corps is a data driven organization and therefore requires a greater number of Marines to possess the knowledge, skill, and abilities of data and information competencies to remain effective on the battlefields of today and the future.[1] However, minimal training is devoted to increasing the proficiency of Marines across all ranks to further develop the knowledge, skills, and abilities required to be effective in an environment characterized by over-the-size-limit email inboxes, duplicative systems of record, unstructured share drives, and disorderly data management practices. Therefore, the Marine Corps must inculcate data and information competency instruction across all modalities of training and education. Our bid for success is to take a systems approach to develop these competencies in our Marines which will have second and third order effects that yield increases in data and information accuracy and, ultimately, a more lethal Marine Corps.

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The Current Environment

Our most important processes require data, information, or knowledge to make informed decisions and take appropriate actions for accomplishing any mission. From planning processes at the tactical edge requiring target intelligence to strategic resource decisions on long-term budget line items, the importance of accurate information cannot be emphasized enough. For instance, a recent RAND report for the intelligence community asserted that, "[e]xploiting the rapidly growing sources of data available for collection and analysis is one of the greatest professional crises facing today's intelligence leaders."[2] Parallels from the RAND report are easily drawn to any community that desires to discover key insights and relies on data to make important decisions. In fact, the Commandant's responsibility to man, train, and equip the force for world-wide deployment or other taskings could not be performed successfully if he did not have an accurate feedback mechanism for measuring the efficacy of his direction and guidance toward producing the capabilities he is tasked to provide. For this reason, the Marine Corps enterprise is constantly producing, sorting, sending, searching, and storing an incomprehensible amount of data and information, which is continually refined at higher levels in the organization to provide this feedback. Therefore, we must imbue in our Marines the importance of data and information by providing the necessary training to make them and our organizations successful.

The Marine Corps is a data driven organization. *(Photo by LCpl Mason Roy.)*

The routine actions and behaviors conducted by Marines on a daily basis are producing data and information that feed higher levels of reporting. For example, lance corporals becoming proficient in their training and readiness standards to the sergeant entering supply transactions into Global Combat Support System-Marine Corps are actions that influence the readiness status of personnel and equipment captured in various systems of record across the

Information is gathered from multiple sources, saved, and shared with other users. *(Photo by LCpl Andy Martinez.)*

enterprise. Most importantly, the cumulative effects of all actions stored in these systems provide an assessment of our true capabilities as an organization available to a geographic combatant commander.

Regrettably, many of our organizational data environments are characterized by a great deal of disorganization, superfluous files, amorphous information, and a variety of bespoken applications, which often replicate the inefficient paper processes. However, this is what we should expect given most Marines receive practically no training on how to use many of the tools they are provided or the paltry online records management course mandated once a year. Marines kludge information from multiple data sources, saving and sharing the data across the enterprise. Versions of information proliferate and spawn subsequent variations with many iterations quickly becoming out-of-date. There is no wonder as to why we find ourselves in this most unenviable position.

As Marines, we take many things for granted when it comes to our expectations for what constitutes a "basically trained Marine." We expect a Marine arriving to his first fleet assignment to understand rudimentary military concepts such as history of the Marine Corps, chain of command, close order drill, weapons safety, and customs and courtesies; we also presume Marines will know the basics of his MOS. However, many Marines within administration and logistics functions will often fall in on numerous spreadsheets, out-of-date slide presentations, and government email accounts. An often-misinformed notion is that today's Marines have a natural penchant for these tools given they are stereotyped as "digital natives." While this may be true, it does not necessarily mean that they know how to use even the elementary capabilities of these tools provided to them, let alone the more advanced capabilities required to effectively accomplish many of the routine tasks required of them. We have all seen the Marine reconciling two spreadsheets side-by-side on a screen or printed copy using his finger to confirm changes or spot anomalies. Worse, Marines will use a separate calculator when adding a column of numbers in a spreadsheet, unaware that this and many other functions are inherently available to them. Recall rosters are distributed to a variety of individuals over email for one unfortunate Marine to cut and paste into the "master" spreadsheet once the various versions are returned. These examples, amongst many others, are the product of an indifferent and ineffective leadership. Such disregard results in countless man-hours wasted by our Marines; man-hours which could be better spent on more meaningful work and activities that are both rewarding and impactful for our organizations.

A Better Way

Marines must be able to adapt to efficiently manipulate and utilize programs such as Excel or Access. In fact, the Marine Corps is currently in possession of a suite of software applications that make data analysis much easier. Yet, Marines are still handicapped by their own ignorance of the availability of these applications combined with a lack of training. Unfortunately, it is too common to see Marines doing things the hard way when it comes to data collection, manipulation, cleansing, and analysis. This must change.

The velocity, volume, variety, and veracity (4Vs) of data within organizations are constantly increasing,[3] which will require an educated workforce that understands the fundamentals of data.[4] If the Marine Corps truly values data as a key driver in understanding combat readiness and performance, it must inculcate a data science mindset across its force. Furthermore, data and information are not the exclusive purview of any particular individual—all Marines are responsible.

To better equip our Marines, the Marine Corps needs to create a data-focused curriculum that will become a periodic training requirement or result in a bona fide certification. The creation of a curriculum that focuses our efforts on the importance of data is not only more empowering, it is needed to help drive innovations and decision making in the future. The proposed curriculum will be composed of, but not limited to, topics such as:

- Introduction to the basics of data science.
- Database fundamentals.
- Basic statistics and analysis.
- The importance of data and how it helps drive decision making.
- Data provenance and information management.

Data information must be updated and readily accessible in order to prepare reports or for easy access by the commander. *(Photo by LCpl A.J. Van Fredenberg.)*

- Data/information/knowledge hierarchy.
- Data visualization techniques.
- Dashboards.
- Data ontologies and taxonomies.
- Extract/transfer/load tools and techniques.
- Basic Excel, Access, Power BI, Tableau, R.
- Data cleansing and manipulation techniques and best practices.
- Logistics focused module on manpower or logistics automated information systems and their data structures.
- Data munging/wrangling/collection.

Many of these topics are already available through SkillSoft courseware on MarineNet and through free online learning platforms such as Coursea[5] and Udacity.[6] The Marine Corps may also potentially leverage the U.S. Army's Operations Research and Systems Analysis program, Naval Postgraduate School Distance Learning, and the Air Force Institute of Technology courses as additional venues for further training. Additional MOS-specific tracks could be created to further define the necessary skills for particular environments or billets.

Conclusion

Creating data literacy across the enterprise is key to ensuring the Marine Corps is postured to understand the importance of their data and how it provides value to the entire organization. Proper organization of our critical information for fast retrieval and data literacy is fundamental for improving our problem-solving abilities and solutions. For these reasons, educating the workforce on the skills and tools they need to curate and understand data will make large strides toward improving data-driven decisions across the Marine Corps. New technologies require large volumes of curated data to train and test appropriately.[7] Therefore, if the Marines Corps desires to leverage technologies, such as artificial intelligence and machine learning, it will need to both understand the data and properly organize it for consumption and training by the algorithms that fundamentally require vast amounts of data. Looking ahead, one may envision an additional MOS for Marines who have earned these credentials in their MOS for being subject matter experts on their field's particular data systems. For instance, the logistics community could create a 04XX AMOS similar to the 0477 or the 8055 Information Management Officer additional MOS as well. Particular billet MOSs might one day be coded with an additional skills designator for a Marine with particular data science skill set.

These skills and technologies are already within our reach and available to all Marines. Leaders need to prioritize these skill sets if the Marine Corps is to be successful in the future. Leaving these skills to hope and chance is not a course of action for success. Rather, they are outdated blueprints for status quo indifference that will continue to enfeeble our efforts toward increased lethality. To thrive as an institution in the current and future environment, we must prepare for it by training our Marines accordingly. Anything less is gross negligence and a prescription for defeat.

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Data-Driven Logistics

Transforming logistics from exploitable vulnerability to lethal competitive advantage

by LtCol Kirk M. Spangenberg, Majs Gregory "Zach" Lucas, Stan Bednar, Jason Fincher, Leo Spaeder, & CWO3 Miguel Beltre

Gunny Ellis jerked awake. It was 0348, and her wrist comms were buzzing. It was a priority message from higher headquarters that bypassed her do-not-disturb setting. "Seriously?" She murmured, as she clawed her way to the surface. OpTempo was high, and her team worked late into the night all week. Today was supposed to be a recovery day. She quickly flicked her left wrist over to activate the projection screen function on her wrist comms to see what the issue was. Blinking several times to remove the sleep from her eyes, she read the encrypted email message projected onto the inside of her forearm. For the hundredth time this week, she was thankful for that mobile server stack in the truck that was about the size of a 1.5 cubic foot dorm room fridge.

As she read the message, the rest of the sleep cobwebs were swept away. An unscheduled mission—a big one—and they had less time than usual to prepare. She eagerly sat up in her cot and ran through a quick mental checklist of all the things they needed. This is what they had trained for, and why they were stationed in this remote area far away from any other unit. With the mission at hand, she knew her team needed several key things that could not wait until the unmanned submersible arrived at the dock next week with their scheduled resupply. They had alot of prep to do. Throwing on her boots, she stepped out.

After she instructed Sgt Meyer to get the team moving and checked in with Capt Velazquez, who had also received the message and was doing his mission prep, she set about getting ready. They had most of what they needed (and very little extra), as the predictive algorithms they used for planning were quite accurate, and the automated push-resupplies based on their LOGSTAT reports (an automated report generated from their on-hand inventories using a network of sensors) had been right on time. However, with their heavier than anticipated OpTempo, combined with the nature of this upcoming mission, they were going to be short infrared chem lights, batteries, energy cells, and some other critical items. They also could not wait on the scheduled delivery of that repair part for the truck. She needed to order them now, and the supplies and parts needed to be on hand within the next several hours. Their 3D printers could solve some of their shortage issues, but not all of them. Once again flicking her wrist to activate the projection screen, she swiped left on her forearm until she reached the rapid resupply screen. After a few drop down menus and swipes, she selected the items she needed, added in the location and requested time, and hit submit. Within seconds, she received a notification that the order was received. The message contained a link that she could activate and track the status.

One-hundred-twenty nautical miles away in the South Pacific, an unmanned cargo vessel sprang into action. These ships were relatively small. While they could not carry huge volumes, there were many of them spread all across the Pacific, and they had low signatures to make them less visible. Their large numbers meant they could easily be replaced should an incident occur. Back in the States, the supply chain designers and planners used modeling and simulation software to design the distribution network and optimize their inventory nodes (of which this ship was one). Using the enormous amounts of data that the planners and data scientists had access to, they built a number of models and used discreet event simulations to predict needs for a number of different scenarios with a high degree of accuracy.

Having received Gunny Ellis' order, the rails and robot arms in the cargo hold whizzed and whirred in dizzying motion. The robotic arms picked out

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>>>>Maj Fincher is assigned to the Operations Analysis Division, Combat Development & Integration, MCCDC.

>>>>>Maj Spaeder is a MAGTF Planner currently assigned to the Marine Corps Warfighting Laboratory/Futures Directorate.

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the items ordered and dropped them into the small shipping container. Closed and sealed, the box whooshed away on the conveyer belt to the loading area, where more robotic arms attached it to the medium-sized electric cargo drone. Another robot, this one on wheels, pushed the cargo drone out of the hangar to the small flight deck, where it launched into the night sky. Gunny Ellis looked at her forearm again as it buzzed with a notification. The cargo drone was inbound. "Reminds me of my pizza delivery status notifications back home," she thought wryly.

In its current state, the Marine Corps logistics enterprise represents an industrial era model built around mass and brute force. Indeed, the *Marine Corps Operating Concept* (MOC) makes this abundantly clear when it states, "We cannot meet the demands of an agile, distributed 21st century MAGTF with a 20th century approach to logistics."[1] In truth, the Marine Corps has been able to accept risk in modernizing logistics to keep pace with modern technology and industry because we have enjoyed maritime and air superiority—even supremacy—and robust fixed bases that took months to build and enormous resources to maintain. While the Marine Corps achieved many great successes with this model in past and recent conflicts, the logistics enterprise certainly is not optimized to support the type of operations or the operational environments described in the National Defense Strategy or the MOC. The MOC states the need to:

> [Redesign] our logistics to support distributable forces across a dynamic and fully contested battlespace–*because iron mountains of supply and lakes of liquid fuel are liabilities and not supportive of maneuver warfare.*[2]

Littoral Operations in the Contested Environment (LOCE) and Expeditionary Advanced Base Operations (EABO) require an agile, flexible, and responsive logistics enterprise that generates MAGTF lethality. In fact, senior leadership noted that in this environment, logistics is the Marine Corps' pacing function—and our legacy configuration—is no longer sufficient. *We must transform our logistics enterprise from an exploitable vulnerability to a lethal competitive advantage.*

Configuring our logistics enterprise with new and advanced distribution capabilities, the ability to integrate diverse sources of supply with global visibility and awareness demands a modern, information age construct. It demands data-driven logistics (D2L). Fully realizing D2L, however, will not be easy. This is not simply a matter of developing and acquiring "wrist comms," deployable server stacks, cargo drones, robotic floating warehouses, and other modern tech gear. Achieving the underlying data infrastructure to allow for the precise planning, agile decisions, and predictive analytics required to accomplish this will require an immediate, comprehensive, and *executable* roadmap. We must rapidly identify required actions the Service must pursue *now*, while informing future capability development and resourcing decisions.

To meet this challenge, one small team of "logistician insurgents" (of which there are many), have proposed a method to build a rapid, detailed, and executable pathway to this digital transformation. This proposal was submitted to the 3rd Annual Logistics Innovation Challenge and the CMC 1st Quarter FY19 Innovation Challenge. While this article is being written, results of those challenges are pending.

The Proposal

We propose conducting a twelve-month D2L experiment focusing on capability development, organizational structure, and culture. The experimentation force will consist of specialized cells within MLGs (Marine Logistics Groups) that will experiment with data (collection, analysis, visualization, decision support) to tangibly *demonstrate* capabilities, limitations, and requirements of D2L. Specifically, these cells will seek to collect, access, and analyze data; produce actionable insights with clear visualizations; and answer questions or solve problems to enable decisions of their host MLG (or, in fact, host MAGTF). (See Figure 1.) In so doing, the experimentation force will outline the roadmap to achieve a true D2L capability that will project MAGTF lethality. This proposal is unique in that it seeks to address the root of the issue—organize, train, and equip—rather than attacking a niche capability.

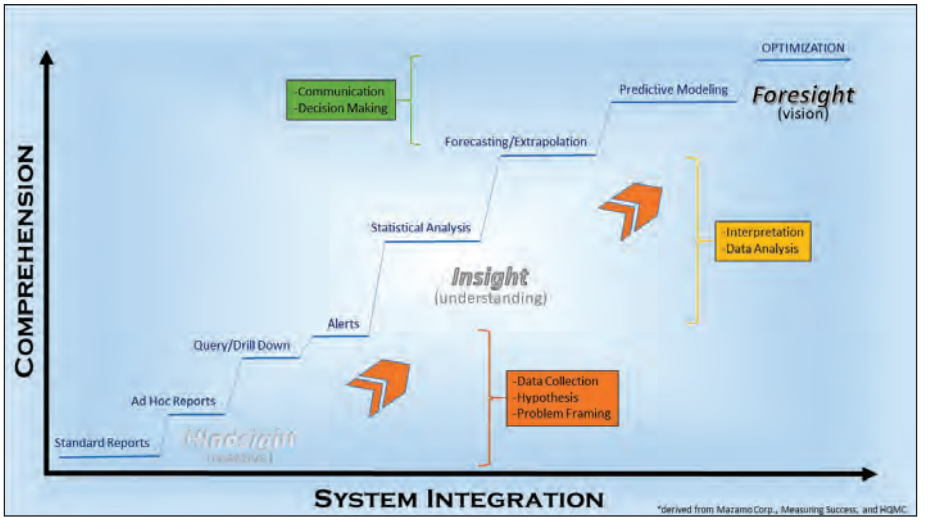

Figure 1. *(Image provided by author.)*

Background and Thesis

What do we really mean by D2L, and what can it actually *accomplish* for logisticians, leaders, decision makers, and commanders? In other words, how do we *operationalize* D2L? Rather than chasing the latest techy gadgets or gear, this submission seeks to help the Marine Corps answer this critically important question. *To put D2L into practice, we*

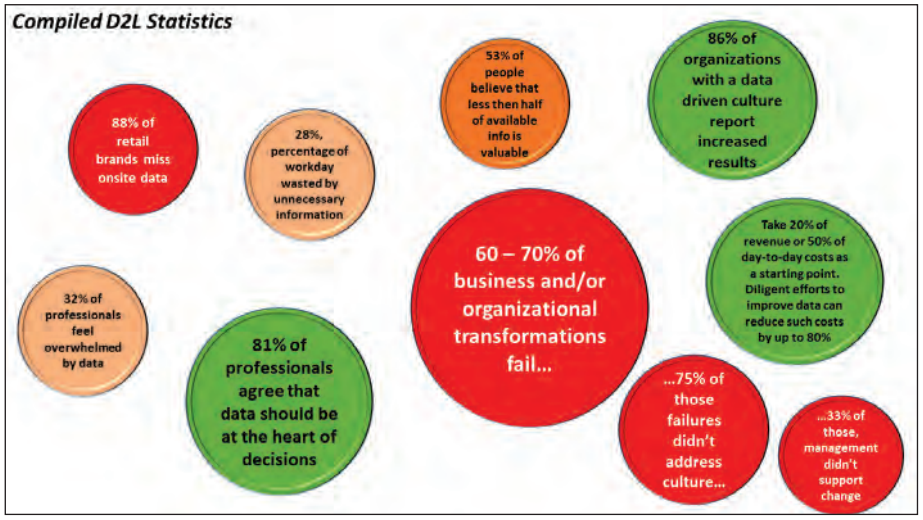

Figure 2. *(Image provided by author.)*

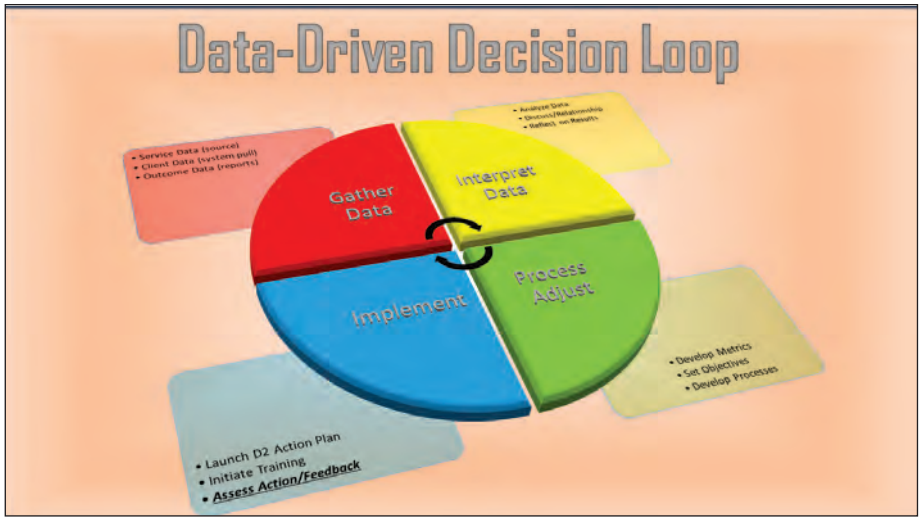

Figure 3. *(Image provided by author.)*

Figure 4. *(Image provided by author.)*

must build the organizational and technical infrastructure to execute it: manpower and structure, roles and responsibilities, hardware and software. The best sensors, gadgets, and information technology systems in the world will not turn the Marine Corps logistics enterprise into a data-driven, information-based organization if we are still organized and trained as an industrial era force. In other words, *we cannot buy a materiel solution for an organizational and cultural problem.* (See Figure 2.)

D2L

At its core, D2L is about decision making. We need the ability to rapidly and consistently make hyper-informed, accurate decisions resulting in better outcomes that are measurable, less manpower intensive, and cheaper. We need capable decentralized decision making with greater accountability while providing leaders greater transparency on causality of outcomes. We need feedback loops for ongoing measurement and improvement. (See Figure 3.) We need our leaders to focus their time and effort on those *qualitative* decisions that require their experience whilst alleviating the burden of the *quantitative* decisions that can easily be handled (or even automated) with math, algorithms, and data. Ultimately, we need to compensate for a declining technological advantage (which must of course still be addressed) by creating an *intellectual* advantage over our adversary—the ability to out-cycle his decisions, use our logistics speed and agility to generate tempo, enhance the MAGTF's lethality and keep the adversary unbalanced and uncertain. All of these advantages are within our realm of capabilities, but the only question is how will we leverage them? That is where our proposal comes in.

Experimentation Force Actions

Each experimentation cell supports the MLG to which it is assigned, while maintaining connections with the other cells and a central coordinating body at HQMC. While each cell will naturally adjust to its host's priorities, key topics to analyze include supply chain, readiness metrics, fiscal metrics, and

manpower. These topics represent key opportunities because of high volumes of associated data and the ways in which analysis can drive decisions. (See Figure 4.)

The experimentation cells will meet for plenary sessions three times during the experiment—at kickoff (level-setting, senior leader guidance, and portions of the training), at mid-year (cross-talk and in-progress reviews for senior leaders), and at the conclusion (out briefs, findings, and after-action reports). They should also stay connected throughout the year to share ideas and collaborate on D2L strategy development. Throughout the year the cells will educate and provide experiment feedback at key advocacy forums (Logistics Consolidated Operational Advisory Group, MAGTF Logistics Board, Installations and Logistics Board). To enhance the learning experience and output quality, the cells will conduct limited engagements with select academic and industry leaders. Additionally, while at home station the cells will provide education to leaders throughout their respective MEFs on the D2L concept, the experiment, its expected outputs, and the cell's capabilities (e.g., a roadshow; likely midway through). This could include conducting targeted analysis for other elements of the MAGTF as part of the learning experience. Finally, because of the broad implications and desired results (D2L roadmap), the cell will need tie-ins (via the Deputy Commandant Installations & Logistics project sponsor) with other staff elements and senior leaders in Training and Education Command and the Deputy Commandants.

In addition to the analytic and decision support the cells provide, each cell will also record the challenges they face and their requirements in terms of hardware, software, facilities, authorities, access, roles and responsibilities, data quality, etc. For example, a cell attempting to conduct maintenance analysis based on GCSS-MC data could be hampered by improperly entered serial numbers, mileage that reads 123,456 or 0,000, or other similar issues from manually entered data. Through such findings, a cell could recommend corrective actions (procedural, structural, or technical) to improve the quality of the data to which they have access and the subsequent analysis that comes from it.

Experimentation Force Structure

Establish cells in three of the four MLGs (leaving one to serve as a control group), Marine Corps Logistics Command, and HQMC I&L. Each cell should be composed slightly differently to allow for diversity in results. The disparate requirements and distributed laydown of Marine Forces Reserve, as well as the diverse experience base of Reserve Marines, make 4th MLG a critical participant in the experiment. Cell size should vary between six and fifteen people, with a mix of Marines and civilians. While core data science capability (the PhDs) is likely more appropriately consolidated at HQMC in general support, minimum expertise requirements within each cell should include:

- Data engineer.
- Systems engineer.
- Software designer.
- Trained analysts, such as Marines who graduated from Naval Postgraduate School with specialties in operations research, systems analysis, or logistics and materiel management.

The remaining cell membership links the core analytic expertise with functional/tactical knowledge and experience. A mix of officer and enlisted Marines should be carefully chosen from among logisticians, maintainers, suppliers, engineers, and administrators. Forming this cell may prove among the most difficult aspect of the experiment because of already strained manpower; thus, sourcing solutions may differ by MLG but could also include tapping into existing resources such as the Logistics Systems Coordination Offices, Materiel Readiness Training Centers, or various innovation cells.

The cells should also be paired with an industry and/or academic mentor to help guide their actions (e.g., UNC-Chapel Hill Institute for Defense & Business; leading industry experts). Lastly, the cell will need to be tied in with an experiment sponsor within DC I&L to monitor progress and provide enterprise-level guidance. However, it must be clear that the cells are independent and work for the host MLG. (See Figure 5.)

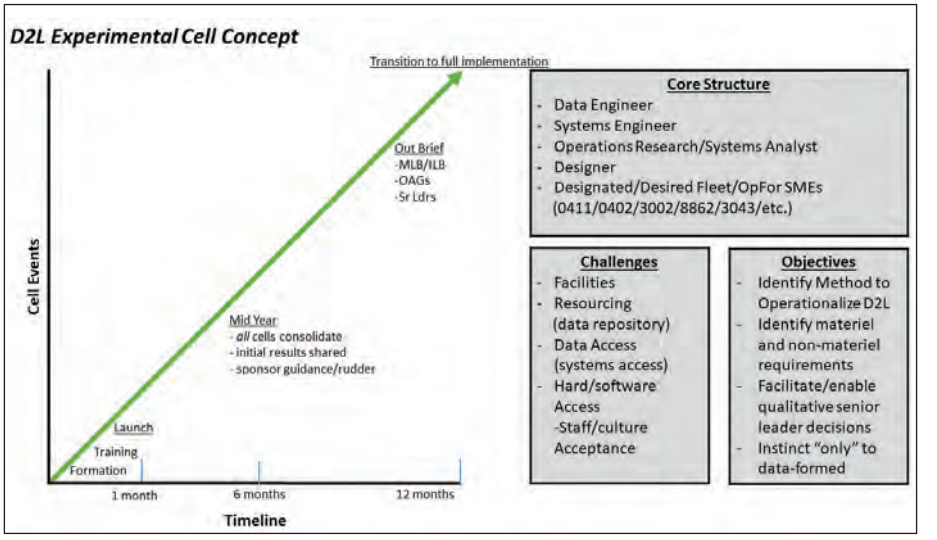

Figure 5. *(Image provided by author.)*

Experimentation Force Requirements

The following minimum requirements are required for the experimentation force:

- Facilities: A place to work.
- Computers and other hardware.
- Software tools (analytics, visualization tools, etc.).
- Access to Marine Corps data.

The Marine Corps must effectively realize D2L capabilities and benefits. *(Photo by LCpl A.J. Van Fredenberg.)*

- Training on software, basic analytics, and relevant systems and tools.
- Travel funds for various engagements.
- Senior leader access.

Experiment Outputs

This experiment seeks to identify a "roadmap" for operationalizing D2L. The cells will help the Service to understand materiel and non-materiel requirements, propose solutions, and identify actions the enterprise could take to effectively realize D2L capabilities and benefits. Furthermore, by enabling real data-driven decisions and actions, the experimentation force will help leaders understand the realm of the possible and begin to address the cultural challenges that inhibit progress. Gaining the support of tactical commanders and senior leaders in the Operating Forces by demonstrating real results is critical to enabling the cultural shift away from "intuition-driven logistics" and toward data-driven logistics.

During the experiment, the cells will encounter obstacles, identify opportunities, and discover organizational infrastructure requirements that will span the entire doctrine, organization, training, material, leadership, personnel, and facilities spectrum. Some questions to inform the roadmap development include:

- Effects on the organization: How did the experimenters affect MLG business practices and decision making?
- Staff organization: What permanent positions and/or offices are needed? How many? Where do they fit on organization charts? What are appropriate roles for contractors and civilians?
- Training and education: What tasks should be written in the training and readiness manuals by MOS, that will drive formal school curricula? What education should be pursued? What training is needed in the operating forces, and how should it be conducted?
- Hardware and software: What are the materiel requirements?
- Leadership roles and responsibilities: What is appropriate and/or required? How do we attack data quality and data governance?
- MOS skills: Do some MOSs need to be reviewed for relevance, or remade into new functions to implement D2L (readiness analysts, supply chain analysts, etc.)?
- Physical infrastructure: What is required? How do we actually collect the data, where do we store it, what are the access requirements?

In summary, while strategic documents such as the National Defense Strategy and the MOC make it abundantly clear that the Marine Corps logistics enterprise must transform, such a large transformation requires a holistic plan. Certainly, the enterprise should not wait to take those discreet actions that are already known (cloud migration, data storage, and access, etc.), but a comprehensive approach must be developed to steer the large, bureaucratic machine that is tailor-made to continue on with the status quo. This proposal seeks to provide the Marine Corps a way to develop that roadmap in a reasonably responsive timeframe. To quote our Secretary of Defense, this proposal represents our efforts to "pursue urgent change at significant scale."[3] It is past time to move out.

... the National Defense Strategy and the MOC make it abundantly clear that the Marine Corps logistics enterprise must transform ...

Notes

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

2. Ibid.

3. Department of Defense. *Summary of the 2018 National Defense Strategy of the United States of America*, (Washington, DC: 2018).

The A-Rating

Improved data from depot to unit

by Maj Amber Coleman

The Marine Corps currently uses readiness reporting metrics that are lacking in historical context, which renders them as poor indicators from which to base future maintenance and operational planning. Supply (S-rating), readiness (R-rating), and materiel readiness (MR-rating) ratings, defined in *Marine Corps Order 3000.11E, Ground Equipment Condition and Supply Material Readiness Reporting Policy*, represent readiness levels at a snapshot in time, yet they can change daily.[1] The R-rating assesses maintenance readiness by subtracting the number of deadlined assets from the number of possessed assets and dividing by the total possessed (see Figure 1). This metric provides no additional information regarding the overall availability of equipment, performance trends, or indicators for which serial numbers have a history of poor performance. It merely provides a binary view of what assets are currently operational. Augmenting this suite of metrics with the operational availability (A-rating) calculation will provide historical context to readiness metrics and will enhance operations and maintenance planning in the Operating Forces as well as provide Marine Corps Logistics Command (LOGCOM) with the level of detail necessary to appropriately allocate the Marine Corps' limited depot maintenance resources.

The R-rating, even at the Table of Authorized Material Control Number (TAMCN) level, only enables commanders to analyze performance across a TAMCN or commodity group. Since the R-rating is only a maintenance snapshot in a specific period of time, additional research is required to determine if specific serial numbers consistently affect unit readiness. However, the A-rating provides a better assessment of

>Maj Coleman, see page 12 for bio.

$$R = \frac{\text{Possessed} - \text{Deadlined}}{\text{Possessed}}$$

Figure 1. Readiness Rating calculation as defined in MCO 3000.11E.

$$\text{A-rating} = \frac{365 - \#\text{ days deadlined}}{365}$$

Figure 2. Simple equation for operational availability.

readiness because it contains historical context that enables data-driven decisions which are specific to each serial number. In its simplest form, operational availability is either the percent of time an asset is available for use or the ratio of asset uptime to asset uptime plus downtime.[2] More complicated explanations of operational availability exist which will require detailed metrics such as the mean time between failures and time to repair, but the enterprise does not have the capability or data quality to calculate these metrics across all TAMCNs. However, the Marine Corps already captures the components required for a simple calculation of operational availability within the Global Combat Support System Marine Corps (GCSS-MC). Key data fields include TAMCN, serial number, operational status, service request open date, and service request close date. By consolidating these variables, we can count the total days deadlined annually to calculate the percent of time the asset was available for each year (see Figure 2).

The A-rating immediately provides better historical context than the R-rating because it leverages performance throughout the year. Analyzing the A-rating for a minimum of three years enables trend identification and in-depth analysis by serial number, all of which provide commanders with the information necessary to make decisions that are more informed. Optimizing readiness and minimizing risk to mission are both complicated Marine Corps maintenance problems that will benefit from the straightforwardness of the basic A-rating calculation.

Complex problems do not necessarily need complex solutions. The approach should be to find the inherent simplicity that exists in the system and then to focus all efforts toward capitalizing on this simplicity.[3] The A-rating is the simple solution to many of our complex maintenance planning and execution problems.

Until recently, counting the number of days deadlined by serial number was a tedious and error-prone task. However, Marine Corps analysts can easily complete this job using open source or free software that is currently available for download on the Marine Corps Enterprise Network, and this simple calculation opens the doors to a range of data-driven decisions.

Commanders can use A-ratings to develop exercise or deployment equipment density lists and ultimately reduce the chance of equipment failures during exercises or operations. This metric will also better inform military equipment rotation in support of contingency operations. Units deployed in support of SP-MAGTF or with the MEU need quality equipment to complete their missions,

yet are typically not collocated with robust supply and maintenance capabilities like garrison units. Deployed units need a high level of equipment availability. The A-rating provides both the unit and their higher headquarters better data to monitor their equipment status. This will potentially prevent catastrophic failure of low-density high demand items by rotating stock before it falls below a certain availability rating. Once the A-rating reaches this threshold, these deployed units will have justification to request a rotation of equipment. The A-rating also allows their higher headquarters to ensure the replacement equipment is an approved asset compared to what the unit currently has. This concept serves a similar purpose when temporarily loaning equipment for major exercises. Requiring an A-rating at or above the enterprise average will reduce the likelihood of receiving substandard equipment in support of major exercises. The equipment ultimately belongs to higher headquarters, so requiring a certain A-rating allows a commander to allocate higher quality equipment according to his priorities.

Calculating the A-rating at the serial number level also enables analysts to identify trends across the Service. For example, calculating an annual enterprise-wide A-rating for each TAMCN will highlight poor performing serial numbers. Through iterative improvements, analysts could also develop tools to compare the A-rating to equipment age, equipment operating time codes, or total dollars spent in repair parts to provide further context to highlight additional trends at specific units or geographical locations. Additionally, commanders at all levels will clearly recognize their poorest performing assets, allowing them to quantitatively identify potential depot-level maintenance candidates.

Over half of the Marine Corps' TAMCNs have a demand-based depot maintenance strategy, meaning they have no regular depot maintenance cycle. LOGCOM is responsible for managing the flow of equipment through the depot maintenance process and depends on Program Managers, Item Managers, and the Operating Forces to identify equipment in need of depot maintenance. These players communicate those needs to LOGCOM during the annual Enterprise Lifecycle Maintenance Program (ELMP) conference.[4] The current readiness metrics fail to provide the level of detail needed to nominate items at the serial number level across all TAMCNs, so the items in most need of maintenance are not always the ones processed through the depot. Giving the ELMP the ability to identify the worst serial numbers across each TAMCN group simplifies depot maintenance nominations, reduces planning time, and helps streamline the depot maintenance execution phase.

Commanders are able to identify the poorest performing vehicles/equipment. *(Photo by LCpl Margaret Gale.)*

Identifying the serial numbers of depot maintenance candidates before the year of execution gives the Marine Depot Maintenance Command more time to properly research, schedule, and resource the depot maintenance plan. Additionally, this information enables LOGCOM analysts to develop and implement predictive cost models that could improve repair cost estimates and depot maintenance planning, ultimately leading to better resource allocation and increased Marine Corps buying power. Furthermore, analysts could potentially determine if an asset is beyond economical repair and recommend disposal before it is shipped, thereby preventing wasted transportation resources and reducing the likelihood of depot maintenance washouts—items that begin the maintenance process but do not result in a completed asset.

Moreover, ELMP planners use a suite of tools called the price and performance model to identify depot maintenance requirements.[5] One of these models, the repair optimization materiel evaluator, depends on readiness ratings as inputs and ultimately determines how many of each TAMCN the Marine Corps must remanufacture each year to maximize enterprise readiness. In some cases, ELMP planners run a repair optimization materiel evaluator two years in advance of execution, making readiness snapshots a poor measure of what will meet Marine Corps readiness needs in the future. The A-rating is a better input to the price and performance model because it provides historical context, and this enables the Marine Corps to better allocate depot maintenance funds, which often exceed one billion dollars over the Future Years Defense Program.

Data quality will significantly influence the Marine Corps' ability to accurately calculate A-ratings. Currently, data quality standards are lacking and may lead to misleading A-rating calculations. However, even at the present state of data quality within the enterprise,

Better allocation of maintenance funding can help maximize equipment readiness. *(Photo by Cpl Kevin Payne.)*

A-ratings provide commanders more useful information in a single metric than the entire suite of current readiness metrics because the A-rating is more than just a snapshot in time. Furthermore, the A-rating will provide units incentive to maintain clean data. Failure to properly close service requests or erroneously opening multiple, simultaneous service requests are just two examples of how poor data will negatively affect A-rating calculations. Both of these occur often, but receive minimal attention under current readiness calculations. Measuring units with an A-rating gives maintenance personnel incentive to pay closer attention to the data they input into GCSS-MC. Moreover, additional analysis of age and usage rates will begin to highlight erroneous entries such as illogical equipment operating time codes, which is another data quality issue that currently receives little attention.

The A-rating is simple to calculate and can be standardized throughout the enterprise by establishing simple business rules to guide its calculation. Furthermore, it enables the Marine Corps to conduct trend analysis and provides visibility at the serial number level—both of which the enterprise is currently lacking. Like all good analysis, it will require feedback loops and iterative improvements that could eventually involve more complicated math and detailed data. Using this analysis, the enterprise can effectively reduce the negative impacts of equipment failure and better allocate limited maintenance funding and resources to maximize readiness. Marine Corps analysts, both uniformed and civilian, already possess the skills and the tools to develop both data aggregation and decision support tools with little more than just the investment of their time. Implementing the A-rating will also foster a culture of data-driven decisions and foster a culture of quality data that enables predictive maintenance capabilities. Data is the only resource that is able be used an infinite number of times without ever depreciating.[6] The Marine Corps must take advantage of the wealth of available data and start making operational readiness decisions based on the A-rating and not simply continue to focus on whether a piece of equipment is available today.

Notes

1. Headquarters Marine Corps, *MCO 3000.11E, Ground Equipment Condition and Supply Material Readiness Reporting (MRR) Policy*, (Washington, DC: 2012).

2. Defense Acquisition University, *Defense Acquisition Glossary,* (Fort Belvoir, VA: 2018), available at https://www.dau.mil.

3. Mandyam Srinivasan, Melissa Bowers, and Kenneth Gilbert, *Lean Maintenane Repair and Overhaul,* (New York: McGraw Hill Education, 2014).

4. Headquarters Marine Corps, *MCO 4790.24, Enterprise Lifecycle Maintenance Program (ELMP)*, (Washington, DC: 2012).

5. Ibid.

6. Schmarzo, Bill, *Institute for Operations Research and Management Sciences (INFORMS),* Business Analytics Conference Keynote Speaker, (Baltimore, MD: 2018).

Innovation in Logistics

Simulation is more than a training tool

by Capt Michael J. Blankenbeker

Currently, the Marine Corps employs simulation methods and systems primarily as a training tool. Whether in a virtual or constructive environment, these simulated training systems are utilized to stimulate the decision-making process for Marine Corps units, staffs, and leadership. Activities such as the Marine Corps Tactics Operations Group, the Marine Corps Logistics Operations Group (MCLOG), and the MAGTF Staff Training Program accomplish this regularly to great effect. However, training is but one of eight enumerated purposes for simulations in the DOD; the others are testing and valuation, planning, medicine, intelligence, experimentation, analysis, and acquisition.[1] While training systems must continue to be used and improved throughout the Marine Corps, there exist numerous other areas where we should be leveraging our capabilities; one particular system that comes to mind is Logistics Innovation. Additionally, there are numerous methods that could be explored such as virtual/augmented reality in maintenance and healthcare, acquisition performance modeling, artificial intelligence and machine learning, and supply chain experimentation. This article demonstrates the effectiveness and existing potential of using discrete-event simulation (DES) to solve supply chain problems. Unlike some innovation articles which explore and extrapolate pre-mature concepts, often not ready for mainstream use, this article specifically addresses center-of-mass challenges that have long plagued the Marine Corps logistics network.

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The Marine Corps depot-level maintenance establishment has several recurring issues preventing it from achieving its maximum potential in terms of maintenance production, throughput, and repair cycle-time. However, one depot-level maintenance process was remodeled in 2018 using simulation tools and methods on one particularly problematic vehicle; the light armored vehicle (LAV). This Marine Corps Logistics Command (LOGCOM) sponsored effort spent a substantial amount of time analyzing the areas causing bottlenecks to provide mitigation for this process. In doing so, LOGCOM created a working, living tool that could be repurposed to analyze other vehicles in their system.[2]

DES is defined as such because of the way time is advanced in the model.[3] As opposed to time-step simulation, in which time is advanced in regular increments, a DES model advances time based on the appropriate events scheduled in a network. The key difference between the two is time-step will only show a trend or change in state across time; consequently, individual events themselves can be missed in a time-step simulation. This concern is not present in the DES model because all events are scheduled and removed from the event list, therefore, advancing time between scheduled events according to how long given events must take.[4] The next three figures will provide pictorial representations of the two models being discussed. (e.g., Figure 1 depicts the discrete-event algorithm of how events are added and removed from the event list. Figure 2 depicts the state transitions in a continuous/time-step simulation. Figure 3 depicts the state transitions in a DES model.)

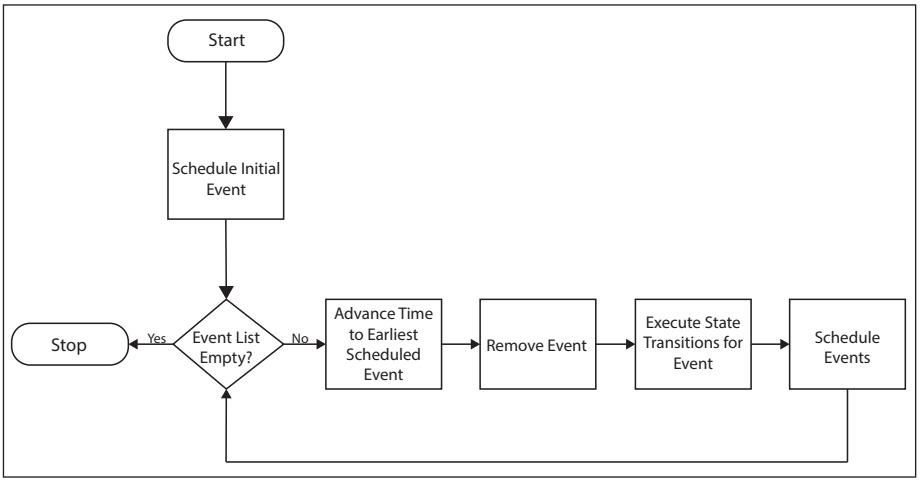


Figure 1. DES next event selection algorithm. *(Image from Buss.)*

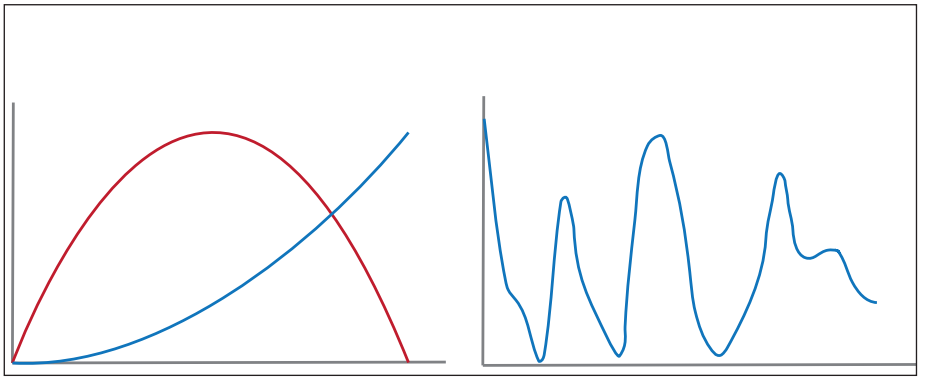


Figure 2. Continuous/time-step simulation state transitions. *(Image from Buss.)*

In a DES model, events are the main triggers, and a single server example is used to explain the concept of DES events.[5] Examples of a single server system are a person arriving in line to be seen by a bank teller or a customer waiting to speak to a service representative on a company's technical support phone line. An "arrival" event is activated to represent the patrons being added to the server's queue. If the server is available to begin service with the person or entity, then a "start service" event takes place. At this point, system state information is captured (e.g., availability of servers/resources and delay-in-queue time). The system will then advance time to represent completion of the stochastically determined service time (i.e., the "end service") event takes place and system state information is captured again (e.g., such as time in system, server/resource availability, etc.). The arrival and service times of a given station are parametric inputs. A random number generator is applied with a probabilistic distribution of the system's data in order to realistically map the inflow and outflow of items within a particular system. In the LOGCOM example, this simple server example is represented by a vehicle being accepted into a queue for its limited technical inspection (LTI) (arrival event), LTI performed (start service event), and leaving that station after the LTI is complete (end service event) to begin its next maintenance step.[6] Figure 4 depicts the behavior of a single server that accepts an entity into its queue and completes service upon specified conditions.

Behavior of any particular step in the maintenance cycle is modeled by incorporating the proper logical flow of how an item's maintenance is expected to take place; in many cases, a simple arrival, begin service, and end service may suffice. For other cases, there may be a need to incorporate delays for quality control failure, spot corrections, or delays where rework is required at previous stations. Component assembly and reassembly may also be represented successfully by creating new entities in the system, where major components of the vehicle are taken off and undergo their own maintenance cycle (e.g., powertrain, suspension, or communications suite).[7]

Once behavior and types of servers are successfully created, the service stations are connected with code in a way that ensures events at any one service station are triggering appropriate events at follow-on stations. Once the system

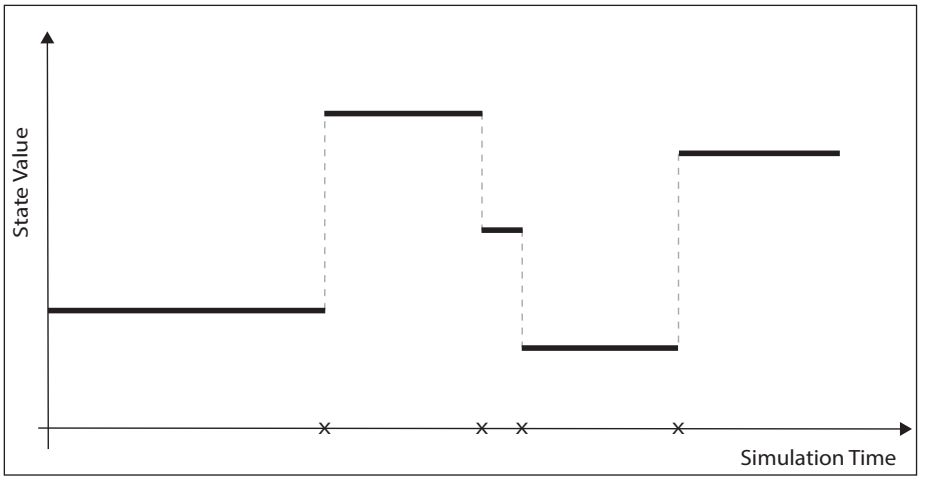


Figure 3. DES state transitions. *(Image from Buss.)*

LAV Entity-Server Class

Parameters

{ts}: set of service times
k: total number of servers

State Variables

s: number of available servers
queue: first in first out container of entities
D: delay in queue
W: time in system

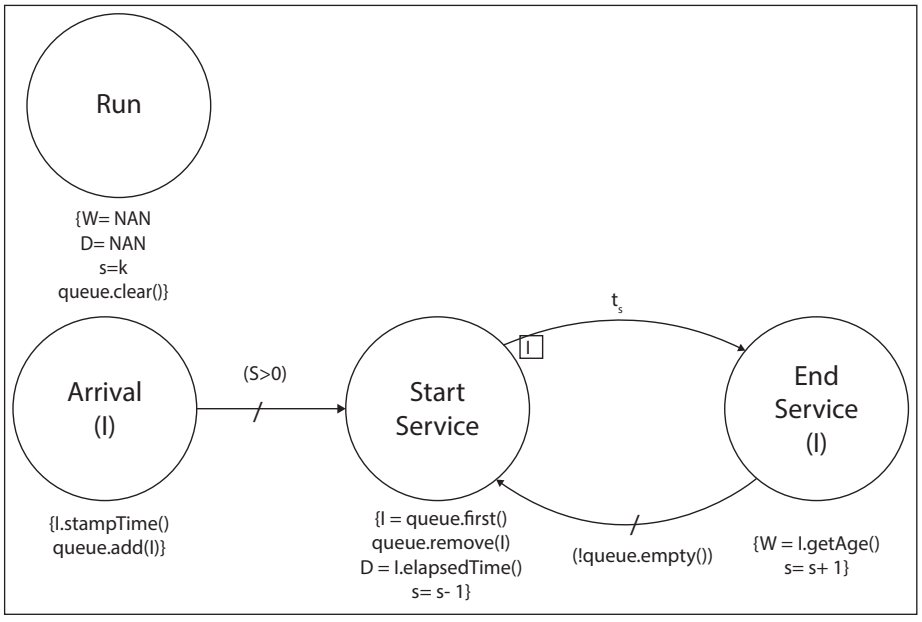


Figure 4. Single server behavior graphic representation. *(Image provided by author.)*

is successfully connected, we can gather statistics and begin data farming to see how the system performs when certain policy decisions are put into effect.[8]

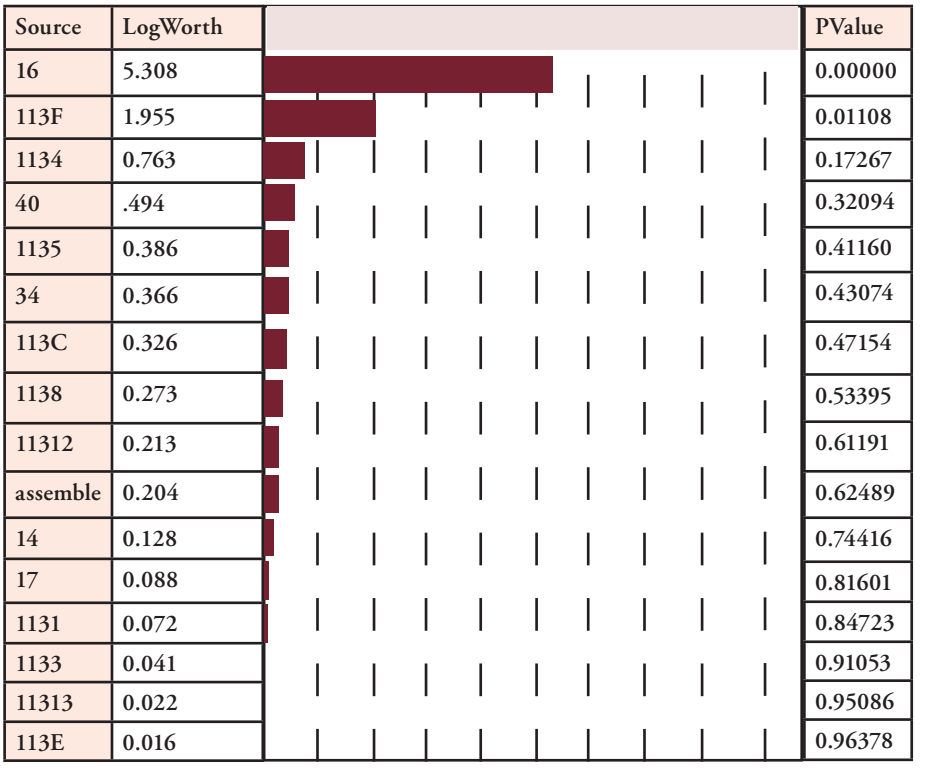
Testing the model consists of running the system with the desired set of inputs. Any given run consisted of a thousand independent replications, with each replication represented five years' time in the maintenance system. The high volume of replications is used to gain confidence in the system and what long-term performance can be expected given the parametric inputs. The LAV study used two primary analysis phases when testing the model. The first tested the throughput of the system as resources (such as employees or maintenance bays) were added to problematic service stations (i.e., where bottlenecks were occurring). Between those runs, resources were incrementally added at the bottlenecks to increase throughput. This incremental process was conducted recursively until all stations were within a prescribed tolerance level. The second phase of analysis tested the varying resource levels, at the problematic stations, during different runs to see how they behaved under different conditions. Varying the conditions determined which stations provided the biggest return on the system as resources were invested into the system.[9] Figure 5 depicts the performance of the system as resources were added to bottleneck stations. Figure 6 demonstrates how the highest payoff servers were statistically identified and explains which resource expansion provided the greatest effect on the maintenance system.

The LOGCOM study found that servers 16 (welding) and 113F (driving differential repair/assembly) had statistically significant impacts on the overall depot-level maintenance cycle time of the LAV. The astounding results proved that DES methods can be effective in solving logistics problems within the Marine Corps. Tying the demonstrated impact of DES, in this particular study, to the greater problems identified in the Marine Corps supply chain system and logistics processes could reap significant rewards for the Service. There are two problem areas that come readily to mind. First, a study on how repair parts are distributed to their end destinations is primed for this level of analysis. The second issue is an analysis on warehousing and maintenance transaction devices.

Currently, the Marine Corps repair part distribution is generally centralized and comes from one of two places: the supporting supply management unit or a Defense Logistics Agency site. Assuming the repair parts are not backlogged (which happens routinely), the parts are shipped individually to the unit, often taking two weeks or more. An alternative to the current process could be establishing a military Autozone-type facility (i.e., where you could physically go and purchase the repair part the same day) at every installation in the Marine Corps. This will allow units to identify the repair parts needed and make an acquisition with the unit's purchase card that very same day. Long shipping times in the maintenance process will be a thing of the past and unit readiness across the Marine Corps will improve. Unlike the current system, where erroneous requisitions become nearly impossible to return and get a refund, a unit could simply take the part back to the shop on base and receive an instanta-

Run	Average Time-in-System	95% Confidence Interval	Average repairs	Employees added	% Cycle-time reduction relative to baseline
Baseline	2966.49	(2940.23, 2992.73)	78.49	-	-
1st Improvement	1630.96	(1611.34, 1650.58)	120.75	10	45.02%
2nd Improvement	1201.52	(1197.10, 1205.94)	131.89	14	59.50%
3rd Improvement	1142.15	(1140.32, 1143.98)	133.32	4	61.50%
4th Improvement	1124.21	(1122.86, 1125.57)	133.43	6	62.10%
5th Improvement	1119.54	(1118.27, 1120.80)	133.68	4	62.26%

Figure 5. Incremental resource capacity expansion and bottleneck mitigation. *(Image provided by author.)*



Source	LogWorth	PValue
16	5.308	0.00000
113F	1.955	0.01108
1134	0.763	0.17267
40	.494	0.32094
1135	0.386	0.41160
34	0.366	0.43074
113C	0.326	0.47154
1138	0.273	0.53395
11312	0.213	0.61191
assemble	0.204	0.62489
14	0.128	0.74416
17	0.088	0.81601
1131	0.072	0.84723
1133	0.041	0.91053
11313	0.022	0.95086
113E	0.016	0.96378

Figure 6. Order of precedence demonstrating which problematic servers had the greatest statistically impact on the overall maintenance cycle time in the system (i.e., from most significant to least significant). *(Image provided by author.)*

neous refund to their operations and maintenance account. Additionally, the stock levels at each installation's shop will be based on previous demand and tailored to the types of repairs that are more likely to occur. The humid coastline of Camp Lejeune will necessitate the need for more corrosion control items than the dry climate of Twentynine Palms. Twentynine Palms, because of its rocky terrain, will require more axle components such as tie rod ends and ball joint boots than elsewhere in the Marine Corps. A DES study could compare the performance of the current system with that of the theoretical system and weigh the benefits of improved readiness and maintenance cycle time across the force. Also, it streamlines the startup costs of establishing the infrastructure and transaction network. DES not only affords the opportunity to explore the short-term effects, but also how the various system adjustments might be expected to affect repair cycle time and unit readiness over the span of years and decades.

In the realm of supply chain sluggishness, the Marine Corps is lagging in terms of warehousing and inventory transactions. Currently, Marines must navigate the user-hostile interface of Global Combat Support System–Marine Corps (GCSS-MC) to locate the appropriate service request and manually input that an inventory transaction has taken place. This could be the warehouse Marine receiving the item from a supply system, an operator from a company/battery applying newly received Stock List 3 to an end item, a Layettes Marine applying a part from his warehouse account to his maintenance inventory, or the mechanic applying a repair part to a vehicle in maintenance. These transactions can take several minutes each if the system is not experiencing a lag or outage. With the technology of today, there is no reason for these transactions to last several minutes per manual entry. We need to leverage both barcode and radio frequency identification technologies to become more efficient. The Service goal must be to utilize these technologies for a nearly instantaneous inventory transaction at any step in the request lifecycle of GCSS-MC. The cost is the time we waste dedicating Marines to continuously complete GCSS-MC transactions, other tasks that are not being fulfilled, and generational loss of overarching tradecraft. A DES study provides a method for insight into what an investment will provide, type of efficiency that could be achieved, and what the American people expect from their Marine Corps.

A DES study is an incredible benefit to the total force and individual warfighters alike and will require a minimal effort to complete. With a team of six dedicated personnel and funding for research/travel costs, a study of this magnitude could be completed typically within six to nine months. Being the center for excellence in Marine Corps logistics operations, MCLOG will be the ideal candidate to spearhead such studies. Along with the various training exercises and courses MCLOG provides, they also maintain innovation as part of their charter. MCLOG will also have the unique opportunity to incorporate their research findings into the greater communities of logistics, supply, maintenance, as well as the logistics education continuum.

MCLOG will also have the unique opportunity to incorporate their research findings into the greater communities of logistics education continuum.

The DES results will provide key leadership a cost-benefit analysis to any of the numerous systems and processes inherent in the Marine Corps. However, there are current shortfalls that limit the ability to begin analyzing and solving these problems. With the burden

MCLOG currently bears in providing collective and individual training to the logisticians throughout the total force, there is little capacity to support such projects, impactful as they may be for the enterprise. MCLOG will need to be resourced with additional personnel with expertise in statistics, research, and experimental design to make this potential analytic capability a reality. Regardless of how the Marine Corps may implement these analytic ideas, thus far, the scope of the analytic activity is focused on existing requirements within the operational or strategic level. Currently, there is no effort to seek out broad, new, and logistics specific problems at the tactical level to then conduct follow-on analysis and implement steps necessary to improve the process.

While simulated training environments are important to the Marine Corps, we have only begun to scratch the surface of its potential to improve both the total force and the individual warfighter. This article demonstrates the effectiveness of DES in decision making and the numerous ways in which a DES will solve major problems in the Marine Corps logistics network. The potential to leverage DES, and other types of simulation to innovate and solve problems, should begin expanding our methods of how we address problems within the Marine Corps.

Notes

1. Defense Modeling and Simulation Coordination Office, "Responsibilities & Governance," *DMSCO,* (Online: 2017), available at https://www.msco.mil.

2. Capt Michael J. Blankenbeker, "USMC Depot-Level Maintenance of the Light Armored Vehicle (LAV): A Discrete-Event Simulation Analysis," (thesis, Monterey, CA: Naval Postgraduate School, 2018).

3. Arnold Buss, *Discrete-Event Simulation (DES) Modeling*, (Monterey, CA: Naval Postgraduate School, 2017).

4. Ibid.

5. Ibid.

6. "USMC Depot-Level Maintenance of the Light Armored Vehicle (LAV): A Discrete-Event Simulation Analysis."

7. Ibid.

8. Ibid.

9. Ibid.

USMC Prepositioning Programs

Our go-to-war equipment and supplies

by Col Andrew J. Bergen

The Marine Corps prepositioning programs have changed since the last major Maritime Prepositioning Force (MPF) offloaded between 2003 and 2004 in support of Operation Iraqi Freedom (OIF). While afloat capability was reduced with the off ramp of Maritime Prepositioning Squadron 1 (MPSRON 1) during the early 2010s, prepositioning remains a critical enabler of Marine Corps support to the joint force commanders who treasure prompt global response. Prepositioning programs also contribute to deterrence when enabling theater support cooperation throughout the globe. The Corps must plan for long-term future prepositioning capabilities while increasing the program's relevance in the near term. Opportunities include the continued refinement of response packages and capability sets to support Marine Corps concepts such as the *Marine Corps Operating Concept* (*MOC*), the Expeditionary Advanced Base Operations concept (EABO), and enhanced logistics information technology integration and in-transit visibility. There are challenges as well, including operational employment in a contested environment against a peer competitor and within the programmatic realm in which the Marine Corps ultimately relies on resourcing from its sister Service, the U.S. Navy.

This article provides a current update of our Corps' strategic prepositioning programs. The programs must be evaluated in light of the National Defense Strategy (NDS) as we envision operations against peer competitors, as was the case during prepositioning program's inception during the Cold War.

The MPF has served the Corps well when operating within the protective bubble of all domain dominance provided by the Joint Force, albeit against lesser adversaries. Greater numbers of more survivable future platforms will be expensive when competing for scarce resources as the Navy also addresses higher priority warfighting capability gaps. *(Photo provided by author.)*

Following a brief history, the article addresses the opportunities and challenges across the operational, programmatic, and innovation realms.

A Brief History

The Marine Corps' strategic prepositioning capabilities were developed in the late 1970s as a way to rapidly introduce credible combat forces into Europe or the Middle East as the United States grappled with the Soviet Union and Warsaw Pact—then peer competitors in the air, on land, at sea, and in space. Identical to how the Marine Corps operates today, the employment of the MPF required combined/joint force supremacy in time and space across all four domains; however, the current force must also contend with the cyber domain. Prepositioned equipment and supplies were eventually built up to three Maritime Prepositioning Squadrons, each holding the majority of

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a MEB's equipment and supplies with a lighter fourth MEB positioned in central Norway. As is the case today, the programs displayed strategic resolve and were a deterrent to peer competitors.

Marine Corps prepositioning capabilities were eventually employed during 1990 within the Middle East, an anticipated region, but against a significantly lesser adversary, the regime of Saddam Hussein. The Corps' prepositioning concept of rapidly closing mechanized brigades with organic fires and logistics combined with aircraft flying via a flight ferry proved vital in dissuading Hussein from further aggression while a grand coalition was built to retake Kuwait. Following DESERT STORM, the MPF was hastily reconstituted and employed again in support of Operation RESTORE HOPE in Somalia. Prepositioning operations remained extremely important to Marine forces and MEF planners, as they were to be utilized in any subsequent major combat operations anywhere in the world. Interest and knowledge of MPF proved a wise investment as it was again employed in support of OIF in 2003 and 2004; equipment and supplies from the Marine Corps Prepositioning Program–Norway (MCPP-N) were also utilized in support of combat operations and to fill home-station training shortfalls as operations in Iraq and Afghanistan continued.

While Blount Island Command focused on reconstitution of the MPF and eventually MCPP-N during the mid-2000s, the command's focus shifted support to Marine forces in Iraq and Afghanistan, providing the headquarters and contracting labor support to Marine Corps Logistics Command–Forward (MARCORLOGCOM-FWD). The command also worked with HQMC and Military Sealift Command as the MPF program divested smaller, aging, and less capable vessels for newer, larger, medium-speed roll-on roll-off ships in order to mitigate the impacts of fielding larger and heavier equipment. Two supply ships providing break bulk stowage and two expeditionary transfer docks supporting ship-to-shore movement were also introduced.

Despite shifts in the strategic landscape and an increasingly revanchist Russia, which invaded the Republic of Georgia in 2008, a decision was made in 2012 to divest one of the original three squadrons, MPSRON-1, formerly based in the Mediterranean Sea. This upset the original habitual alignment of each MEF with one squadron; it also decreased the percentage of forward deployed equipment and supplies readily available to rapidly outfit a MEF. Whereas three squadrons ensured two and a half forward deployed at any given time, the divestment of MPSRON-1 left our Corps with only one and a half (or less, based on ship maintenance delays) forward at any given time. Shipyard delays have left up to four ships' worth of equipment and supplies, a third of the current twelve-ship MPF (excluding both expeditionary transfer docks) downloaded at Blount Island Command.

While not a formal program of record, the MEU Augmentation Program-Kuwait (MAP-K) has morphed over the years, supporting operations across the Middle East, and continues to provide support to Marine Forces Central Command and its forward deployed MEUs and assigned task forces.

Operational Realm

The future holds many opportunities and challenges for today's strategic prepositioning programs as they support geographic combatant commander shaping operations in exercises throughout the globe (five major exercises in 2018, four during 2019, and six during 2020). MCPP-N also supports several smaller exercises each year; its usage has greatly increased following the divestment of MPSRON-1. These programs are also ready to support forces that will deter aggression against any of the adversaries mentioned in the current NDS. The deployment and employment of the MPF today, as is the case with most other joint and combined forces closing via vulnerable means of conveyance, remains reliant on combined and joint forces mitigating adversary threats across all five domains.

Both MPSRONs continue to support the preponderance of two MEBs' equipment and supplies based on Marine Corps Force 2025; the CMC prioritizes what is loaded, and Blount Island Command works with HQMC Installations and Logistics, MARCORLOGCOM, and Marine Corps Systems Command to ensure equipment and supplies are available and operationally ready for embarkation. The MPFs' load out during the current MPF Maintenance Cycle 12 provides 58 percent of two MEBs' worth of equipment and supplies to support initial operations. This percentage is the result of the increased capabilities of the MEB and associated equipment that is not traditionally loaded on the MPF because of cost and procurement plans (e.g., communications, headquarters, and high-mobility artillery rocket systems). Each squadron provides 19 percent of the Command Element's table of equipment, 75 percent of the GCE's, 67 percent of the ACE's, and only 33 percent of the LCEs. These facts must be considered as arrival and assembly operations wind down and MAGTF operations commence while the remainder of the MEB's capability is closed via U.S. Transportation Command's strategic air and surface capabilities. Because of the divestment of MPSRON-1 and a third MEB equipment set, the remaining two squadrons provide 22 percent of a MEF's requirement. Furthermore, MCPP-N's capability is being refined in light of NDS priorities. Large-scale exercises and strategic mobility exercises are continually planned and coordinated with our Norwegian allies. MCPP-N and USNS *Lopez* were major enablers in 2018's NATO Exercise TRIDENT JUNCTURE in Norway.

Peer competitors across domain capabilities challenge the employment of the current Maritime Prepositioning Squadrons, which are manned by government, civilian, and contracted mariners who lack any real defensive capabilities other than those provided by nearby combatant vessels. This remains a significant challenge, especially when deploying closer to the shores of a peer competitor. Military Sealift Command is developing a nascent capability in which Reserve naval personnel embark aboard Maritime Prepositioning Squadrons and work to keep the ships integrated within the protection of the combatants. The introduction

of current MPF capabilities will be dependent on joint and combined force dominance in time and space across all five domains. Host-nation support has also been utilized in the past to rapidly assemble the force and is planned for future contingencies.

As the equipment and force structure behind Marine Corps Force 2025 continues to grow and provide increased operational and force protection capabilities, there are no currently available acceptable substitutes for large ocean-going vessels to rapidly close heavy military equipment within the Marine Corps' arrival and assembly timelines.

Excluding its inability to operate at acceptable risk in a contested environment until the area of operations is properly set by the joint/combined force, the MPF retains relevance in supporting the tenets of the MOC and concept of EABO. For instance, each MPSRON is currently loaded with a crisis response force package comprised of tailored equipment and supplies to support a 5,000-man MAGTF, including an outsized aviation component and is loaded for rapid download across three vessels. The MPF also contains critical enabling capability sets that are loaded for rapid offload. These packages enable the establishment of forward arming and refueling points and support limited expeditionary airfields. Five ships have an assault amphibious fuel system with the ability to pump fuel or water up to two miles from shore into a 1.2-million-gallon storage capacity. Other fuel capabilities include the tactical airfield fuel-dispensing system with 320,000-gallon storage capacity, the helicopter expeditionary refueling systems of 500-gallon drums and 3,000-gallon bladders, and 900-gallon truck-mounted fuel containers. Other readily assessable capability sets include water storage (80,000 gallons produced by two tactical water purification systems), sustenance, tentage, medical, and security.

The MAP-K continues to support Marine Forces Central Command requirements. While the program's current amount of mine-resistant ambush protected vehicles could support operations anywhere, the capability requirement is being reviewed by HQMC and Marine Forces Central Command. The divestment of large amounts of these vehicles will reduce the amount of warehouse space required for the program, allowing the entire MAP-K to be housed aboard Camp Arifijan, Kuwait.

The MPF has served the Corps well. *(Photo by author.)*

Programmatic Realm

Programmatic opportunities exist as MPF Maintenance Cycle 13 (2020–2023) is planned to maximize the amount of equipment and supplies loaded aboard the MPF while seeking to modernize critical capabilities across the MAGTF, including Joint Strike Fighter and CH-53K support requirements, the joint light tactical vehicle, and the amphibious combat vehicle. Modernized equipment will also drive alterations to prepositioned support equipment, repair parts, lubricants, and batteries.

While Blount Island Command coordinates program resourcing with MARCORLOGCOM and HQMC Installations and Logistics, the current challenges involve programs that require funding from our sister Service, the Navy. Naval funding of Military Sealift Command-provided platforms is set to increase. Recently, vessels were delayed for as long as six months, leaving equipment and supplies that were refurbished on Blount Island exposed to the elements for too long. More importantly, equipment and supplies are not forward deployed and ready to respond to contingencies. Over the past two years, it has not been unusual to have four ships, or 33 percent worth of equipment and supplies, aboard Blount Island at any one time. Costs will only increase, as the five Bobo class ships are over 30 years old today, edging toward the end of a 50-year service life by the mid-2030s.

As the Navy explores ways to improve current and long-term readiness, increased resourcing will be required. There is currently a debate over how to support the prepositioning programs, the surge, and ready sealift required to move the rest of the force under our current mobility paradigm; the considerations include service life extensions for the most capable current vessels, buying or leasing commercial capacity, and/or buying new ships, specifically the common hull auxiliary multi-mission platform (CHAMP). A common hull will support various mission sets, including prepositioning and strategic sealift, aviation intermediate maintenance support, medical services, command and control, and submarine tending, thus leading to cost savings associated with economies of scale. This will require real resourcing, unlike the MPF recapitalization between 2008 and 2010, which was resource neutral as existing government owned vessels from the surge and combat support fleets replaced leased commercial vessels.

Prepositioning will remain a low priority for the Navy, especially in light of naval warfighting gaps against a peer competitor. CHAMP and other

concepts considering greater numbers of smaller, more survivable, shallower drafting and semi-submersible vessels will compete for constrained resourcing and require solid force movement and ships' characteristic requirements. A greater number of smaller and more survivable prepositioning ships, combat loaded with tailored equipment sets, will change the current paradigm. Furthermore, a larger number of ships will mitigate risk in a contested environment, as any ship lost is a smaller percentage of the overall capability.

Finally, funding to support the maintenance of the Navy's improved Navy lighterage system has also receded as the program reaches its midlife. As MPF's organic connectors, the system requires proper resources to continue to perform during the second half of its service life, which will likely be extended as well. This capability is interoperable with amphibious vessels, has substantial lift capability, and is quieter than other ship-to-shore mobility as it approaches a foreign coast. Furthermore, it could be used to lighten vessels and reduce a ship's draft prior to entering ports.

Innovation Realm

While challenges remain in coalescing logistics information technology, Blount Island Command's fifteen-year experiment with passive radio frequency identification (pRFID) for planning and tracking during arrival assembly has proven to be highly effective during exercises and has been exported to MCPP-N as well as MARCORLOGCOM. Increased use of pRFID for virtual accountability in garrison and in transit visibility from staging areas to ports of embarkation and debarkation will benefit the entire Marine Corps. Combat Logistics Regiment-15, 1st MLG is currently experimenting with its use as well.

Two major exercises during 2018, COBRA GOLD in Thailand and TRIDENT JUNCTURE experimented with use of its Global Combat Support System-Marine Corps enterprise automated task organization tool, which will be utilized during a large-scale contingency. Deploying units expand their provisional accounts while integrating prepositioning equipment and supplies with home-station capabilities flow via strategic sea and air lift. This use of our Corps' supply accountability and maintenance system of record, particularly during TRIDENT JUNCTURE, is something to build upon, and valuable lessons learned will be leveraged by all Marine forces and MEFs. Exercising the enterprise automated task organization process will also ensure all maintenance conducted is captured and available for historical maintenance trends as service requests are transferred.

Blount Island Command retains detailed data on the tens of thousands of items within its prepositioning programs within the Marine Corps Prepositioning Information Center suite of applications which have also become increasingly capable over the last fifteen years. Interface with the Sea Service Deployment Module is under development to enable the Operating Forces visibility and planning of force closure and arrival and assembly operations. Both systems are now complementary until greater interface is achieved.

Further integration of logistics systems for planning, executing, and assessing logistics support remains a goal for prepositioning programs. The acquisition of tablets during 2019 will allow Blount Island to "go paperless" during exercise support as well as during maintenance and supply operations on Blount Island, in MCPP-N, and in the MAP-K. These tablets have pRFID sensors, tag reading and writing capabilities, and the ability to upload joint limited technical inspections while accessing Global Combat Support System-Marine Corps and pertinent maintenance and supply publications when connected to a network.

Conclusion

Despite being developed with peer competitors in mind, the Marine Corps' prepositioning programs have never been employed in the face of such an adversary. Unless our Corps decides to fundamentally alter its combined arms doctrine requiring armored maneuver forces supported by fires with corresponding heavy sustainment requirements, the deployment and employment of current and future capabilities will require large or many ocean-going vessels at some point. Conflict against peer competitors during both World Wars demanded the need for shipping escorts and joint dominance on the surface, sub-surface, and air—such is the case today with the addition of space and cyber domains.

MPF operations have matured and still offer support to the MOC and EABO but will be dependent on joint force dominance, if only for long enough to close required forces. Emerging concepts will need to mature to detailed force and lift requirements. The vision of smaller and increasingly survivable prepositioned assets is currently incongruent with the CHAMP plan and others being currently analyzed by the Navy and will be expensive. As mentioned in a recent news article critical of current sealift readiness, 90 percent of the joint force is currently relying on "black bottom" or commercial type surface means of conveyance. Logistics information technology integration is an exciting initiative, and MPF exercises are an exceptional platform for continued experimentation. Finally, Blount Island Command will remain agile and adaptive as the force supported by prepositioning, and the platforms from which the force is deployed and employed will change in light of renewed great power competition as outlined in the NDS. Semper Fidelis.

Notes

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Organizational Maintenance

Cracking the nut on systemic readiness issues

by LtCol Dana S. Demer

"Operational requirements are dominant and even in the sphere of maintenance and supply call for appropriate arrangements."[1]

Recently, I observed a "simple" procedure that highlighted larger issues within our maintenance and supply functions. The Marine Corps continues to struggle with the retention and development of our motor transportation mechanics, supply chain management, and the environmental factors and their effects on our equipment. We will continue to face readiness issues until these problems are addressed by the institution.

I spent a couple of hours with our Organizational Automotive Mechanics (MOS 3521) to try and understand why our D-Table of Authorized Material Control Number readiness is hurting. I was paired with a junior Marine who was struggling with a simple procedure: changing a boot for the rear axle anti-sway bar link boot on an AMk23 Medium Tactical Vehicle Replacement. This procedure should take approximately 1.6 hours per the technical manual.[2] However, the Marine had been working on this one nut for almost a week because of rust and corrosion.

I questioned this Marine to understand why he had not simply cut off the sway bar and order a replacement. His answer highlighted the decisions made at the organizational level and was indicative of larger issues that plague readiness. He responded that if he cut the sway bar off, the vehicle would be deadlined for two to three weeks depending on stockage at the supply management unit and delivery time from the States. The lance corporal factored different variables into his decision including time in maintenance for the vehicle, maintenance funds available, manpower, and lead-time on certain parts. He did not consider how many other vehicles could be worked on during the time he was working on freeing that one stubborn castle nut and allowing the supply chain to support his efforts. Our combined readiness equals operational capability and our junior Marines make these decisions every day.

>LtCol Demer is the CO, Combat Logistics Battalion 4 and a former 3521.

Our 3521s work hard. They battle against aging equipment, the lack of fellow mechanics, and harsh environments that exacerbate readiness issues. Recent studies at 1st and 3d Marine Logistics Groups (MLGs) demonstrated that with all of the external requirements (annual training, briefs, fleet augmentation programs, etc.), the Marine Corps has approximately 40 percent of their available mechanics actually servicing

Our 3521s work hard. *(Photo by author.)*

equipment. When this is coupled to staffing goals and Marines who are unable to perform their primary specialty for various reasons, the problem is exacerbated.

It takes a significant amount of time to train a 3521, not just in the initial training, but the experience learned on the shop floor and in the maintenance facilities. This experience usually translates into training and mentoring junior mechanics whilst functioning as quality control to ensure that during initial induction into the maintenance cycle all issues are captured and addressed at one time.

There have been no bonuses for re-enlistment for at least ten years[3] and current re-enlistment rates are under the available "boat spaces" allocated to the MOS. Their skills are valuable to the outside world and retention rates of these talented individuals should surprise no one, especially with a strengthening civilian job market. This is in stark contrast to the aviation community when faced with readiness issues, money and resources were targeted to the maintainers and the facilities in which they work.

Our supply system works hard, but so do washing machines cleaning 782-gear; there must be a better way. If my privately-owned automobile—regardless of make or model—requires parts, I can get these in less than two days. This is not the case for our military motor transport equipment. The simplest of parts, if not available locally, are at least two to three weeks from shipment. Shipments are too often lost resulting in more delays and more manpower expended to recoup missing money and reordering parts. I have personally experienced estimated ship dates of over 270 days. Printing our way out of the problem is still a dream as three-dimensional printing (3D) is dependent on proprietary regulations subject to legal review.

We continue to admire issues with our supply chain. The Marine Corps Logistics Education Program at Penn State, and the LOGTECH Advance at University of North Carolina introduce Marine Corps leaders to concepts and ideas that can solve many

One of our vital MTVR wreckers, nicknamed "Mater" after the beloved but dilapidated tow truck from the film* Cars*, was deadlined for over 1,000 days before it was finally accepted for recoverable item report (WIR). Repairs to the vehicle exceeded 200 percent of the original vehicle cost and almost 4,500 manhours of labor at various levels. When we combine the atrophy of a deadlined vehicle with a corrosive environment, other issues emerge requiring additional maintenance when we eventually receive the parts. Start the process over again.

"The Pentagon's broken sustainment model translates into fewer platforms and systems available either to be deployed to war zones or at home stations on which Service members can train. This, in turn, means reduced proficiency for individuals and units, including maintainers. The overall effect is a readiness crisis."[4]

The simplest of parts, if not available locally, are at least two to three weeks from shipment.
(Photo by LtCol Matthew James.)

of these problems. These outstanding education opportunities focus on supply chain management with some of the brightest minds in the industry, academia, and the military. The Marine Corps invested a significant amount of time and resources in these programs with no end in sight to the problem. Regardless, the issues (long lead times and readiness problems) that we address continue to plague us. New programs, such as the joint light tactical vehicle (JLTV) for example, give greater reasons for concern. At close to half a billion dollars for the program, the JLTV weighs more, has no warranty, no interchangeable parts with our current fleet, and currently has only a single source for replacement parts. Mobile training teams will train our mechanics on this new vehicle. The sundown of the HMMWV will result in longer wait times for parts as industry stops making parts for a vehicle that is going away. The institution must be ready for degraded light-vehicle readiness as one program goes away and another comes online.

The British light-tactical vehicle also happens to be a robust civilian sport utility vehicle that anyone can obtain parts for. The simplicity makes me jealous. Survivability is significantly less than the JLTV, but does the JLTV help or hinder our ability to seize and secure advanced naval bases as well as support expeditionary advance base operations? Can we accomplish these missions with a lighter vehicle?

The Marine Corps operates and resides in highly corrosive environments and salty air.[5] Rust and corrosion exacerbate readiness issues. There are programs that address these issues, but they are not enough to keep up with a problem that is literally corroding our readiness. There is a reason why car enthusiasts refer to rust as cancer. The castle nut that the mechanic struggled with at the beginning of this article was literally rusted to the sway bar and much of the metal was brittle to the extent that it could break off by hand. These are the vehicles that we operate on a daily basis.

All is not lost. Recommendations for correction.

Invest in our mechanics and the facilities in which they work. There is a stark contrast between aviation maintenance facilities and their ground brethren. The F-35 program factored in amazing maintenance facilities that took lessons from NASCAR facilities increasing both efficiency and efficacy. The JLTV that will replace the HMMWV will be repaired in the same facilities that struggled to keep this latter fleet of vehicles afloat. Target reenlistment bonuses that reflect the investment in these technical MOSs and then seek to retain this knowledge and experience. Revisit structure changes that reduce maintainers at the organization level because technology cannot fill an experience gap.

We must improve the efficiency of our supply chain. This begins at the inception of a new program. Industry

Rust and corrosion acerbates readiness issues. *(Photo by author.)*

There is a reason why car enthusiasts refer to rust as cancer. *(Photo by LtCol Paul Goguen.)*

Commanders should not have to expend valuable resources just to bring a vehicle up to a certain condition to be eligible for WIR. *(Photo by author.)*

The greatest weapons systems become worthless if they are not maintained in an expeditious manner. *(Photo by author.)*

fights to sell the Marine Corps programs, but they must devise a responsive supply system to support. Programs with single-source vendors and unique parts need to be shut down. The greatest weapons systems become worthless if they are not maintained in an expeditious manner. Are new programs designed to address deficiencies identified in the previous fight or the future fight? The supply chain must seek to end long lead times on deadlining parts; if the civilian supply chain achieve this, then it is possible for the Marine Corps to be efficient as well.

The Marine Corps need to smooth the WIR process. Commanders should not have to fight to rid themselves of known hanger queens. "Retain and repair" equates to "throw money and resources at the lemon," and this should be a depot-level issue to address, not the operational forces' problem. Commanders should not have to expend valuable resources just to bring a vehicle up to a certain condition to be eligible for WIR. Understand the definition of sunk cost and know when to walk away from a vehicle.

The Marine Corps has invested a lot of resources[6] into preventing corrosion of its equipment, but some improvements can be made. Increase allocations and improve the Combat Ready Storage Program facilities. Outdoor storage of equipment in highly corrosive environments such as Del Mar (Camp Pendleton, CA), Kaneohe Bay, and Camp

"The U.S. military's Achilles heel in future conflicts will not be inferior technology. Rather, it will be an antiquated, industrial-age sustainment model. The way the Pentagon is organized to conduct maintenance, repair and overhaul (MRO) work gives rise to endless parts shortages, large numbers of so-called 'hanger queens' and fleets of aircraft, ships and vehicles with availability rates well below the minimum levels needed to meet global mission requirements."[7]

The training value that these organizations provide is invaluable to commanders, staffs, and maintenance and supply support sections as we collectively address readiness issues.

Kinser (Okinawa) only increase corrosion. Increase Corrosion Prevention and Control Program quotas and visits from the corrosion support teams.

I am fortunate to pass the Field Supply and Maintenance Analysis Office-West and Logistics Systems Coordination Office on my way to my maintenance facility. The training value that these organizations provide is invaluable to commanders, staffs, and maintenance and supply support sections as we collectively address readiness issues.

Our mechanic freed the stubborn nut on the afternoon of the fifth day he worked on the vehicle. He was proud that he did not have to cut the sway bar off but acknowledged that the sway bar would probably have to be replaced soon because of the corrosion. As leaders, are we supporting his efforts and setting him up for success? His actions directly translate into combat readiness and effectiveness.

Notes

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Flattened Logistics

The future of Marine Corps logistics and the company landing team

by Maj Leo Spaeder

LCpl Snippert, a distribution combat logistics integrator (CLI), is ready to hit the beach during Operation LITTORAL RESOLVE. *The battalion is conducting four widely-separated attacks on islands 500 miles apart. The 1st Platoon grunts of Snippert's company landing team had already hit the beach in assault amphibian vehicles ten minutes prior and Snippert's landing craft, loaded with his leader-follower logistics vehicles (LFLV) and 1st Platoons' light off-road vehicles, lands against the sand. Immediately after the bow drops, Snippert moves his vehicles onto the beach and to the pre-arranged casualty collection point. He sees the corpsman working on two Marines who were wounded during the assault. Picking up his unmanned aerial logistics platform (UALP) remote control, he directs two of the four light UALPs that he launched from the landing craft before the assault began and assists the corpsman. Within 10 minutes, he has both Marines slung under the UALPs and on their way to the operating room on the USS* America *60 miles off-shore. Without having to wait for a manned aircraft to arrive, the two Marines receive treatment within the critical golden hour and survive.*

Moving to the logistics platoon rally point, LCpl Snippert is met by the rest of the platoon. He leaves his LFLVs with the platoon commander and platoon sergeant; launches two light UALPs with speed balls of blood plasma, ammo, and water bottles and two with medical evacuation setup; and moves to meet 1st Platoon for their next attack over the ridge. The grunts have already attacked and seized the objective without casualties, so Snippert brings down the UALPs and distributes supplies to refill their magazines and hydration systems. One infantryman's M240 machine gun is broken; LCpl Snippert takes it and returns to the logistics platoon on the beach.

>Maj Spaeder is a MAGTF Planner currently serving at the Marine Corps Warfighting Laboratory. This article was his School of Advanced Warfighting future war paper.

On the beach, Sgt Mooney, the senior maintenance CLI, was setting up his 3D printer while Cpl Baker was troubleshooting a Weapons Platoon light off-road vehicle that kept overheating. Sgt Mooney took a quick look at the M240 and noticed the broken feed tray. Unfortunately, there were no replacements for this part within the small repair block on-hand, so he began to fabricate one using the 3D printer. A few hours later, the M240 was delivered back to 1st Platoon via a UALP from the beach. The vehicle was unable to be fixed on-site, so a replacement was forwarded and the broken vehicle sent back to the intermediate maintenance detachment aboard ship via the same heavy UALP.

Meanwhile, the sustainment CLIs were operating their water purification systems, refilling empty five-gallon water jugs, and sending them to the platoons via LCpl Snippert and the other distribution Marines on their off-road vehicles. After delivering water and picking up dead batteries, the sustainment CLIs unrolled the flexible solar panels and began recharging radio, LFLVs, and UALP batteries. Since the distribution CLIs resupplied the grunts with chow and ammo, the sustainment section counted their stocks and ordered resupply from the embarked MEU Combat Logistics Battalion (CLB). Two hours later, a heavy UALP drops three pallets of rations, mortar rounds, and various small arms ammo; the supplies are then loaded onto their LFLVs.

Since the company seized its objectives, the logistics platoon displaces to the company headquarters at a half-finished airfield to prepare for tomorrow's next attack. The logistics platoon commander coordinates with the company landing team commander and the battalion logistics officer to reorganize logistics assets to support upcoming operations. Just ten years before, an operation of LITTORAL RESOLVE*'s audacity would have been logistically impossible from the old organization of the battalion's logistics assets.*

During the 2014 RIM OF THE PACIFIC exercise (RIMPAC14), Special Purpose MAGTF 3 (SPMAGTF-3) was task-organized as part of a Marine Corps Warfighting Laboratory (MCWL) advanced warfighting experiment. The purpose was to determine if "a sea-based SPMAGTF–organized, trained, and equipped to conduct distributed operations–can sustain … multiple widely disbursed Company Landing Teams (CLT)."[1] While published two years before the current *Marine Corps Operating Concept* (MOC), this experiment tested three key aspects of the Marine Corps future warfighting concept: the ability to integrate the naval force to fight at and from the sea; evolving the MAGTF; and enhancing Marines' ability to maneuver.[2] SPMAGTF-3 uncovered a critical gap in sustaining our forces from the seabase, which will inhibit our ability to defeat the enemy.[3] *To unleash the combat power and potential of the CLT, the Marine Corps must fully embrace hybrid logistics, flatten the logistics concept of support, devolve the lowest echelon of logistics support to the company level, and combine tactical logistics-related MOSs.*

During RIMPAC14, SPMAGTF-3 employed three CLTs for a period of 96 hours and sustained those units from amphibious shipping with CLB-3 and

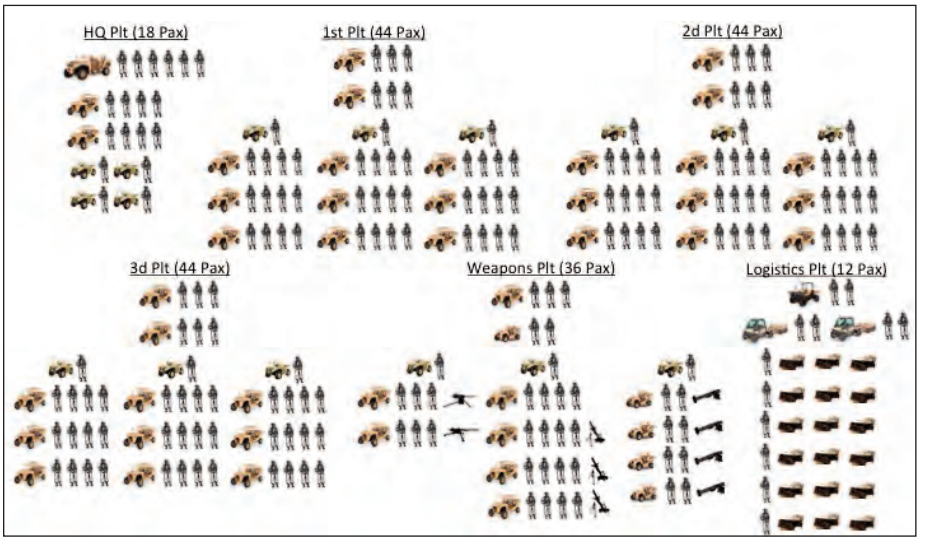

Figure 1.
Company landing team task organization with communications and medical attachments.

a composite aviation squadron. The unit identified three main failures in the effort to sustain these widely dispersed units: reliance on "push" logistics, the lack of available manned aviation assets, and company-level distribution once supplies reached ashore.[4] These gaps were a direct result of the Marine Corps' failure to leverage unmanned aviation platforms to sustain forces within the area of operations and the structural unsuitability of the battalion logistics organization.

With regard to the first and second issues, the ACE of the MAGTF—specifically the assault support components (medium and heavy rotary-wing and KC-130 transport airframes)—does not possess the capacity to deliver logistical sustainment across a widely disbursed area. During amphibious distributed combat operations, the order in which the ACE's probable prioritized assault support missions are as follows: troop insertion, casualty evacuation, and sustainment. Additionally, the requirement for armed escort for these sorties—and slower deck cycles associated with shipboard aviation operations—further restrains manned aviation capacity. Accordingly, SPMAGTF-3 resorted to "push" logistics when manned aircraft sorties were available to ensure that vital supplies were sent forward when possible instead of when needed. As a result, the receiving unit was inundated with supplies when it did not possess the distribution mechanism to service platoon-level organizations. While the lack of manned aviation assets contributed to this bottleneck of supplies, it was not the only factor.

With respect to the third issue, the current organization of the battalion logistics formation is inadequate. As the lowest echelon of sustainment, the battalion logistics section provides subordinate companies with supply, maintenance, and transportation. Infantry companies only possess the ability to transport up to two days of ammunition, food, and water; have limited ability for maneuver and medical triage; and no ability to generate power or produce potable water. Without a permanent logistics capability at the company-level, battalion efforts to embed logistics providers into their CLTs will remain ad-hoc, haphazard, and insufficient to enable the full potential for operational maneuver.

A logistics platoon, organic to the company landing team and empowered by hybrid logistics, will overcome these two structural challenges inherent in CLT operations. The incorporation of hybrid logistics concepts, in particular LFLVs and UALPs, will resolve current aviation sustainment capacity shortfalls and flatten the concept of logistics support between the CLT and the LCE. Moreover, the CLT logistics platoon provides a standardized capability which will enable an effective entry-level training pipeline and realistic training for combat operations.

Before demonstrating the ability of a hybrid logistics-enabled CLT logistics platoon, key assumptions must be outlined and terms defined. Fundamentally, this article assumes that the organization, manning, and equipping of the CLT is the organization that will be accepted as the standard subordinate unit of the future infantry battalion, equivalent to the current infantry company. This article also assumes that current manpower for logistics personnel within the infantry battalion will not expand. Finally, the infantry battalion will retain an appropriate ability to conduct supply functions which must be supervised by the battalion commander and executive officer.

Given these factors, the CLT will consist of three rifle platoons, a weapons platoon, a logistics platoon, and a headquarters section for a total of 198 Marines and Sailors as depicted in Figure 1.[5]

The CLT will be mounted aboard light, off-road vehicles, which are internally transportable by MV-22, in order to provide enhanced ground mobility and survivability through speed and dispersion. The rifle platoons will maintain the current organization of three rifle squads with organic light automatic weapons. The weapons platoon will field the current light mortar, medium machine gun, and light anti-armor weapons capabilities and be reinforced with medium/heavy mortars, heavy machine guns, and medium/heavy anti-armor weapons. The CLT will use an "armory locker" construct, where the various weapons and appropriate weapons mix are selected based on mission analysis. The headquarters section will retain the current command team augmented by a fires support team, a company-level intelligence cell, and a reconnaissance team. Each infantry battalion will have four company landing teams and a headquarters and services company.

Additionally, the concept of hybrid logistics will power the CLT logistics platoon and was best outlined by the former Deputy Commandant for Installations and Logistics, LtGen Mi-

Occupational Field	Marine Officers	Enlisted Marines	Total
Logistics (04)	4	7	11
Ground Ordnance Maintenance (21)	0	5	5
Ground Ammunition (23)	0	2	2
Food Service (33)	0	9	9
Motor Transport (35)	0	24	24
Total	4	47	51

Table 1. Current infantry battalion CSS personnel.

chael Dana. Its key tenets include: the blending of new and proven technologies such as additive manufacturing, unmanned air and ground platforms, and expeditionary medicine; being naval in character; remaining flexible and expeditionary; and implementing extensive cross-training and certification in multiple MOSs.[6]

The current table of organization for an infantry battalion contains 51 Marines to provide combat service support, exclusive of the battalion supply section, as depicted in Table 1.[7]

The vast majority exist within headquarters and service company under the battalion S-4 (logistics) with each infantry company possessing one Landing Support Specialist (MOS: 0481) and Weapons Company having one Motor Transport Operator (MOS: 3531) and Ground Ammunition Technician (MOS: 2311). The current supply chain uses a hub-and-spoke distribution model: the S-4 collects all logistics reports from the companies and coordinates resupply with the CLB, the CLB delivers supplies to the battalion position, and the battalion logistics train delivers supplies to the companies as directed by the S-4. Maintenance is consolidated at the battalion, so all inoperative equipment is sent to the battalion, repaired, and returned to its owner. Any equipment requiring maintenance beyond the battalion's organic capabilities is evacuated to the appropriate MLG unit and returned to the owner via a CLB convoy and the battalion logistics train. This combat service support model is both stove-piped with eleven MOSs operating within their small slice of logistics and unresponsive with the multiple layers between the infantry companies and the CLB's supply depots as depicted in Figure 2.

The CLT logistics platoon concept will affect all aspects of battalion logistics. First, it will re-task the battalion S-4 to a logistics coordination role and integrate logistics directly into line companies. The S-4 will consist of the personnel listed in Table 2 on the next page. This organization will combine the MOS subject matter experts with CLIs who understand the unique nature of flattened logistics. Additionally, the S-4 will provide logistics to headquarters & services company.

The preponderance of combat service support personnel will be relocated to the four CLTs within the infantry battalion. These self-contained platoons will provide the existing combat service support functions (motor transportation, vehicle and ordnance maintenance, maintenance management, food service, and ground ammunition) with additional capabilities including: landing support, water support, expeditionary power, and unmanned aerial logistics operations. The personnel listed in Table 3 (on next page) will possess skills spanning several MOSs to provide a distributable capability beyond the current structure of the infantry battalion's logistics. Marine Corps Special Operations Command already executes a version of cross-trained logisticians within the Marine Raider Support Battalions.

These CLTs will coordinate resupply and intermediate-level maintenance directly with the CLB via air and ground means without coordination with the battalion S-4. The battalion S-4 will coordinate with the CLTs to ensure proper support from the assigned CLB or reallocate logistics forces per mission requirements. This integrated and flattened logistics construct will enable

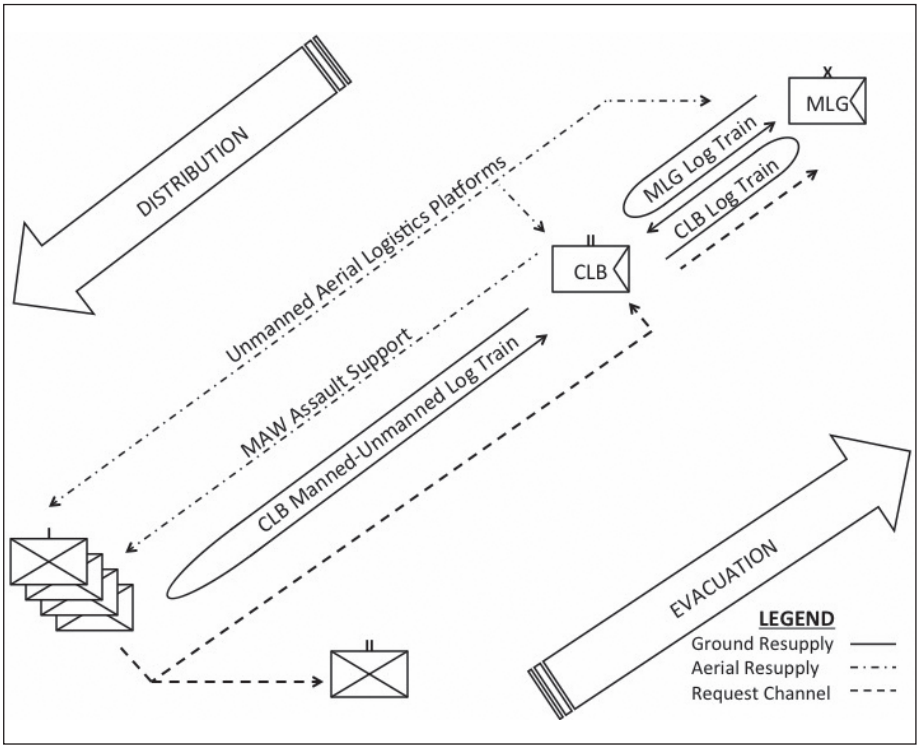

Figure 2. Current logistics distribution model.

Billet	Rank	MOS	Existing or New Billet
Battalion Logistics Officer	O3	0402	Existing
Combat Logistics Integrator–Chief	E7	TBD	New
Motor Transport Maintenance Chief	E6	3529	Existing
Motor Transport Operations Chief	E6	3537	Existing
Food Service Chief	E6	3381	Existing
Maintenance Management Chief	E5	0411	Existing
Ground Ammunition Chief	E5	2311	Existing
Combat Logistics Integrator–Sustainment	E4	TBD	New
Combat Logistics Integrator–Maintenance	E4	TBD	New
Combat Logistics Integrator–Distribution	E3	TBD	New
Combat Logistics Integrator–Distribution	E3	TBD	New

Table 2. Proposed infantry battalion logistics section.

Billet	Rank	MOS
Company Logistics Officer	O2	0402
Combat Logistics Integrator–Chief	E6	TBD
Combat Logistics Integrator–Sustainment	E5	TBD
Combat Logistics Integrator–Sustainment	E4	TBD
Combat Logistics Integrator–Distribution	E5	TBD
Combat Logistics Integrator–Distribution	E4	TBD
Combat Logistics Integrator–Distribution	E3	TBD
Combat Logistics Integrator–Maintenance	E5	TBD
Combat Logistics Integrator–Maintenance	E4	TBD
Combat Logistics Integrator–Maintenance	E3	TBD

Table 3. Proposed company landing team logistics platoon.

operations across a widely distributed area of operations.

As previously mentioned, the CLIs will retain and expand the infantry battalion's combat service support capabilities to respond to new requirements and avoid the previous "iron mountain" approach to logistics. Each will require a specific training pipeline that will endure throughout their careers.

The CLI–Distribution (CLI-D) will harness the capabilities of ground vehicles and UALPs. These Marines will operate the light off-road vehicles, LFLVs, and UALPs as well as provide landing support to distribute supplies to the CLT. Additionally, they will repair the CLT's UALPs. As trained Landing Support Specialists (MOS: 0481), they will assist the loading of the CLTs onto and off of amphibious shipping and aircraft. Further, they will be the subject matter experts to train and lead Marines—CLIs and non-CLIs alike—in helicopter support team external load operations. CLI-Ds will receive supplies from the CLB and disseminate them to the platoons via ground assets or organic UALPs. Any injured personnel or inoperative equipment will be evacuated to the rear by CLI-Ds. The CLI-D formal entry-level training pipeline will include the Basic Landing Support Specialist Course, a to-be-developed LFLV Operator Course, a to-be-developed UALP Basic Operator Course, and a to-be-developed UALP Repair Course. Upon completion of the pipeline, CLI-Ds will be licensed to operate the light off-road vehicles via a locally executed course.

The CLI–Maintenance (CLI-M) Marine will primarily service and repair the CLT's vehicles, small arms, and UALPs. While their primary focus will be the maintenance of the light off-

road fleet and LFLVs, the CLI-Ms will be trained to repair the entire Marine Corps' wheeled tactical vehicle fleet (HMMWVs, JLTVs, MTVRs, and logistics vehicle system replacements) as all Automotive Organizational Mechanics (MOS: 3521) are capable. Additionally, they will possess the same skills as the Small Arms Repairer/Technician (MOS: 2111) and Electro-Optical Ordnance Repairer (MOS: 2171). Through these skills, CLI-Ms will maintain all weapons organic to the CLT. The training pipeline will include: the Automotive Maintenance Technician Basic Course, a to-be-developed UALP Repair Course, a to-be-developed LFLV Repairer Course, the Small Arms Repair Course, the Electro-Optical Ordnance Repairer Course, and aspects of the Towed Artillery Repair Course (focused primarily on the Expeditionary Fire Support System 120mm mortar).[8] Similar to the CLI-Ds, these Marines will also be licensed to operate the light off-road vehicles at their first duty station.

Next, the CLI–Sustainment (CLI-S) Marine will provide key classes of supply, specifically classes I (subsistence), III (fuel), V (ammunition), and IX (repair parts), expeditionary power, and water generation. CLI-S Marines will fabricate limited repair parts via a portable, low-power 3D printer and provide maintenance management oversight to support the CLI-M's maintenance operations. Primarily using solar power and small fossil fuel generators, these Marines will provide expeditionary energy to support the CLT's communications equipment and battery-powered devices. Furthermore, these Marines will train to maintain and repair all Marine Corps electrical equipment for missions requiring enduring distributed operations, similar to the extended forward operating base model of Iraq and Afghanistan. Overall, these Marines will have similar capabilities to Ammunition Technicians (MOS: 2311), Electrical Equipment Repair Specialists (MOS: 1142), and Water Support Technician (MOS: 1171). The CLI-S formal training pipeline will include: the Enlisted Ammunition Specialist Course, the Basic Engineer Equipment Electrical Systems Technician Course, and the Basic Water Support Technician Course. After this pipeline and assignment to their units, these Marines will also be trained to operate the light off-road vehicles, the 3D printers, and solar power charging systems via home station training courses.

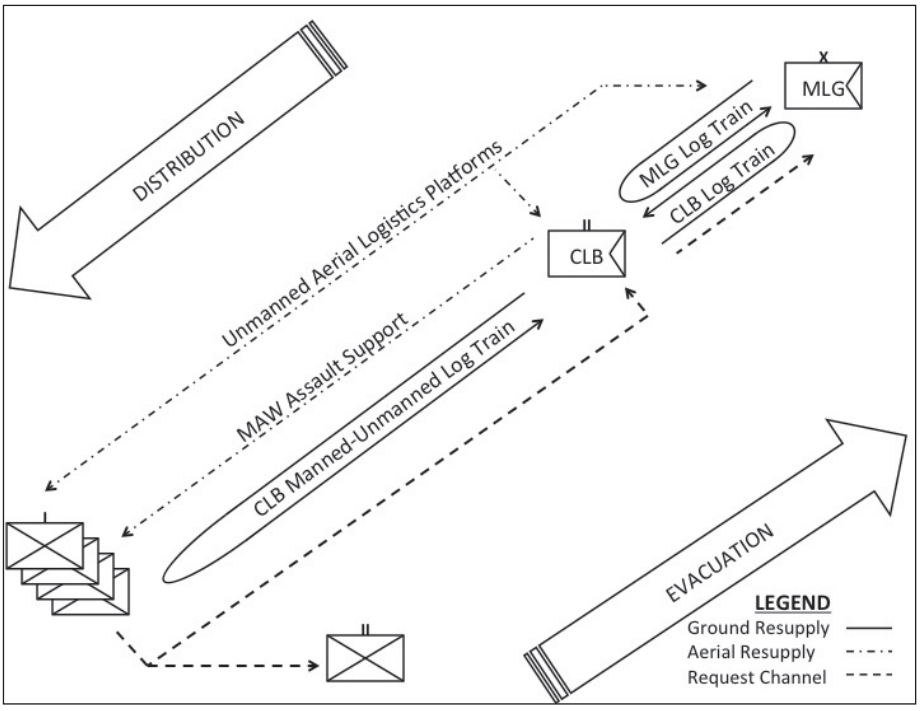

Figure 3. Proposed logistics distribution model.

Upon promotion to staff sergeant, these CLI Marines will become a CLI–Chief (CLI-C). Principally trained as a maintenance, distribution, or sustainment integrator, the CLI-C will receive cross-leveling training from the other CLI pipelines to create a well-rounded logistics supervisor. The CLI-C will provide oversight to the CLT logistics platoon's CLIs as well as counsel to the logistics platoon commander on the unit's employment and operations. Since they will require an understanding of the entire Marine Corps logistics enterprise in order to harness its capabilities, the CLI-Cs will attend the same school as current Logistics Mobility Chiefs (MOS: 0491); the Advanced Logistics/Mobility Course. As the CLI construct includes more knowledge and skills from outside the 04XX occupational field and, therefore outside of the 0491 curriculum, an additional, specific CLI-C course must be established to provide tailored supervisor training from the 11XX, 21XX, 23XX, and 35XX occupational fields listed above.

Finally, the CLT logistics platoon commander must be addressed. While not a new MOS, the proposed use of the Logistics Officer (MOS: 0402) is more intensive than before. Trained as generalists at the Logistics Officer Course, 0402s are currently employed within a specific aspect of logistics upon assignment to the infantry battalion—such as the maintenance management officer, motor transport officer, or food service officer—and only approach logistics from a holistic approach as the assistant battalion logistics officer or battalion logistics officer. However, there is no career-level training to bridge this specific-to-holistic transition. Therefore, the 0402s will continue to attend the established formal training pipeline. However, once assigned to the CLT logistics platoon, they will attend the same local home station training courses as their CLIs previously outlined.

Since the reorganization of infantry battalion logistics will have far reaching consequences, we must analyze them thoroughly utilizing the Joint Capabilities Integration and Develop-

ment System's DOTMLPF analysis.[10] Specifically, we will focus on doctrine, organization, materiel, leadership and education, and personnel.

Doctrine. Regarding doctrine, the CLT logistics platoon concept flattens the supply chain by converting the battalion S-4 to a logistics coordinator instead of a logistics provider. This fundamental change alters the relationship between the CLT and the CLB, empowering the CLT to directly request support from the CLB as depicted in Figure 3. The infantry battalion and regiment will retain their existing authority to provide priorities of effort for their subordinate battalions and companies to the CLB. Similarly, the CLB will continue the practice of seeking infantry battalion or regiment guidance if requests exceed capacity or source external support from the MLG. Additionally, the CLT will gain the ability to evacuate inoperable equipment to the MLG maintenance battalion in cases where the direct support CLB does not have the capability or capacity to conduct required maintenance action, saving another time-consuming stop at an intermediate node.

A considerable doctrinal hurdle is the operation of UALPs by the CLT logistics platoons and LCE units as well as the required reconciliation with the ACE. The Marine Air Command and Control System, in accordance with Marine Corps doctrine, is founded upon the central tenet of centralized command and decentralized control. Centralized command allows the ACE to plan aviation operations; plan the use of the battlespace; coordinate ordnance, fuel, and facilities; coordinate with joint and multinational aviation partners; and allocate aircraft and crews. Considered altogether, these factors allow the ACE commander to create an executable air tasking order (ATO) to be executed via decentralized control.[11] The specific categorization of unmanned aerial *logistics* platforms requires LCE commander ownership and precludes centralized ACE command outlined in *MCWP 3-2, Aviation Operations*. While seemingly at odds, deconfliction of UALP operations with the ACE and integration into the MACCS makes this exception practicable. As previously mentioned, the most important aspect of centralized command is the ability of the ACE commander to apportion and allocate aircraft. Since UALPs are solely dedicated to logistical support, centralized command is not required for the ACE commander to accomplish the mission. Pre-planned airspace coordinating measures, such as transit corridors, combined with existing air control agencies, such as battalion air officers, will allow for safe execution of this proposal.

Currently, there is no MLG organization that possesses or operates UALPs, and the CLT logistics platoon concept will require considerable throughput via UALP.

Organization. Currently, there is no MLG organization that possesses or operates UALPs, and the CLT logistics platoon concept will require considerable throughput via UALP. The Marine Corps has three options to incorporate the UALP capability into the MLG and maintain current force levels. First, a UALP platoon could be organized within the CLB by replacing one motor transport platoon to provide direct support to the Marine division. Second, the Marine Corps could create a UALP company within the transportation battalion by replacing one of its motor transport companies.[12] Lastly, the re-established landing support battalion could replace a landing support company with a UALP company.[13] If this capability is created through the second or third options, these functional battalions will send detachments to the CLB during combat operations and retain the remainder for general support to the MEF. Within the Marine division, the truck company might also trade a motor transport platoon for a UALP platoon to reinforce the infantry regiments' and battalions' maneuver capabilities.

Materiel. The CLT logistics platoon concept will require considerable materiel acquisition and fielding, some of which already exists while others must be developed. The most critical technology to be developed concerns the UALP. The Marine Corps must develop and field three UALP models: light, medium, and heavy. The CLT logistics platoon will have primarily the light model with a few medium UALPs. The LCE should operate all three models with emphasis on medium and heavy capacities. The light model should be capable of transporting a payload between 300 and 400 pounds. This allows the movement of a casualty, ammunition, rations, fuel, repair parts, and other critical sustainment. The medium model's payload capacity should be approximately 1,250 pounds in order to move larger, heavier echelons of logistics. This includes major repair parts (replacement JLTV engine weight: 900 pounds), larger fuel drums (155-gallon bladder: 1,239 pounds), larger packaged rations (MRE pallet: 1,010 pounds), and small ground vehicles (LFLV: 500 pounds). The heavy UALP must be capable of transporting 5,000 pounds which includes all vehicles organic to the CLT. Marine aircraft currently fielded, such as the CH-53 (30,000 pound external load) and MV-22 (15,000 pound external load), will fulfill the super-heavy movement requirements.

Next, the Marine Corps must develop and procure sufficient ground logistics vehicles that are capable of leader-follower operations. Leader-follower capability is necessary for the CLT logistics platoon concept as it enables a greater, malleable payload-to-operator ratio. With five CLIs trained in LFLV operations and a two vehicle setup per operator (one leader and one follower vehicles), the CLT will be capable of transporting 16,500 pounds of supply based on current technology. Adding an additional follower vehicle per operator increases the unit payload capacity by 8,250 pounds.[14] In addition to payload, the leader-follower concept will allow

Distribution	
Unmanned Logistics Aerial Platform Operators Course *	77
Unmanned Logistics Aerial Platform Repair Course *	66
Basic Landing Support Specialist Course†	35
Leader-Follower Logistics Vehicle Operator Course ‡	15
Total (Est.)	***193***

Maintenance	
Automotive Maintenance Technician Basic Course†	73
Small Arms Repairer/ Technician Course †	38
Electro-Optical Ordnance Repairer Course †	111
Towed Artillery Repairer Course (Partial) †	25
Leader-Follower Logistics Vehicle Repairer Course	28
Unmanned Logistics Aerial Platform Repair Course *	66
Total (Est.)	***341***

Sustainment	
Ammunition Technician Course †	27
Basic Engineer Equipment Electrical Systems Technician Course †	101
Basic Water Support Technician Course †	77
Food Service Specialist Course	56
Total (Est.)	***261***

* Estimated from established equivalent course

† Established course length

‡ No established equivalent course

Table 4. Combat logistics integrator formal training pipelines.[9]

flexible employment of personnel as one leader vehicle can handle as many followers as the mission and operational environment allows. The LFLV should primarily be wheeled; however, it should also have the capability to replace wheels for tracks to operate in snow environments.

To conduct expeditionary maintenance, a 3D printer should be included that is capable of creating military grade replacement parts within the CLT table of equipment. The 3D printer should operate from the power provided by solar-charged battery packs; however, a fossil fuel generator can be paired or incorporated into the expeditionary 3D printer if this is not technically achievable. Additionally, customized tool kits and repair part blocks must be developed to support the CLT's table of equipment and LFLV beds.

In regard to sustainment, the CLT logistics platoon must be outfitted with sufficient solar chargers, battery packs, and small fossil fuel generators. As the CLT is mounted on light, off-road vehicles, each vehicle should be outfitted with light and medium solar chargers to fulfill individual power requirements. The logistics platoon's heavy solar chargers will recharge battery packs similar to the current Ground Renewable Expeditionary Energy Network System and additional batteries for man-portable radios. Ideally, these solar chargers and battery packs will be capable of powering the small 3D printer discussed above. Water purification systems, currently capable of 3,600 gallons per day at only 150 pounds weight, will provide a surplus of water to support the company under the harshest arid conditions.[15] Development of polymer ammunition will increase the logistics platoon's transportation capacity by reducing weight on individual Marines and unit vehicles.

Leadership and Education. The main concern regarding the CLT commander is an overload of responsibility. Under this construct, this Marine will be fighting his three rifle platoons and employing fires from his weapons platoon. Adding the responsibility of providing his own logistics will increase the level of complexity. However, the inclusion of a logistics officer as the CLT platoon commander minimizes this concern and provides the CLT commander more freedom of action than they previously had. Without this organic capability, the CLT commander would still coordinate logistics through his company gunnery sergeant and logistics NCO, yet remain dependent on an external organization that is not under his command and is rarely proximate. The logistics platoon concept provides the commander with greater flexibility and control over his operations.

Both the CLT commander and the battalion S-4 will require education on the capabilities, limitations, and methods of employment of the logistics platoon. While the CLT commander will interact with the logistics platoon as an infantry rifle platoon commander, he will need to receive a standardized education to understand how to best employ the asset. Most likely, the battalion S-4 will have had no previous interaction with the logistics platoon construct because of the assignment of 0402s across other elements of the MAGTF. A specialized course on CLT logistics platoon operations must be created for these battalion S-4s and the concept should be integrated into both career- and intermediate-level logistics education.

Personnel. As depicted in Table 4, the training pipelines for CLI Marines are time intensive. Sourcing of CLI personnel could be executed via two methods: initial accession or lateral move. For initial accession, considering initial recruit training and Marine combat training span approximately five

months, the proposed training pipeline implies training cycles of twelve months for CLI-Ds, fifteen months for CLI-S, and eighteen months for CLI-Ms.[16] A standard 48-month contract does not allow for sufficient return-on-investment for the Marine Corps. The first-term enlistment should be extended from 48-months to 72-months for CLI Marines produced through this method. Through a lateral move model, some of the time-consuming aspects of a particular track will already be completed. These seasoned Marines will have Operating Force experience, MOS credibility, and demonstrated their proficiency, intelligence, character, and worthiness for investment. This will limit the Corps' exposure to heavily investing resources and time in a newly ascended Marine who is more likely to be discharged for misconduct or behavioral issues in comparison to a Marine who has successfully completed the first-term contract.

After the enlistment obligation is completed, the CLI skills—especially of the maintenance track—will likely strain retention without the use of incentives, whether they be financial or otherwise. As CLIs will possess multiple primary MOSs, the option to move laterally into a desired MOS, billet assignment, or geographic location will retain core talent if this issue arises. The multi-disciplinary nature of the CLI provides for flexible personnel solutions.

In conclusion, the requirement for the infantry battalion to operate across wide expanses, especially in Pacific Command's area of responsibility, necessitates the use of the CLT and the creation of a new concept of logistics support. This new concept of support must fully embrace hybrid logistics, flatten the supply chain, devolve the lowest echelon of logistical support to the company-level, and combine tactical logistics-related MOSs into multi-disciplinary personnel. The embedded logistics platoon and revised battalion logistics section fulfills all of these requirements and enables distributed operations across wide expanses. The Marine Corps should designate an infantry battalion as a test unit, cross-train existing logistics personnel per the proposed training pipeline, acquire equipment with existing technology, develop technology to meet currently unmet requirements, and begin field testing to validate the concept's viability. Once proven, the Marine Corps should adopt the logistics platoon construct within all infantry battalions as its standard structure.

Notes

1. SPMAGTF-3, "Company Landing Team: Employment from the Seabase," *Marine Corps Gazette,* (Quantico, VA: January 2015).

2. Headquarters Marine Corps, *Marine Corps Operating Concept: How an Expeditionary Force Operates in the 21st Century,* (Washington, DC: September 2016).

3. "Company Landing Team: Employment from the Seabase."

4. *Ibid.*

5. This 198 personnel figure assumes no growth in combat arms personnel end strength. This includes three 181-Marine rifle companies, which excludes the Landing Support Specialist (MOS: 0481), and one 144-Marine weapons company, which excludes the Motor Transport Operator (MOS: 3531) and Ammunition Technician (MOS: 2311), evenly divided across four CLTs. The new organization consists of 171 combat arms Marines, 10 organic logistics Marines, and 17 Headquarters and Service Company Marines (communications and medical).

6. Michael Dana, "21st Century Logistics." *Marine Corps Gazette,* (Quantico, VA: October 2017).

7. Headquarters Marine Corps, "*FY2019 Infantry Battalion H&S CO, RFL CO, WPNS Co Tables of Organization and Equipment*," Total Force Structure Management System, (Washington, DC: 2017), available at https://tfsms.mceits.usmc.mil.

8. This article was written before the decision to remove the EFSS from the inventory.

9. Training and Education Command, "*Course & Class Information*," Marine Corps Training Information Management System, (Quantico, VA: 2017), available at https://mctims.usmc.mil. The estimated course durations for the Unmanned Aerial Logistics Platform Operators and Repairer Courses listed are based on the current Unmanned Aircraft System Common Core (course code: A12VAH1) and Unmanned Aircraft System Repairer (course code: A12V-AR1) courses. The Leader-Follower Logistics Vehicle course duration is based on the author's anecdotal experience for incidental motor vehicle operator courses, which consist of five days of classroom instruction and five to ten days of practical application.

10. Joint Chiefs of Staff, *CJCSI 3170.01G: Joint Capabilities Integration and Development System,* (Washington, DC: March 2009). The full acronym stands for Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, and Facilities.

11. Headquarters Marine Corps, *MCWP 3-2: Aviation Operations,* (Washington, DC: May 2000).

12. Headquarters Marine Corps, *MARADMIN 127/17, Publication of FY 2017 through 2037 Tables of Organization and Equipment*," (Washington, DC: 2017), available at http://www.marines.mil. Currently, Transportation Battalion is designated as Transportation Support Battalion. However, it will be re-designated as Transportation Battalion under the approved FY19 Table of Organization.

13. Ibid. Landing Support Company will be reestablished under the approved FY19 Table of Organization.

14. The General Dynamics Multi-Utility Tactical Transport 8x8 Wheeled/Tracked vehicle is capable of a 1,200 pound payload.

15. W.S. Darley and Company, "*5S3P Water Purification System Specifications Sheet*," W.S. Darley and Company, (Itasca, IL: 2017), available at https://www.darley.com.

16. Training and Education Command, "*Course & Class Information*," Marine Corps Training Information Management System, (Quantico, VA: 2017), available at https://mctims.usmc.mil.

Optimized Energy Storage

Thirty-six percent reduction in FOB generator fuel use

by Capt David J. Chester, USMC; LtCol Torrey J. Wagner, USAF; & Douglas S. Dudis

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>>>Dr. Dudis is the Director of the AFRL Energy Office and provides guidance to professional societies and strategic energy forums at the USAF, DOD, interagency, and international levels. He has experience leading research in an active laboratory and has supervised and mentored numerous masters and doctorial students, faculty, and postdoctoral researchers.

The DOD energy policy is to increase energy security resiliency, and mitigate costs in the use and management of energy.[1] Forward operating bases (FOBs) are remote, austere base camps that support an operationally defined mission with a limited or no ability to draw from an energy grid and have historically relied on diesel-powered generators for the primary production of energy.[2] Generators are sized to meet a theoretical peak demand, but steady state loads are far below this peak, resulting in under-loaded generators.[3] Under-loaded diesel generators decrease efficiency and increase the need for maintenance, affecting the lifespan of the systems.[4 5]

This article analyzes the coupling of current power generation technology with energy storage. The addition of optimized energy storage to current diesel generators reduces fuel consumption by 36 percent and reduces energy system costs by 24 percent. Decreased fuel requirements at outlying FOBs equates to fewer resupply convoys, reducing operational fuel use, time spent outside the wire by service members and associated combat casualties.

Background

Military operations involve the projection of military power beyond the sovereign boundaries of the United States. Base camps are evolving military facilities that support deployed units executing military operations by providing the necessary services and support to sustain operations. The primary purpose of a base camp is mission support—providing survivability and protection to the deployed forces, managing resources and critical infrastructure, and maintaining facilities.

At a minimum, a forward base must be able to power and support a combat operations center (COC) that houses the radio equipment, laptops, and minimal lighting required to command and control battlefield operations and support the warfighting capability of the unit.[6] Additional energy can be used to power billeting and personnel support measures, including climate control and lighting. The average power demand for an Afghanistan COC is approximately 2.2 kW, with a 4.5 kW peak power demand and a daily energy requirement of 53 kWh.[7] The average power demand for climate control for the same platoon patrol base is 1 kW, peaking mid-day at 1.6 kW, with a daily energy requirement of 24 kWh.[8]

Figure 1 (see next page) displays the combined COC and climate control power demands that are combined to create the energy requirement used in this analysis. The daily energy requirement totals 77.5 kWh with 3.2 kW average power and 5.4 kW peak power.

Engineering an energy system to provide power to an austere forward base requires more than just selecting a generator that can meet power demands. It is essential to apply a life-cycle analysis on the generator and consider its total cost of ownership including logistics and disposal, requirements for use, and maintenance. The selected energy system for an austere forward base must meet the minimum COC power demands but must also be rugged and resilient, as forward deployed platoons and companies are often not staffed with generator mechanics. Fuel requirements are an equally important

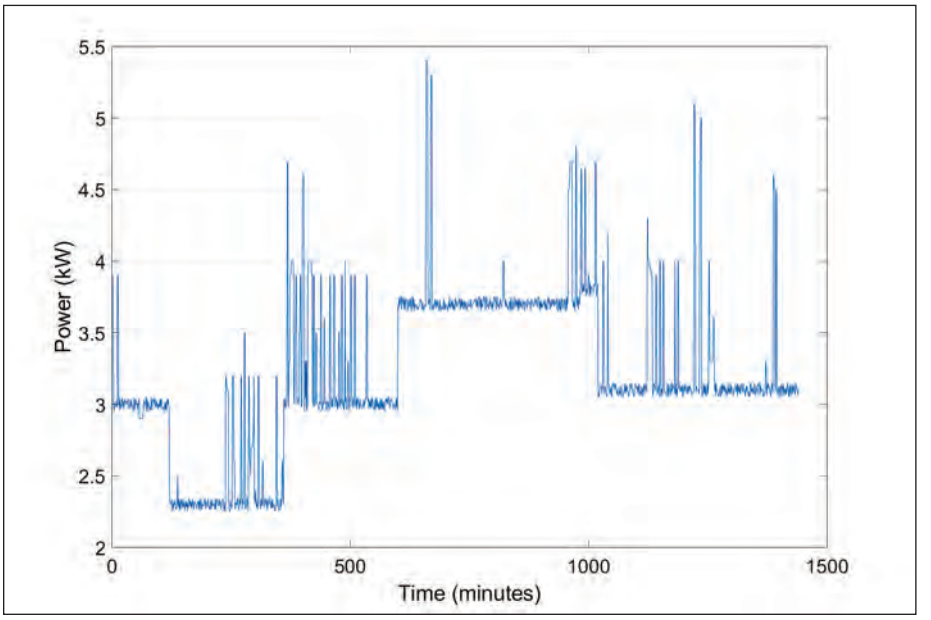

Figure 1. Combined platoon patrol base power demand.

	Generator	Battery	Inverter/charger
Component Cost	$1,120 / kW[9]	$490 / kWh[10]	$900[11]
Replacement	-	600 cycles[12 13]	-
Weight (lbs)	800[14]	300[15]	100[16]
Fuel Cost ($/gal)	10[17]	-	-
Peak efficiency	26 percent	-	-
Power Output (steady state / max)	5 kW / 5 kW[18]	5 kW / 7 kW[19]	6 kW / 6 kW[20]
Max Storage	-	13.5 kWh[21]	-

Table 1. Cost and performance model parameters.

consideration, as resupply to austere locations is considered a combat operation and requires significant commitment of personnel and resources.

Method

The energy system modeled consists of a generator and battery controlled by an inverter/charger. This configuration allows the generator to run at full load, where it is most efficient, and store the excess generated power in a battery. Once the battery is full, the excess energy is discharged from the battery, allowing the generator to shut down to conserve fuel and wear. When the battery has discharged to its minimum-allowable level, the generator turns back on, and the cycle repeats. Cost and performance values used in the system model for representative generator, battery, and inverter/charger components are shown in Table 1.

The generator efficiency curve is modeled from the manufacturer's specification, with an efficiency of 26 percent at 5 kW output and 10 percent at 1 kW output.[22] It was assumed that the cost of starting the generator was ten seconds of fuel use. The representative battery is advertised to fully discharge during each cycle with a lifespan of 10 years,[23] but literature shows lithium-ion batteries have an expected life between 300 and 600 discharge cycles at 100 percent depth of discharge.[24 25] The model accounts for eight percent round-trip battery energy loss and replacement of the battery if it exceeds the above-noted number of discharge cycles and increases the battery cost accordingly. The ten-dollars-per-gallon fuel cost is an average calculated from historical fuel usage from Camp Leatherneck to outlying FOBs.[26] The model used 37.9 kWh/gallon of energy available in diesel fuel, which was converted from 46 MJ/kg.[27]

Generator performance was modeled based on the daily load from the 45-Marine patrol base shown in Figure 1 and the model parameters shown in Table 1. The first simulation used the 26 percent maximum efficiency of the 5 kW advanced medium mobile power sources to calculate fuel consumption for a 24-hour period. With constant efficiency, the daily required diesel fuel to power the patrol base was 12.2 gallons, or $122. The second simulation added battery storage and the inverter/charger. The daily required diesel to power the COC was then reduced to only 7.9 gallons, or $79, a dramatic 36 percent reduction in fuel requirements because of intermittent generator use at peak efficiency.

Optimization

The total cost is defined as the cost of components and fuel over the period of the deployment, and we assumed a 180-day operation. The model tracked the parameter "minutes not met" (MNM) if the combined generator and battery could not meet the power demand for a specified minute. The analysis considered zero tolerance for any MNM. This section examines variations in battery size, generator size, and then the battery and generator optimally sized for the lowest cost.

As battery capacity increased, the price of the battery also increased, but fewer battery replacements were required to meet the 180-day deployment demand. This created a saw-tooth variation in battery cost, as shown in Figure 2 (see next page). The cost of diesel was relatively stable for all battery sizes. This makes intuitive sense, as the battery is directly charged from excess power from the generator, and that stored power is eventually used while the generator is off, which does not require additional fuel.

As generator size increased, there was a gradual increase in generator cost; however, the battery cost increased with larger generators. This is because the larger generators charged batteries quicker, allowing more frequent discharge cycles of the batteries, hastening their replacement. Similar to the batteries, smaller generators were unable to maintain the base load and charge the battery, eventually unable to meet demand.

Both battery capacity and generator size were varied and the resulting cost and MNM were calculated and are displayed in Figure 2. The saw-tooth variations in Figure 2 are because of the cost of battery replacements, and optimal configurations are shown in red.

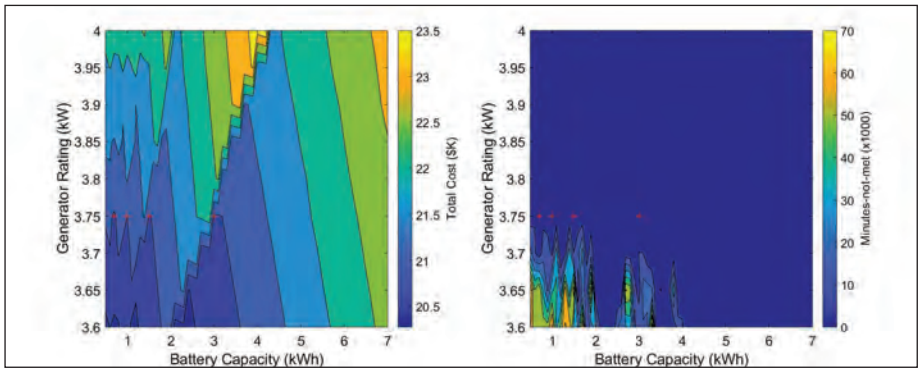

Figure 2. Total cost (left) and MNM (right) while varying generator size and battery capacity.

The optimal configuration is to meet the requirement with the smallest generator and the smallest battery that doesn't require replacement.

The left side of Figure 2 shows that the lowest cost (dark blue) is a 3.6 kW generator paired with either 0.7, 1.1 or 2.2 kWh battery capacities. However, this does not account for whether the generator can meet system demands—the right side of Figure 2 shows unacceptable levels of MNM in these configurations. The optimal configurations shown in red avoid regions with high MNM and use a 3.75 kW generator paired with either 0.7, 1, 1.5 or 3 kWh battery capacities. For those configurations, the battery needs to be replaced three, two, one and zero times, respectively.

The optimal configuration is to meet the requirement with the smallest generator and the smallest battery that does not require replacement. The 3.75 kW generator was the smallest possible generator still able to meet steady-state demand and contribute energy to the battery. The 3 kWh battery was large enough to handle any large spikes in demand to not require replacement across a 180-day deployment, and to power the FOB for an hour of generator-free operation, and it was small enough to limit costs. For this configuration, Figure 3 plots the COC power demand, the power output of the generator, and the charge of the battery for two days of operation.

Conclusion

This proof-of-concept showed that energy storage coupled with current power generation technology for a FOB can reduce fuel use by 36 percent while saving 24 percent of the energy system cost. The diesel fuel required to meet an actual Marine patrol base energy requirement for 180 days—relying solely on a 5 kW advanced medium mobile power sources and accounting for the inefficiency of under-loading a generator—is nearly 2,200 gallons, with a combined fuel and generator cost of $27,600. It saves 760 gallons of fuel and $6,600 to power the same FOB using a 3.75 kW generator, a 3 kWh battery, and a 6 kW inverter/charger. Decreased fuel requirements at outlying FOBs will also equate to fewer resupply convoys, reducing fuel use further, and reducing time spent outside the wire by service members.

Running generators at optimal efficiency has the additional benefit of reducing maintenance and replacement costs. As the cost of fuel continues to rise and technology improvements reduce battery costs, this cost difference will only continue to improve.

Notes

1. Department of Defense, *Department of Defense Instruction 4180.01, DOD Energy Policy*, (Washington, DC: 2017).

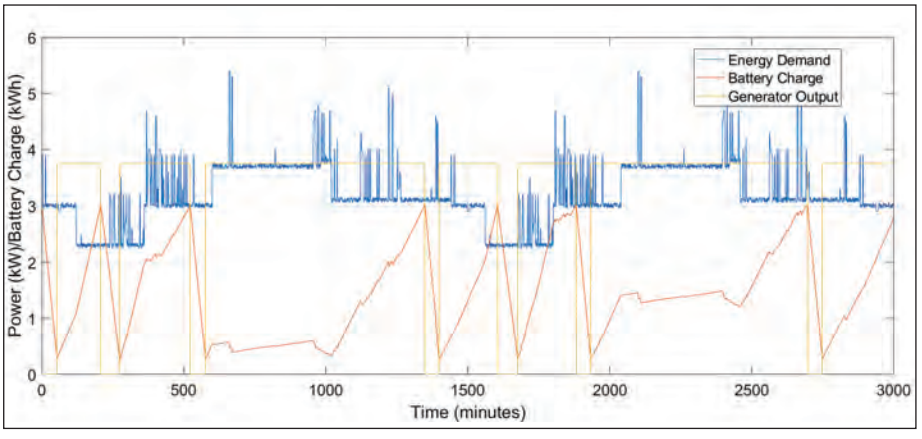

Figure 3. Power demand, 3.75 kW generator power production, and 3 kWh battery discharge at the cost-optimized configuration.

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3. B.H. Newell and E.B. Shields, *Expeditionary Energy Data Collection within Regional Command Southwest, Afghanistan*, (Washington, DC: USMC Expeditionary Energy Office, 2012).

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27. David J. Cookson, C. Paul Lloyd, and Brian E. Smith, "Investigation of the Chemical Basis of Diesel Fuel Properties," *Energy & Fuels*, (Mulgrave, Australia: 1988).

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Industry Innovation

A new fellowship program

by Maj Reginald Thomas & Capt Anthony L. Shearer

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>>Capt Shearer is 0402, Logistics Officer. He is currently a student at LOG C3 (formerly CLCCC) at Fort Lee, VA. During the fellowship he was a Logistics Officer at 1st Marine Raider Battalion.

The Deputy Commandant for Installations and Logistics (DC I&L) is aggressively leading the charge to resolve logistics challenges that the MAGTF currently faces whilst ensuring that the Marine Corps is postured for the challenges of tomorrow. A force multiplier in this effort is the vital partnerships formed with private industry. The *Marine Operating Concept* (MOC)[1], the 2018 National Defense Strategy, and the Marine Corps Gap Lists have identified the necessary imperatives of innovating and partnering with private industry to be prepared for the current and future fight. DC I&L turned this guidance into actionable results. HQMC, Installations and Logistics successfully partnered with private industry during the conduct and ongoing activities of the Innovation Challenges and the Hybrid Logistics Symposium. DC I&L identified five innovation thrust areas for the Marine Corps Logistics Enterprise (LogEnt) to provide a focus and unified effort in exploring potential training, education, and technology.

Among the many important innovation accomplishments the Service has seen, DC I&L and Military District 5 (MD5) collaborated to develop a pilot fellowship program designed to equip Marines with cutting-edge innovation and technology training and education. The MD5 National Security Technology Accelerator is a program office reporting through the Office of the Under Secretary of Defense (Research & Engineering). The mission of MD5 is to create new communities of innovators that solve national security problems. MD5 operates both from its Washington, DC headquarters and through a network of national research universities. MD5 delivers programming designed to bring innovation methods and practice knowledge to warfighters and to connect the Department to non-traditional problem-solvers in major research universities and the venture community. It is through MD5's defense innovation network and its programs that DC I&L is able to explore the key terrain of this innovation fellowship landscape. The vision and purpose of the DC I&L Industry Innovation Fellowship (I2F) is to ensure Marines are prepared to face the complex challenges regarding the Marine Corps Logistics Enterprise (LogEnt) by partnering with private industry and academic institutions through innovation-focused fellowships, training, and education. The partnership activities will enable Marines to observe, absorb, and participate in a culture of creative and innovative thinking that improves the LogEnt. The partnership experiences will influence a positive culture change in the Marine Corps and shape an adaptive mindset that Marine leaders need in order to pivot toward the future. Marines will be equipped with the skills necessary to identify and solve tomorrow's problems today.

The open New Lab environment facilitates organic conversations and free flow of information. *(Photo by New Lab.)*

New Lab uniquely supports entrepreneurs working in these core advanced technology disciplines. *(Photo by New Lab.)*

To maximize the innovation training and education experience of Marines, the Marine Corps sent their first I2F Marine Fellow to New Lab in Brooklyn, NY. Located in the Brooklyn Navy Yard, New Lab is an innovation-focused community that creates and fosters partnerships between public-private industries. With over 130 member companies in the innovation and tech-space (almost all under the same roof), it was the ideal place for DC I&L and MD5 to develop partnerships and pilot a Marine Fellowship.

The I2F initiative is informed by the innovation objectives and imperatives outlined in Secretary of Defense James N. Mattis' 2018 National Defense Strategy, Gen Robert B. Neller's MOC, and the logistics-related items of the Marine Corps Gap List. The I2F Program is the LogEnt's response to the direction and guidance of its leadership. In addition to tackling complex issues, I2F is designed to: create a positive culture change in the Marine Corps in order to identify and develop creative, innovative, and thought-provoking leaders; reward innovative thinkers and incentivize innovative thinking; and explore innovation and technology while ensuring we seek to achieve a balance between developing an enhanced mindset and developing a new product.

Similar to the Hybrid Logistics Symposium calling message, DC I&L's ideal I2F candidate is not your typical rank and file "Yes-Marine." The leadership specifically screened candidates for their willingness to challenge the traditional way of doing business and search for improvements. The desired candidate was a young, career-level Marine who is unafraid to question traditional methods and look at problems and solutions through an innovative, creative lens. After reviewing several candidates, DC I&L selected then-1stLt Anthony Shearer, an 0402 Logistics Officer from 1st Marine Raider Support Battalion, Camp Pendleton, CA. 1stLt Shearer details his I2F pilot experience below.

Fellowship Experience

What began as a random conversation at the 2017 Marine Corps Logistics Excellence Awards Dinner rapidly transitioned into a two-month fellowship at a civilian industry innovation hub. HQMC I&L and MD5 leaders recognized the opportunities of a fellowship at New Lab and swiftly acted to turn this promising idea into reality. With a unique billet overlap because of a shift in change of station orders, and backed by my Marine Special Operations Command leadership's support, I was available for temporary duty assignment. Just over a month after that initial discussion, I arrived at New Lab.

New Lab "curates" their environment with specific technology startups across a range of disciplines, including Internet of Things (IoT), artificial intelligence (AI), robotics, energy, augmented/virtual reality (AR/VR), and additive manufacturing (AM). Being a member at New Lab also enables companies to access a network of potential partners that includes Fortune 500 companies, government agencies, universities, and investors. At just under 20 people, the New Lab staff impressively manages all aspects of the 84,000-square foot space that hosts over 130 member companies, totaling more than 600 people, which provided abundant learning opportunities to a newcomer such as myself.

Upon arrival to New Lab, I began a series of introductory conversations with the staff members and select member companies. Each conversation exposed me to information about startup culture, cutting-edge technology, and unique insights from each person's varied background. Their words sparked countless ideas of how to use the products or processes we were discussing. After a short amount of time, I produced a sizable list of promising technologies, potential uses, and impacts to the LogEnt. I reviewed again the MOC and Marine Corps Gap List and refined my focus toward solutions to the stated goals and gaps.

One of the most valuable lessons I received from my time embedded at New Lab was the unfiltered exposure to the startup mentality and culture. For example, in New Lab's lean staff the "XO" sits right beside the "OpsO," near the "CommO." Ideas, information, questions, and answers are shared quickly and efficiently. The enhanced communication equates to rapid workflow and faster task completion. What about privacy? The ample open space created in lieu of personal offices makes available various spaces to conduct counseling sessions, interviews, and private calls. There are no ranks or visual designators of prestige within the company nor any signs of segregation between seniors and juniors, yet everyone knows their role and performs exceptionally well in their

assigned capacity, often volunteering to take on more responsibilities. Everyone is respected, no person is off limits, everyone is approachable and trusted not to abuse the system. This system works exceedingly well.

How Industry Fellowships Can Bridge Gaps

Based on my time at New Lab, I argue that industry fellowships will help bridge three gaps within the Marine Corps: industry experience, knowledge, and capabilities.

Experience. The highly efficient "machine" that enabled U.S. dominance in the past is no longer suited to tackle the majority of unpredictable problems of today and the future. The last few decades taught us that we must be more flexible, contrary to an efficiency model, which Gen Stanley McChrystal detailed in his book, *Team of Teams*.[2] Along with adopting the best practices from the past decades of combat, there are many other lessons in versatility we can learn from modern businesses regarding processes, procedures, how they interact, communicate, and collaborate. Industry startups must adapt to the current market or they will fail. They do not have the institutional stability that established corporations and government organizations enjoy when facing difficulties. We must learn from their experiences.

Knowledge. We do not know what we do not know. Fellowships can increase collective knowledge by infusing current industry insights to our culture in a way even the best books, podcasts, or lectures cannot. The lessons gained from exposure to startups, industry, and other commercial cultures is invaluable and equips fellows with novel information and approaches that can be used to address the problems and gaps in the MOC and gap list.

Capabilities. Three areas the Marine Corps will benefit from are automation, autonomation, and AI, which we are currently dabbling in and will need to increase over time. The question we should ask ourselves is, "Does a human need to do this process?" If a machine sufficiently performs a specific task we can reassign our limited human capital. Additionally, humans require substantial resources to simply exist, such as clean air and water, food, sanitation, clothing, salary. These resources are further strained in an austere or unsafe military environment, where safety equipment and processes, force preservation, and security requirements are of the utmost importance to survival and success. In comparison, machines are generally low maintenance, and if they fail a human is able to resume those duties during repair or replacement. An example of autonomous systems being tested for Marine Corps use is the autonomous aerial cargo-utility system which converts a UH-1H/Y helicopter or potentially other aircraft into an autonomous platform. The autonomous aerial cargo-utility system serves as an alternate means to provide time-sensitive logistics support to greatly disbursed locations while reducing requirements for air and ground crew to support the logistics operations. Although many more specific considerations need to be taken into account, especially when considering human versus machine assignments, exposure to such cutting edge technology and associated applications will help us evaluate where we go from here. For every minute a machine does work instead of a human, the human has the ability to accomplish higher cognitive tasks, including engaging in creativity, innovation, and improving physical, mental, and spiritual fitness.

... we recognize opportunities and seize them.

Industry Fellowships—Part of the Creative and Innovative Processes

Fellowships are perfect vehicles to fully immerse a Marine in industry, though the most obvious drawback is the lengthy time commitment. Based on my experience at New Lab, any industry interaction is valuable, regardless of the length or capacity. In addition to supporting fellowship opportunities, leaders should support and incentivize their people to attend trade shows, industry conventions, panel discussions, and similar venues, even when there is no readily applicable connection to unit requirements. To ensure the value gained from these sources is utilized, leaders must facilitate and support on-base events for occupational field and grade-specific gatherings and combine enlisted Marines and officers as much as possible. These events facilitate the exchange of ideas and information collected from external sources, consider this new knowledge in the context of high-priority internal topics, and capture collective input for decision-makers' usage. Send announcements via Twitter, Facebook, and LinkedIn? Post the event agenda and minutes for viewing on milSuite? It is 2018, and there are options more effective than email and automated message handling system messages to coordinate meaningful professional discussions that introduce ideas from outside the Corps on a frequent basis.

The Corps' Agile Advantage

The Marine Corps is perfectly suited to lead the creative and innovation charge because we are an agile organization of action; we recognize opportunities and seize them. We thrive while pushing our limits and discovering possibilities as a team. Our adversaries and challenges will continue to evolve, as will we, so long as we remain flexible, focused, and recognize when stagnation challenges these core tenets. After all, one of our fundamental traditions is adaptability. Adapt and overcome, Marines. We will do better, together.

Notes

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LCE as Rear Area Command

1st MLG embraces the RACOM mission

by Majs Katharine E. Carlson, Joshua S. Edwards,
Col James R. Hensien & BGen Stephen D. Sklenka

I MEF MAGTF Development Program FY 2018–2020 delineates in its CG's Warfighting Philosophy and Training Guidance section that, in fighting a single integrated battle, "the rear battle is fought by the MAGTF's LCE to sustain and protect the force." MEF Exercise (MEFEX) 2018, supported by the MAGTF Staff Training Program, presented the first opportunity for I MEF to exercise its LCE as the rear area command (RACOM). Upon completion of MEFEX 18 and during the facilitated after-action review, the I MEF CG reiterated his intent to retain 1st MLG as RACOM in future operations that necessitate rear area establishment. The 1st MLG fully embraces its RACOM mission and, informed by its experience during MEFEX, asserts that it is able to command rear area operations without diminishing tactical logistics support to I MEF during sustained operations ashore.

Marine Corps rear area tactics, techniques, and procedures are predominantly addressed in *MCTP 3-30C, Rear Area Operations*,[1] and *MCRP 3-30C.1, MAGTF Rear Area Security*. The term "rear area" is also included in the 2018 *Marine Corps Supplement to the DOD Dictionary of Military and Associated Terms* (*MCRP 1-10.2*) and is defined as "that area extending forward from a command's rear boundary to the rear of the area assigned to the command's subordinate units." *MCRP 1-10.2* further describes the rear area as "provided primarily for the performance of combat service support functions." The rear area construct applies to contiguous and noncontiguous MAGTF battlespace (see Figure 1).[2] Additionally, the rear area generally expands and contracts through the phases, stages, and parts of a given operation.

Rear area functions, as enumerated in *MCTP 3-30C*, include: security, communications, intelligence, sustainment, area management, movements, infrastructure development, host-nation support.

Successful rear area operations within and between these functions require effective command and control (C2).[3] To execute rear area C2, the Marine commander (Service component

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>>>>BGen Sklenka is the CG, 1st MLG.

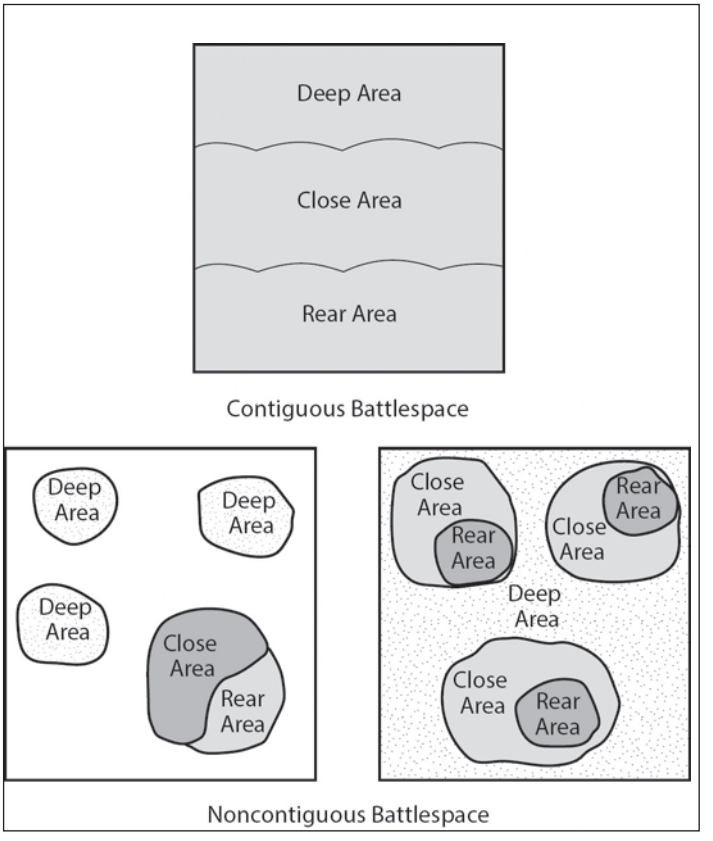

Figure 1. Notional contiguous and noncontiguous battlespace. *(Image from* **MCRP 3-30C.1***.)*

or MAGTF) has three options: retain C2 of that portion of the battlespace, designate a rear area coordinator, or designate a rear area commander. Like the rear area itself, the Marine commander may alter the rear area C2 structure as an operation progresses and rear area operational demands evolve.

The rear area coordinator or rear area commander typically establishes a C2 facility from which to coordinate or direct operations, including those which involve security forces, fire support agencies, support units, movement control agencies, and bases and base clusters. The C2 facility may be within, adjacent to, or stand apart from an existing higher C2 facility. *MCTP 3-30C* prescribes that rear area C2 facilities used by rear area commanders be referred to as "rear area command posts" while those used by rear area coordinators be called "rear area operations centers" (RAOC).[4]

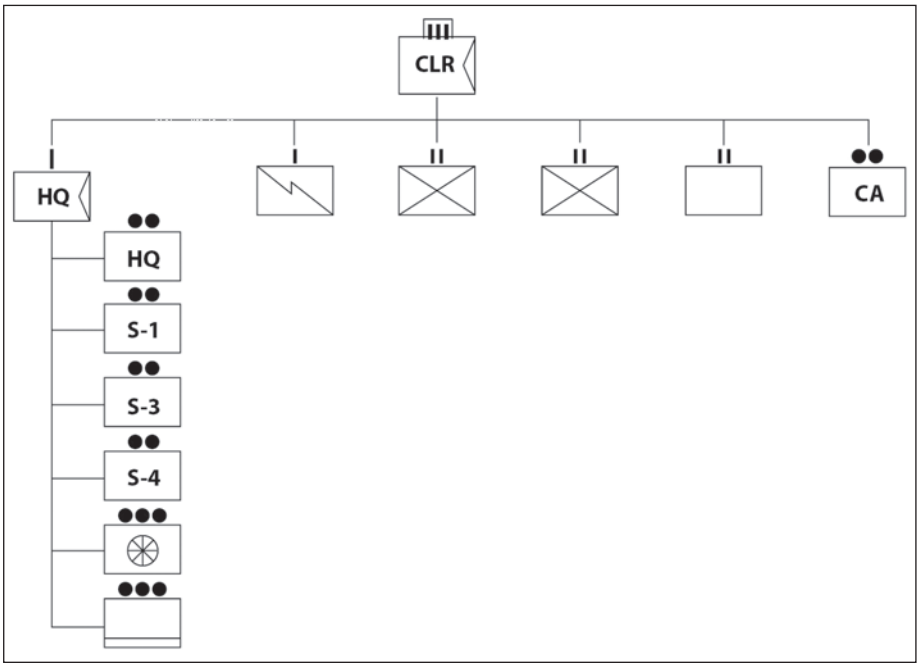

Figure 2. Headquarters regiment MEFEX 18 task organization. *(Image provided by author.)*

Early during MEFEX 18 planning, the I MEF CG, informed by output from MEFEX 16, designated 1st MLG as RACOM.[5] To accommodate this assignment, the 1st MLG CG assumed responsibilities for overall command of the I MEF rear area battlespace and assigned rear area functions to the CO of Headquarters Regiment, 1st MLG.[6] In this context, the 1st MLG CG was the rear area commander, and the Headquarters Regiment CO served as the rear area coordinator. Headquarters Regiment established ROAC collocated with the 1st MLG command post from which to manage the eight rear area functions.[7] Headquarters Regiment conducted movement control, developed dynamic targets, coordinated fire missions, managed intelligence collection, and coordinated aviation support from the RAOC during MEFEX 18. Prior to MEFEX, Headquarters Regiment rehearsed the various rear area functions during regimental command post exercises in conjunction with an MLG-level command post exercises.

Because of the broader MAGTF responsibilities associated with rear area operations, Headquarters Regiment's overall task organization was adjusted for the exercise and reinforced by 1st MLG headquarters in addition to units throughout the MAGTF to enable effective execution of functions that exceeded the regiment's normal structural capacity. Headquarters Regiment retained its S-shops and communications company[8] and was reinforced with key G-3 (operations) and G-2 (intelligence) staff members to add necessary staffing depth within the RAOC. Specifically, the 1st MLG G-3 reassigned its tactical readiness and training staff and its fire support cell entirely to the Headquarters Regiment's RAOC. Additionally, because Headquarters Regiment lacks any regimental-level S-2 structure, 1st MLG G-2 provided intelligence officer and specialist augmentation to conduct production and analysis, collection management, and targeting. From outside 1st MLG, Headquarters Regiment was reinforced with two infantry battalions, a law enforcement battalion, and a civil affairs detachment. 3d MAW also provided an air support control officer to support rear area operations. (Task organization is depicted in Figure 2.)

Importantly, the Headquarters Regiment's assignment to conduct rear area functions during MEFEX in no way degraded 1st MLG's tactical logistics support to I MEF. CLR-15 provided intermediate-level maintenance and supply support to I MEF, and CLR-1, with its task-organized combat logistics battalions, provided direct support tactical logistics support to 1st MarDiv in line with its habitual support relationships. 7th Engineer Support Battalion (7th ESB) provided general support engineering services whilst 1st Medical Battalion, with a dental company attached, maintained general support health services to I MEF and provided direct support surgical platoons to 1st MarDiv regiments.

Headquarters Regiment's capacity across rear area functions during MEFEX was sufficient to support the exercise's 12-hour inject schedule; however, the reinforced unit structure is insufficient for supporting extended duration 24-hour combat operations. A principal benefit of MEFEX 18 was the exercise's clear demonstration that, to provide adequate tactical logistics support to I MEF and serve as RACOM in major combat operations, 1st MLG requires additional augmentation of key capability sets, such as fire support coordination, aviation support coordination, and intelligence.

Rear area operations require the capability to coordinate lethal and nonlethal fires in support of deliberate and dynamic targeting within the rear area. 1st MLG has limited personnel

within its table of organization with MOSs that are trained to execute fire support coordination tasks. The 1st MLG G-3's temporary reassignment of its fire support cell to the RAOC during MEFEX created gaps in 1st MLG headquarters' ability to oversee fires planning; coordinate subordinate unit fire support requirements; coordinate fires with adjacent major subordinate commands (MSC); and contribute to I MEF's fires-related boards, bureaus, centers, cells, and working groups as an MSC. Additionally, 1st MLG collateral employment of group staff members against MSC-level fire support requirements left gaps in key staff areas. Once Future Force 2025 structure is staffed, 1st MLG headquarters will possess a supporting arms liaison team, which will begin to address this critical fire support shortfall. However, in the interim, 1st MLG requires augmentation with a capability comparable to a liaison section in support of a regimental fire support coordination center. This liaison section-like capability will conduct MSC-level fires planning at the group while MLG's organic fire support cell conducts 24-hour fire support coordination within the RAOC.[9]

The 1st MLG only has one forward air controller/air officer[10] to coordinate aviation support for the entire LCE, and that officer is amply employed at the MSC-level. The battlespace ownership associated with RACOM introduces a requirement for a RAOC-specific conduit into the aviation C2 architecture beyond the preexisting MSC-level requirement. Specifically, the RAOC requires an air support element to coordinate the employment of aviation assets within rear area battlespace.[11]

Assuming RAOC collocation with the 1st MLG CP, the dedicated rear area baseline intelligence manning requirement to conduct doctrinal intelligence operations center functions (operations, plans, production and analysis, collection, and targeting) is three officers and eight enlisted intelligence specialists/analysts. 1st MLG's limited intelligence capacity necessitates augmentation to satisfy the baseline rear area intelligence requirement.[12]

MEFEX 18 validated the requirement for rear area security force augmentation. While the attached two infantry battalions and law enforcement battalion were sufficient security forces to meet MEFEX 18's defined mission requirements, the mission scope of future rear area operations will drive security force requirements accordingly. Absent augmentation, 1st MLG will need to balance its mission requirements and shift capacity from tactical logistics support functions to source security forces internally.

Finally, 1st MLG anticipates a sustained requirement for a civil affairs capability to execute the host-nation support function of rear area operations. Should I MEF CG or the joint forces commander (JFC) establish a civil military operations center, 1st MLG will also need to coordinate with that entity.

Although the aforementioned augmentation requirements are discussed in the context of an MLG conducting a RACOM mission, these requirements apply to any other MAGTF LCE as well. Just as any unit assigned as RACOM requires appropriate task organization and augmentation, a MEB, MEU, or SPMAGTF LCE typically requires augmentation with fire and aviation support coordination, intelligence, security, and civil affairs capabilities. While the scale of augmentation depends on the size of the specific LCE involved, the overall capabilities requirements will remain unchanged.

A current of thought within the logistics community assert that MLGs and other LCEs should focus on their tactical logistics support mission and omit RACOM from their repertoire. The 1st MLG argues otherwise and considers the fundamental question regarding RACOM assignment: If not the LCE, then who? Arguably, another headquarters could perform rear area functions as effectively or potentially with less augmentation than the LCE; however, if the ACE's primary focus is operations in the deep area, and the GCE's primary focus is operations in the close area, what element of the MAGTF is most appropriately aligned to rear area operations? The LCE has the preponderance of the forces operating in the rear area, the majority of its principal sustainment nodes reside in the rear area, and many of its operations are conducted in the rear area. In other words, the LCE's primary operating area is the rear area. Thus, the LCE must embrace the requirement to manage and coordinate rear area operations as a battlespace owner.

Moreover, RACOM assignment does not necessarily degrade the tactical logistics support mission. Having an LCE commanding rear area operations does not inherently entail removing vehicle operators from behind the wheel or mechanics off the line; it does not necessitate converting service members with logistics-specific occupational specialties into security forces or using them in a provisional infantry or law enforcement capacity. The aforementioned augmentation requirements address this point.

In reality, RACOM complements and reinforces the LCE's ability to sustain the MAGTF. During MEFEX 18, 1st MLG experienced an enhanced ability to provide tailored tactical logistics support because of its RACOM role. RACOM requirements and the associated battlespace ownership compelled the 1st MLG staff to fully integrate into I MEF's battle rhythm, which yielded greater situational awareness across all 1st MLG staff functions. Such amplified integration also facilitated 1st MLG staff's ability to anticipate support requirements, which afforded I MEF and the other MSCs increased decision space. The 1st MLG's RACOM assignment during MEFEX 18 also resulted in the LCE experiencing noticeably enhanced support in the areas of targeting and intelligence collection, which in turn further improved 1st MLG's quality of support to I MEF.

Additionally, RACOM assignment directly enables the LCE's Marines and Sailors to fully integrate into all of the MAGTF's warfighting functions. It compels LCE units to extend themselves beyond traditional LCE responsibilities and forces them to be legitimate warfighting partners of the other MAGTF elements. To conduct rear area functions, the LCE's Marines and Sailors must be thoroughly proficient and conversant with vital tactical actions such

as fire support coordination, aviation support coordination, and security operations.

Another prominent counterargument that emerges when discussing the LCE as RACOM (or in discussing rear area generally) is the assertion that the rear area no longer exists. Some elements of this counterargument are experiential (e.g., operations in Iraq and Afghanistan) while others are doctrinal. Indeed, in joint doctrine, joint security operations supplanted rear area operations as codified through the revision and renaming of *Joint Publication 3-10* (*JP 3-10*), *Joint Security Operations in Theater*, in 2014 from its previous title *Joint Doctrine for Rear Area Operations*. The terms "rear area" and "rear area operations center" were also approved for deletion from the *DOD Dictionary of Military and Associated Terms* and are no longer recognized by the joint force. The term "joint security area" (JSA) in turn replaced rear area.

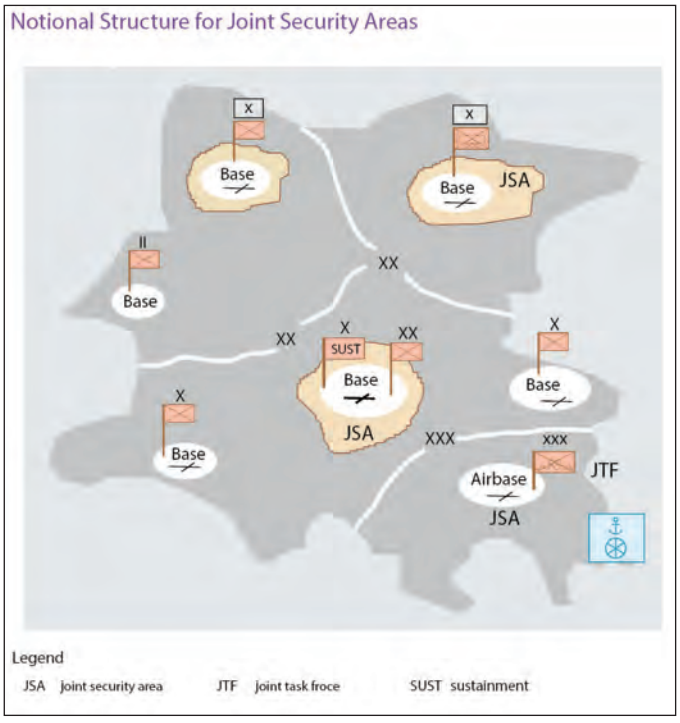

Figure 3. JSA notional structure. *(Image from* **JP 3-10***.)*

However, the doctrinal disparity between Marine Corps and joint doctrine is less substantive than it may appear upon first glance. Arguably, the terms rear area and JSA are considered analogous. The JSA is defined as a specific surface area designated by the JFC to facilitate protection of joint bases and their connecting [lines of communication that support joint operations.[13] This definition applies in linear and nonlinear operations similar to the rear area construct in contiguous and noncontiguous battlespace. Moreover, *JP 3-10*'s notional JSA depiction (see Figure 3) is remarkably similar to *MCTP 3-30C*'s rear area depiction in a noncontiguous battlespace. Additionally, while the JSA as described in *JP 3-10* is a more evolved and explicitly holistic concept than its rear area predecessor, the term JSA, with its joint denotation, will not apply to exclusively MAGTF battlespace. Thus, rear area remains a viable Service-specific supplemental term applicable to MAGTF battlespace,[14] and as such, it was retained in the 2018 *Marine Corps Supplement to the DOD Dictionary of Military and Associated Terms*.

Ultimately, MEFEX 18 served to justify the assignment of both the 1st MLG as the RACOM for I MEF and the LCE as RACOM within MAGTF battlespace. If appropriately task organized and augmented—as any other RACOM entity will require—the LCE is capable of commanding rear area operations without diminishing its tactical logistics support capacity. Additionally, in circumstances which dictate the establishment of a rear area within MAGTF battlespace, the LCE's mission and disposition are more appropriately aligned to rear area operations than that of any other MAGTF element.

Notes

1. Formerly *MCWP 3-41.1, Rear Area Operations*.

2. Headquarters Marine Corps, *MCTP 3-30C, Rear Area Operations*, (Washington, DC: May 2016).

3. Ibid.

4. Ibid.

5. Marine Corps Center for Lessons Learned, *I Marine Expeditionary Force Exercise-2016/Large Scale Exercise-2016*, (Quantico, VA: March 2017).

6. Headquarters Regiment, 1st MLG, was re-designated as CLR-17, effective October 2018.

7. Because of exercise particulars, the RAOC actually exercised six of the eight rear area functions during MEFEX 18; infrastructure development and host-nation support were not exercised.

8. Headquarters Regiment's food service and services companies were attached to CLR-15 to enable its general support tactical logistics mission.

9. Headquarters Marine Corps, *MCTP 3-10F, Fire Support Coordination in the Ground Combat Element*, (Washington, DC: May 2016).

10. 1st MLG headquarters table of organization denotes one captain 7502, forward air controller/air officer.

11. Headquarters Marine Corps, *MCRP 3-20F.5, Direct Air Support Center Handbook*, (Washington, DC: May 2016). See also *MCTP 3-10F*.

12. While the Future Force 2025 initiative increases 1st MLG's intelligence structure in some disciplines, it does not increase the number of MAGTF/ground intelligence officer (0202/0203) or intelligence specialist (0231) billets.

13. Joint Staff, *JP 3-10, Joint Security Operations in Theater*, (Washington, DC: November 2014).

14. Within a joint operational area, the Marine component commander could potentially be assigned as the joint security coordinator responsible for overall joint security operations within the JSA(s) in accordance with *JP 3-10*; however, that circumstance is beyond the scope of the LCE RACOM discussion.

Installation—neXt

Learning from the Trojans

by Col A. Ché Bolden

The city of Troy, as depicted in Homer's *Iliad*, is the archetype fortress— a stronghold buffered against the threat of man and nature, resilient in the face of all manner of assault, and capable of generating and sustaining the full combat power of the Trojan army. In Homer's epic, the Trojan War lasted for a decade because of the city's ability to counter repeated assaults while withstanding siege. Whether the Trojan War is legend or history, it is an illustrative tale of the value of a resilient citadel. Today, Marines give little thought to the operational resilience or lethality of our installations, or the role they play in power projection. However, the evolution of the operating environment gives rise to a reality grounded by the fact that the homeland is no longer a sanctuary, and we may need to fight from "home station." The relative security previously experienced by the "Supporting Establishment" is eroded by the long-range precision fires, omnipresent cyber-attacks, and the increased potential from the insider threat. Our Marine Corps is spending a significant amount of Service capital to build a next-generation MAGTF to fight and win our Nations battles during "away games." It is time we begin to design, build, and operate the complementary next-generation installation to dominate the "home game."

The Evolution of Troy

Marine Corps Order 5400.54, Marine Corps Installations Command Roles and Responsibilities, dated 19 April 2013, states:

> As the single authority for all Marine Corps installations matters, Marine Corps Installations Command (MCICOM)/Facilities and Services Division (LF) exercises command and control of regional installation commands, establishes policy, exercises oversight, and prioritizes resources in order to optimize installation support to the Operating Forces, tenant commands, Marines, and family members.

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Thus, Commander, Marine Corps Installations Command (COMMCICOM)/Assistant Deputy Commandant, Installations and Logistics (Facilities) (ADC, LF) has the ultimate responsibility to ensure our installations are resourced to execute their primary mission—to *generate and sustain combat power*.

Figure 1. MCICOM logo.
(Provided by the author.)

In November 2016, the Commandant signed the "Infrastructure Reset Strategy," which provided guidance to prioritize facility capital investment and "right size" our infrastructure footprint after years of deferred sustainment in favor of readiness for the Operating Forces. While well-conceived, this strategy—even if fully resourced and implemented—will only restore our installations to the original designs laid out by existing master plans. These master plans and guiding strategies were conceived and decided upon years and, in some cases, decades ago. To meet the needs of the next-generation MAGTF, our Service must embrace the idea of the next-generation installation.

In July 2017, COMMCICOM established the G-7 Modernization and Development Directorate to act as the total force integrator for the installations enterprise and realize the vision of the next-generation installation. The directorate is tasked to ensure the long-term viability for Marine Corps installations and training areas that support the warfighter by serving as the locus for capability acceleration and integration, strategic engagement and mission sustainment, and in-depth data analytics. Foundational to the task is the development and implementation of a complete operating concept that ensures our installations are integrated into Service, joint, and national concepts.

A New Operating Concept for Installations

Over the course of the last eighteen months, COMMCICOM led the development of "Installation—neXt (IX)," an operating concept for the next-generation installation. In alignment with Office of the Secretary of Defense guidance, the National Defense Strategy, and as the *Marine Operating Concept* (Washington, DC: HQMC, September 2016), the next-generation installation concept is driven by the threat and buoyed by the drive to modernize. Following three complementary lines of effort (technology, organizational ad-

aptation, and process) and across eight interdependent lines of operation (protection, resilience, operational reach, C2, mobility, maintenance, training and range support, and community), IX is driving Marine Corps installations into the future as resilient and lethal sources of combat power.

Protection

COMMCICOM's number one priority is to protect life and property aboard Marine Corps installations. To achieve this objective, we must equip installation commanders with the tools to obtain and maintain awareness of who has access to their base or station, monitor what happens aboard the installation, and respond across a wide spectrum of mission areas. Current master plans have not evolved much since the days of Troy, and installations continue to use natural and manmade obstacles to limit or constrain access to a few controlled points. Maintaining awareness across the physical boundary is resource intensive and cost prohibitive. As such, IX will utilize the emerging concept of the "digital fortress." This will leverage networked robotics and autonomous systems—enabled computer vision, machine learning, and a common user interface—to push awareness to the tactical edge, giving greater mobility to installation personnel.

Resilience

In order to generate and sustain combat power, Marine Corps installations must be able to take a punch, stay standing, and counterpunch. The risk of man-made hazards and threats from potential attack or catastrophe must be mitigated through resilient design. Recent events, like the 2017 EF-3 wedge tornado in Albany, GA, or Category 4 Hurricane Florence, have forced us to contemplate our situation and highlighted our resiliency deficit resulting from deferred maintenance and sustainment. Natural disasters exact a high price on facilities designed to antiquated or lower construction standards. We have established a fourteen-day supply threshold for future installations, as well as the ability to provide uninterrupted energy for that duration.

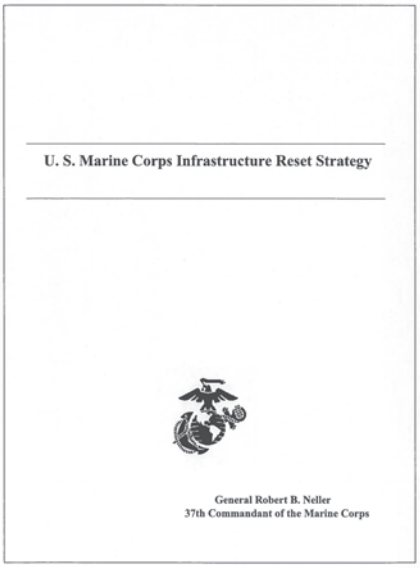

Figure 2. **U.S. Marine Corps Infrastructure Reset Strategy.**

Operational Reach

Emerging capabilities provided by the MEF information group; joint processing, exploitation, and dissemination cell; and medium altitude long endurance unmanned aerial system remote-split operations have enhanced the reach of operational forces and blurred the old distinction of the "rear area." These capabilities require a significant reboot of the power grid, information technology infrastructure, and manning policies.

C2

As we add new capabilities aboard our installations and better integrate operations, every installation commander will need to ensure unity of command through unity of effort. Similar to the concept of smart cities, the idea of "digital twining" our installations will give our commanders the ability to monitor and direct actions across the installation in a responsive and agile manner. To create effective digital twins, we must aggressively develop and implement a comprehensive data strategy. The pillars of data collection and storage, data management and processing, and data analytics, are foundational to informed decision making and decisive action. The application advanced user interfaces that integrate artificial intelligence, computer vision, and machine learning will give installation commanders and their staffs "minority report-" level situational awareness.

Mobility

On the surface, mobility transformation is easily achieved through the adoption of multi-modal conveyance systems, ride sharing technologies, and the steady integration of autonomous vehicles. These solutions will translate into greater efficiency and cost savings. Ultimately, the goal is to maximize individual autonomy by reducing our reliance on traditional work flow. Assured access, via multi-path authentication and geo-rectification, will allow us to streamline the movement of people and things around the installation. On-premise processing of information will enable further responsive decision making and reduce the time required to accomplish essential tasks. Mobility is about amplifying—to the maximum extent allowable—awareness to the entirety of the installation community.

In order to generate and sustain combat power, Marine Corps installations must be able to take a punch, stay standing, and counterpunch.

Maintenance

Historically, installation business is typically associated with facility asset management and sustainment. Installations are the Corps' second largest expenditure within the Marine Corps total obligation authority. The total plant replacement value across the installation enterprise is in excess of $80 billion. Maintaining a portfolio of that magnitude is challenging with the traditional maintenance practices and existing

workforce. Coupled with the growing complexity of facilities-related control systems and the different mission assurance processes, it is imperative that we find enhanced, more efficient methods. Again, digital twinning will allow installation commanders the ability to make informed decisions in a timely fashion. This will facilitate predictive analytics (sense and respond), and allow for targeted inspections and more routine and preventive maintenance. The adoption of advanced manufacturing techniques and Internet capabilities of everyday devices—paired with virtual and augmented reality tools— will effectively grow a limited workforce by giving amateur or apprentice level personnel, master-level capabilities.

Training and Range Support

The F-35 Lighting, CH-53K King Stallion, MQ-9B Reaper, high powered microwave weapons, and commercial off-the-shelf UAS are all new platforms and capabilities are either currently, or soon to be, active in the Operating Forces. Our training areas and ranges are not equipped to support and lack the connectivity, depth, and interactive feedback to keep pace with these emerging technologies. The next-generation installation must find new and alternative methods to train and hone the lethality of the Operating Forces. Limited user evaluations, such as the tactical decision kit, and developing concepts, such as an integrated mesh blue force network, give us a glimpse into innovative ways to support the warfighter through technology. Our installations are optimum tests for new and emerging capabilities and offer controlled and secure environments for testing and evaluation. Establishing proving grounds and test sites for emerging technologies will accelerate the validation and verification of rapid prototyped capabilities and concepts.

... our fight starts and finishes at home.

Community

Marine Corps communities are isolated and underserved, often lacking equivalent resources and access to services "outside the fence line." A bifurcation of policy (profit driven) and execution (customer driven) has led to a lag in response and costly delivery of services. The quality and value of services provided by local and private organizations are attractive targets for partnership and shared services. Going forward, our installations will seek to fully integrate with the surrounding public to better strengthen Marine Corps communities. Public-public, public-private, and intergovernmental support agreements are some of the available tools to be implemented.

Way Forward

The analogy of ancient Troy as a resilient and lethal fortification only tells half the tale. Just like the Trojans, our fight starts and finishes at home. But remember—Troy fell. The Trojans failed to adjust to the evolution of their environment and became vulnerable in the simplest of ways. Gone are the days where forts, camps, and outposts were merely logistics resupply points, administrative garrisons for mobilizing forces, or listening posts on the frontier. Modern installations perform a variety of complex tasks in direct support of military operations. The basics of installation management are not cheap. Funding for sustainment must be consistent, but the task of modernization must be prioritized as well.

Where we previously enjoyed the shelter of the homeland, the evolving operating environment has eroded that sanctuary. Whether it be destructive acts of nature, the increasing threat from our near-peer adversaries, or the growing potential from asymmetric threats and the insider threat, our bases and stations are at greater risk of disruption or intrusion. This reality has increased our sense of urgency to harden our installations and infrastructure. Installation—neXt is looking to new and emerging technologies, organizational adaptations, and processes to create resilient installations to enable the next generation MAGTF. (See Figure 3.) With the development and completion of the IX operating concept, MCICOM will have a blueprint for the next generation installation and a roadmap to fulfill the singular goal of any Marine Corps installation—to *generate and sustain combat power.*

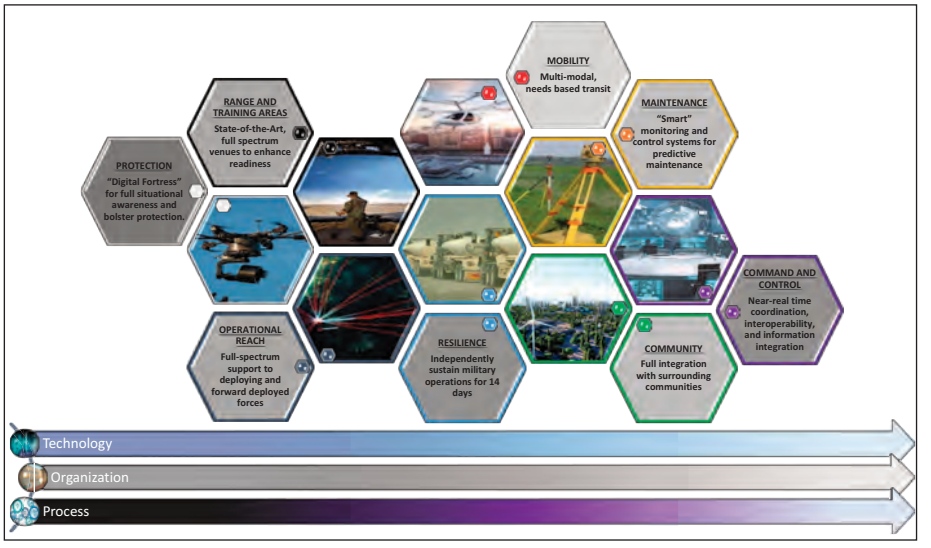

Figure 3. *(Image provided by author.)*

Supporting our Warfighters

Marine Corps Installation Command's efforts to reduce encroachment

by Erica Rohr

Marine Corps installations and ranges are key national defense assets that offer a unique combination of ocean, coastal, riverine, inland, and airspace training areas. Corps installations and units have continuously faced pressures on the resources needed to conduct the training, testing, and operations necessary to sustain mission readiness. These include challenges linked to incompatible uses on the land, seaspace, and airspace required to sustain mission readiness and protect natural resources and habitats. Encroachment may cause restricted, unrealistic, or inadequate training that fails to prepare our Marines and Sailors for their missions. Severe encroachment may result in the relocation of missions and the loss of training and operating capabilities.

LCpl Kirstyn Peterson, a transmissions system operator with Combat Logistics Company 36 (CLC-36), provides security with an M4 carbine during a Marine Corps Battle Skills Test at MCAS Iwakuni, Japan. CLC-36 conducted the training in order to maintain proficiency in skills that Marines learn during recruit and Marine Combat Training. The test included refresher training on immediate action drills, land navigation, and crew-served weapons. ***(Photo by Cpl Andrew Jones.)***

The Marine Corps' Approach to Mission Sustainment

Marine Corps Installations Command's (MCICOM's) Mission Sustainment Program was established to support the long-term sustainment and functional integration of robust training environments and deployment platforms for the Operating Forces. The Mission Sustainment Program promotes compatible land uses to prevent the loss of training days and workarounds that reduce training realism and effectiveness. Continuous communications and strategic partnerships with our communities is essential to forestalling further encroachment on our installations, especially those training resources located off-base and offshore. Engagement with external and internal stakeholders helps the Marine Corps identify solutions that sustain mission requirements, maintain quality of life for Marines and their families, and fulfill our communities' objectives.

Encroachment has significant and lasting effects on mission sustainment. Previously isolated bases and stations now experience development right up to the limits of their boundaries. Low-level flight routes are becoming congested with wind towers, transmission lines, and other infrastructure. Urban growth near Marine Corps installations continues to rise, which amplifies public interest and concern regarding base activities. The first to address these inquiries are the base and station commanders with their community plans and liaison officers (CPLOs). Commanders and CPLOs spend a significant amount of time engaging with their local communities. They are the de facto face of the Marine Corps to those who come in contact with the installations. Their presence and constant public engagement are essential to maintaining and expanding training areas vital for op-

>Ms. Rohr is the Mission Sustainment Officer (G-7), Marine Corps Installations Command.

The Marine Corps purchased a restricted use of easement to buffer the Townsend Bombing Range. *(Photo by LCpl Christian Moreno.)*

erational readiness as well as being the good neighbor that every community desires.

Mission Sustainment Program Activities

To support commanders and CPLOs, the Mission Sustainment Program undertook a programmatic assessment of the encroachment threats to Marine Corps ranges and installations through the execution of encroachment control plans. These documents provide an overview of the demographic context of the installations and MCICOM regions and the pressures and constraints they face as aligned against the recognized encroachment factors. The plans also provide recommended management actions, including encroachment partnership opportunities, information about energy-development siting, and communications and outreach strategies for the commander and CPLO to execute.

Encroachment Partnerships. A key tool for combating encroachment is encroachment partnering, also known as the DOD's Readiness and Environmental Protection Integration (REPI) Program. Through cost-sharing partnerships, the Marine Corps works with state and local governments along with private conservation organizations to obtain easements or other interests in land from willing sellers who preserve critical areas near our installations. Encroachment partnering enhances military readiness by helping installations to reduce, avoid, and mitigate restrictions on training and operations by promoting compatible development and protecting important natural habitats and species. To date, the Marine Corps' encroachment partnering projects have protected over 91,000 acres of land at 9 installations.

Recently, the Marine Corps completed a decade-long effort with the Georgia Department of Natural Resources and the Nature Conservancy to preserve almost 55,000 acres of land along the Altamaha River corridor in Georgia. This area protects the ingress and egress necessary to conduct training at the recently expanded Townsend Bombing Range with minimal impact to the community and helps conserve the gopher tortoise habitat, a candidate species for listing under the Endangered Species Act. Marine Corps Base (MCB) Camp Pendleton, CA, is also working with local land trusts to protect critical wildlife habitats and ensure the long-term viability of installation wildlife populations. In partnership with the Trust for Public Land, MCB Camp Pendleton conserved 35.5 acres of a much-needed coastal sage scrub habitat for the federally threatened coastal California gnatcatcher habitat that is adjoined to the base's southwestern border in Oceanside. This is the Marine Corps' first project supporting a federally listed species, and it will facilitate the direct removal of training restrictions for a habitat located on base.

Much of the land use within the Marine Corps' North Carolina operational footprint is comprised of working farmlands and forests. To preserve such compatible uses, the Marine Corps developed a partnership with the state to access the North Carolina Agricultural Development and Farmland Preservation (ADFP) Program for encroachment partnering projects. The ADFP Program will enable installations in North Carolina to leverage the ADFP Program trust fund and U.S. Department of Agriculture grants as matching funds toward the purchase of agricultural conservation easements. Marine Corps Installations East is also using ADFP Program to establish 25-year minimum term easements on privately owned working lands, another first for the DOD. New uses of the encroachment partnering authority provide the Mission Sustainment Program with increasingly flexible tools to react to and support the evolving *Marine Corps Operating Concept*, (Washington, DC: HQMC, September 2016).

Compatible Energy Development. In response to the growing prevalence of renewable energy near installations, ranges, and airspace, the DOD established the DOD Siting Clearinghouse to work with industry to overcome risks to national security while promoting compatible domestic energy development. The Mission Sustainment Program coordinates through the Siting Clearinghouse's mission compatibility evaluation process to conduct timely, transparent, and science-based analyses of the potential impact to military operations and to identify mitigation strategies. A vital aspect of the evaluations is receiving input from the tenant commands and Operating Forces on the potential impacts of the proposed projects on the Marine Corps' current and future training and operations, which MCICOM facilitates and coordinates. The Mission

Sustainment Program is continuously engaging with Federal agencies, developers, landowners, and state, Indian tribal, or local governments to educate them on Marine Corps requirements and to find solutions to encroachment concerns identified through the MCE process.

In response to the Bureau of Ocean Energy Management's (BOEM's) National Outer Continental Shelf Oil and Gas Leasing Draft Proposed Program for 2019–2024, MCICOM is diligently working with the DOD Siting Clearinghouse to assess potential impacts to operations and chart a path forward for future planning and engagement efforts. The Marine Corps' mission compatibility assessments inform BOEM of factors to consider in the early stages of its planning for possible future offshore energy development. For example, representatives from Marine Corps Installations West coordinated with Navy and Air Force stakeholders in the southwest region to engage with BOEM, the state of California, and multiple energy developers to find a potentially compatible site for an offshore wind farm outside a DOD test or training range, warning area, or operating area. Similar efforts in the past led to BOEM withdrawing interest in a wind energy development area within a key Marine Corps offshore live fire training area north of Oahu, HI. While the Marine Corps remains a committed partner in supporting compatible domestic energy development, the Mission Sustainment Program strives to first and foremost support the warfighter's ability to safely train and operate.

*Community Outreach and Engagement.*Two-way communication between the Marine Corps installation commanders and their CPLOs and our communities is critical to building enduring relationships and successful compatible land-use planning. In a 2014 *Gazette* article, MajGen Juan G. Ayala, USMC(Ret), emphasized that the role of being good neighbors cannot be overstated; however, a commander's and CPLO's most important task is to remain diligent in ensuring that installation training areas are not encroached upon and that surrounding communities understand and support the Marines and their mission.[1] Commanders and their CPLOs are on-the-ground advocates against encroachment and the Marine Corps' primary interface with the public—from addressing noise complaints to assuring government leaders and environmental advocates that Marines are some of the best stewards of natural and cultural resources in the world. They educate civic and business leaders of the bases' economic impact on the communities, and advocate on the behalf of Marines and their families on issues such as education and housing. Commanders and CPLOs often serve as thought leaders by speaking at events such as school-board meetings, state commander councils, and other community forums. As the face of the Marine Corps, their access, influence, and status in their communities strengthen alliances, inform influential elected representatives, and showcase the Marine Corps story.

Areas must be protected, but the surrounding community must also support the Marine Corps' training mission. *(Photo by PFC Aaron Harshaw.)*

... Marines are some of the best stewards of natural and cultural resources ...

Way Forward

Our ability to minimize encroachment is based largely on the trust and partnerships we establish with our diverse stakeholders at all levels of influence. The Marine Corps Mission Sustainment Program will continue to support our installation commanders in proactively partnering and engaging with our internal and external communities to preclude mission degradation from encroachment and enabling our installations to serve as key force projection platforms.

Note

1. MajGen Juan G. Ayala, "MCICOM: Providing Sustainable Force Projection Platforms to the Warfighter," *Marine Corps Gazette*, (Quantico, VA: October 2014).

The Mission Criticality of Energy Resilience

Enhancing survivability and recovery for installations

by Randy J. Monohan

Secure and resilient supplies of energy are critical to an installation's mission, yet many Marines take energy security for granted. Our installations are vital to the defense of our Nation but are also vulnerable to various threats and resource limitations that put our energy security at risk. Extreme weather events, accidental and deliberate disruptions, reliance on a fragile and complex commercial grid, and deliberate cyberattacks can cause missions or essential services to be interrupted with little to no warning. As the 2018 National Defense Strategy makes clear, the homeland is no longer a sanctuary. In response to these threats and the growing need to increase Marine Corps energy resilience, Marine Corps Installations Command recently set a goal of energy independent operations for priority base services and mission-critical operations. By establishing a fourteen-day supply of energy for critical functions and securing energy-related control systems, installations will be able to support the Marine Corps mission of generating combat power through any foreseeable disruption to energy supply.

The Marine Corps recognizes that innovation is the road to resilience and is focusing on energy resiliency projects and technologies to help installations harden energy distribution systems, survive in the event of a prolonged loss of electrical service, and to enhance recovery from disruptions. By recognizing and investing in innovative energy security projects and new technologies capable of responding to disruptions in the energy supply chain, the Marine Corps will improve its ability to sustain critical missions, better equip Marines for forward operations, and heighten overall readiness of our operational forces.

>Mr. Monohan is the Energy Projects Officer (GF-1), Marine Corps Installations Command.

Resilience is an Attitude

The concept of resilience is intrinsic to the Marine Corps. Marines are trained to be resilient and self-sufficient in diverse combat situations, responding swiftly to risks and adapting to various environments. The readiness and resilience of Marines sets them apart and allows them to complete the mission despite any adversities. It is necessary to bring this same culture of readiness and resilience to installation energy operations.

The Marine Corps is instilling energy security awareness in its Marines, civilians, and organizations, with a focus on personal energy behavior. The Marine Corps' energy ethos is the shared vision that the efficient use of energy resources

APS reviews the controls in the MCAS Yuma microgrid which eliminates energy interuptions to allow Marines to focus on their aviation mission. *(Photo by author.)*

is a critical component of mission readiness. A successful Marine Corps energy ethos will ensure a secure and resilient supply of energy and water to support the operating forces, their mission, and their families. Energy ethos is the foundation for installation energy culture, emphasizing the value of our energy supplies and the connection between energy performance, warfighting capability, and battlefield survivability.

While the energy ethos focuses on reducing the demand for energy, it is part of the larger program to achieve energy security. The installation and facility systems that provide and use energy resources need to be reliable, resilient and efficient in order to provide the mission support that the Marine Corps requires. Accomplishing this feat goes beyond merely investing in reliable power sources. Achieving resilience includes assessing and prioritizing the energy security needs of installation operations, developing contingency plans, and training essential personnel to ensure operations continue through disruptions. Now more than ever, stakeholders from across the installation including public works departments, mission assurance teams, facility managers, tenant commands, information assurance, and cybersecurity managers need to work together. Finding the optimal energy security solutions to ensure mission success requires careful collaboration and leadership engagement at every level. Several installations are already implementing these concepts. Now, all commands need to recognize the importance of resilience to Marine Corps readiness and work together to create greater energy security on our installations.

Marine Corps Installations Seeing Benefits of Resilience Projects

The commercial electric grid, which the Marine Corps does not operate or control, typically supplies installation energy. Using commercial grids as the primary—and sometimes, only—energy supplier for Marine Corps installations comes with several risks, including unanticipated power outages, inclement weather, operational errors or accidents, and potential physical or cyberattacks. Sometimes, the solutions and risk mitigations are simple. For example, the Marine Corps recently conducted an energy resilience exercise at an administrative building. The exercise found that a portion of mission-critical computer equipment was connected to outlets that were not powered by the emergency generator. During a power outage, the generator kicked in; however, the equipment that the unit needed to continue operations still did not have power. Many lessons were learned and the unit relocated the equipment to an outlet that is served by the backup generator. This easy, low-tech exercise increased resilience and illustrates the importance of Marines coming together to prepare for any situation.

The new cogeneration (CHP) plant at MCRD Parris Island under construction in July 2018. ***(Photo by author.)***

Energy supply and distribution often create a single point of failure.

In other situations, solutions are more complicated. Energy supply and distribution often create a single point of failure (SPOF) in terms of continuity of mission. To address a SPOF, Marine Corps bases are beginning to use a mix of micro-grids, renewable energy, and backup generators to combat the threat of a prolonged grid outage. In a few locations, the bases are already seeing the benefits.

Marine Corps Air Station (MCAS) Yuma. At MCAS Yuma, home to the F-35B Joint Strike Fighter, a 25-megawatt (MW) backup power plant connected to a micro-grid went online in February 2017. During times of high operational tempo training and preparing F-35B pilots and crews for deployment, losing power to the airfield is not an acceptable outcome. Without reliable and resilient power, computer equipment cannot function, which could cause support system malfunctions or grounded aircraft. The new power plant produces enough electricity to power the entire base in the event of a commercial grid outage. MajGen John J. Broadmeadow, former Commander of Marine Corps Installations Command, said at the groundbreaking:

> This project will make MCAS Yuma 100% resilient to external grid failures, and is an example of an effort that will ensure our bases remain at the forefront of the defense of the country.

Arizona Public Service (APS) constructed the micro-grid through an enhanced use lease where the utility constructed, owns, and manages the micro-grid that was built within MCAS Yuma's fence line. The micro-grid is connected to the utility's substation and can protect both MCAS Yuma and

other local APS customers on the Yuma grid. Since going live, the micro-grid has started up nearly 60 times, preventing and mitigating impacts that could have degraded both the mission and the surrounding community. "The system constantly monitors the power grid in real time and can see fluctuations in frequency," explained David Morton of APS, "When it notices something that could cause harm to the base, it automatically starts 25 MW of power from a dead stop, to a full load powering into the grid, in just 15 seconds." MCAS Yuma will remain mission ready because of this newly patented technology that provides all systems on base uninterrupted power in times of energy disruption.

While MCAS Yuma's micro-grid arose out of a need to support mission readiness, it has also provided other substantial benefits. The structure of the enhanced use lease means that the DOD did not need to fund the project and was able to lease the underutilized land to the utility where the micro-grid is installed. APS continues to maintain the land, saving DOD maintenance dollars and personnel that will instead be devoted to mission critical work.

Marine Corps Recruit Depot (MCRD) Parris Island. MCRD Parris Island has plans to install a variety of new energy security systems to help reduce the installation's dependence on the commercial grid and diversify its energy sources, increasing the base's energy reliability and resilience. MCRD Parris Island entered into a $91.1 million, 22 1/2-year term energy savings performance contract with an energy service company that bundles long-term payback resilience measures with shorter-term payback standard efficiency upgrades (e.g., LED lighting and HVAC upgrades). This project is scheduled for completion in spring of 2019 and will include the installation of a 3.5 MW cogeneration plant, 3.5 MW of backup steam generators, and 5.6 MW of solar energy. The new on-site solar generation assets are installed in two locations at MCRD Parris Island: a solar carport on a large parking lot used for boot camp graduation and an array on an old airstrip. The energy produced by these new resources will be stored in an 8-megawatt hour battery connected to the installation's micro-grid control system. This state-of-the-art control system will monitor use, optimize energy performance as well as provide "islanding" capability, which means powering the micro-grid in stand-alone mode in the event of a prolonged commercial grid outage. The combination of these distributed energy resources and secure control systems will enable the Parris Island training mission to continue critical operations through future disruptions.

Marine Corps Air Station (MCAS) Miramar. As part of its mission to provide combat ready expeditionary aviation forces, MCAS Miramar has become a leader in energy security innovation. In June 2016, the installation established islanding capability for its public works building using a 250-kilowatt (kW) flow battery, a rechargeable battery that stores energy in two tanks of liquid that flow past each other to generate electricity. The flow battery stores power from a 230kW solar-powered micro-grid system. This micro-grid system uses 100 percent solar power and advanced energy storage technology to provide complete independence from the grid while supplying enough power to cover all of the energy the building consumes.

This building-level micro-grid is just the beginning. MCAS Miramar is currently constructing an installation-wide micro-grid, which will supply on-site resilient power to over 100 mission-critical and essential facilities. This project will leverage the existing landfill gas power plant and on-site solar generation combined with new diesel and natural gas generators. All of these distributed resources will be controlled and managed at two separate locations to provide the energy security needed for mission assurance and this important installation.

Creating resilience for energy security requires many stakeholders working together across the installation.

The Future of Resilience

Creating resilience for energy security requires many stakeholders working together across the installation. Mission owners, facilities, energy, utility, and control systems communities must collaborate to identify critical, priority, and essential requirements to achieve mission assurance. Collaborating and sharing information will enable the development of effective technical solutions for each of our unique installations. Completed projects show that the Marine Corps can—and should—be prepared to provide uninterrupted power in support of the mission. An energy-resilient Marine Corps is a stronger Marine Corps, capable of training, power projection, operational support, and sustainment of forward deployed forces.

In the future, the Marine Corps plans to support and protect all critical installation missions from energy supply disruptions by providing energy security and the technology to be self-sufficient. Just as Marines are resilient in the face of threats in the field, our bases must also be resilient to recover from energy security risks at home. The Marine Corps is proud to be at the forefront of energy resilience innovation within the DOD.

Expeditionary Warfare School Contemporary Issues: First Place

Improving Aircraft Readiness

Adequate staffing makes mission

by Capt James L. Welch

The 31st Commandant of the Marine Corps, Gen Charles C. Krulak, once said:

> I believe in my heart and soul that the 'A' in the MAGTF is critical. If we took the 'A' out of MAGTF, you don't have a Marine Air-Ground Task Force. You don't have a Marine Corps.[1]

Marine aviation has been in a steady decline during the last decade. Critical manning shortages, an aging fleet of aircraft, enlisted retention issues, and pilot retention issues are only a few of the many factors contributing to falling aircraft readiness figures.[2] Organic tactical aircraft (TACAIR) is what separates the Marine Corps from the Army. Each MAGTF has TACAIR that are employed in support of the ground scheme of maneuver. Aviation logistics (AVLOG) generates aircraft readiness through maintenance and supply structure. Without AVLOG, there is no TACAIR. The Marine Corps must do everything within its power to improve aircraft readiness. Pilots should not staff the squadron aircraft maintenance officer billet; professional aircraft maintenance officers should serve in that billet.

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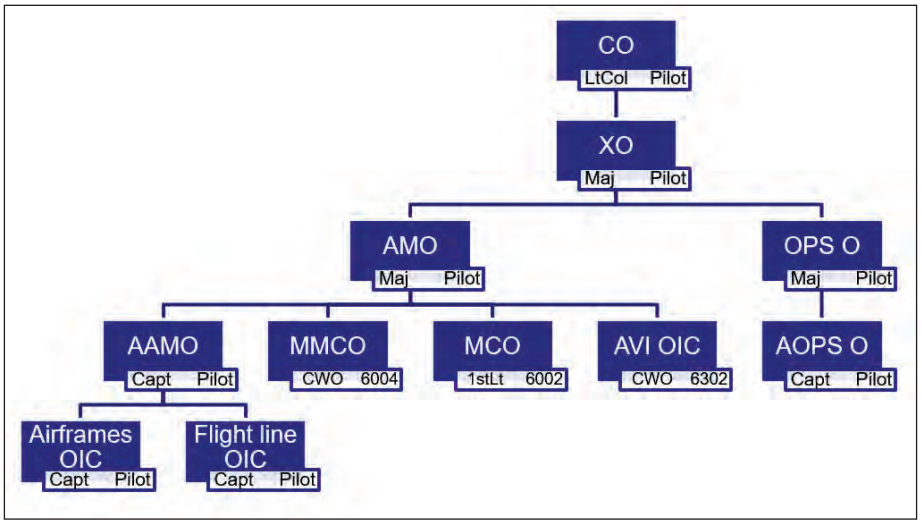

Figure 1.

In United States Marine Corps flying squadrons, there are several key billets that are called department head billets. The most senior officer grade billet is the executive officer (XO, major), the commanding officer's second-in-command who assists in the administration of the squadron. The operations officer billet (major) is responsible for the planning and conduct of current and future operations. The aircraft maintenance officer (AMO, major) is responsible for the material readiness of the squadron and providing healthy aircraft to source training and operational requirements as detailed by the operations officer. Active pilots hold all three of these billets and are also required to train other pilots whilst keeping their flying qualifications current. The officer with a MOS of 6002, Aircraft Maintenance Officer, is a lieutenant or captain who works for the AMO as either his assistant aircraft maintenance officer (AAMO), material control officer (MCO) or, in rare instances, the material maintenance control officer (MMCO)—usually a chief warrant officer. The preponderance of the daily operations of the squadron is conducted by the 6002 and 6004. Many times the pilot AMO is not there because he is flying. The Marine Corps should implement a 6002 major AMO at the squadron level who will focus on the management of critical resources and improve readiness.

The primary metric for measuring readiness is not mission capable (NMC), mission capable (MC) and full mission capable (FMC). MC is the "material condition of an aircraft that can perform at least one and po-

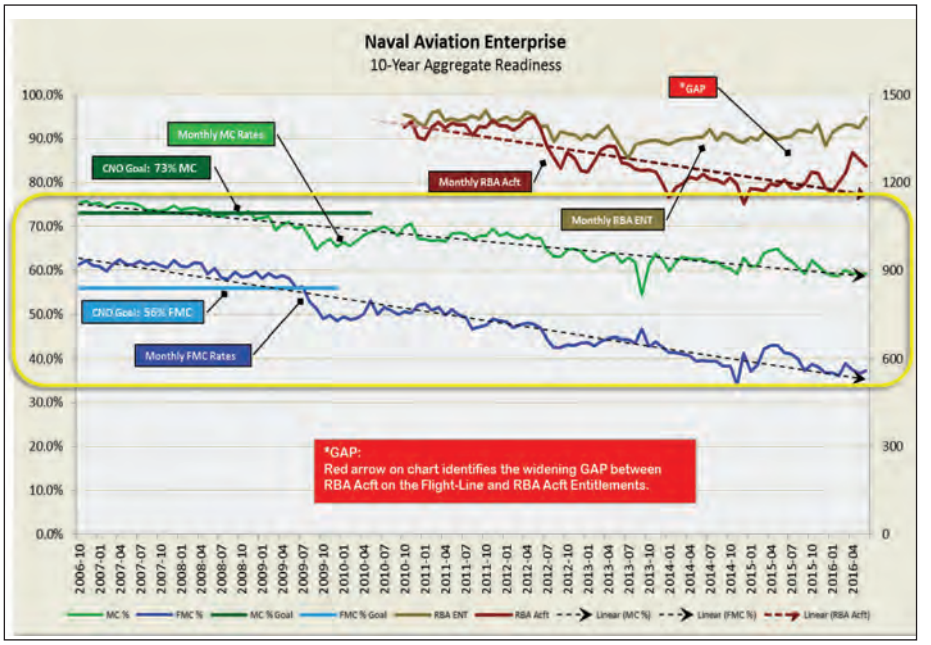

Figure 2.

tentially all of its missions."[3] FMC is the "material condition of an aircraft that can perform all of its missions."[4] The Chief of Naval Operations (CNO) has set a goal of 73 percent MC and 56 percent FMC.[5] While the Marine Corps was initially meeting the MC and FMC goals in 2006, they fell below the MC goal by October 2008 and FMC goals by July 2009.[6] As of January 2018, the Marine Corps had yet to recover. By the start of summer 2016, MC/FMC rates had fallen to 60 and 37 percent, respectively. Key personnel shortfalls in engineering manpower, enlisted maintenance experience, maintenance training, and readiness programs with a limited scope reflect the human factor contributions of the decline.[7] While the material, manpower, and expertise cannot support the current type/model/series the Marine Corps has, the first fifth generation aircraft the Marine Corps fields is vastly more technically challenging. It will compete with not only other Services for parts and labor, but it is also being sold to thirteen other countries.[8] The Marine Corps needs to leverage a focused and experienced officer to serve as the squadron AMO in order to begin to improve readiness.

In the *Headquarters Marine Corps Aviation Commanders Mentorship Handbook*, commanding officers of flying squadrons are taught, "The center of gravity of a flying squadron is its maintenance department. Everything is possible with good aircraft availability. Nothing is possible without it."[9] According to *MCWP 3-20, Aviation Operations*,

> centers of gravity are the characteristics, capabilities, or localities from which a military force derives its freedom of action, physical strength, and will to fight.[10]

Observing that the maintenance department is the main effort; the Marine Corps should staff it accordingly with competent professionals whose only focus is aircraft maintenance. The AMO should be a professional AMO instead of a pilot who has too many duties. As it stands now, 6002 company grade officers serve several years learning their craft at the flying squadron. When they reach their prime, they are moved to the Marine aviation logistics squadron. Weighing the maintenance department with a professional AMO will improve readiness. 6002 majors should also serve as squadron AMOs.

Life for a pilot in a flying squadron is incredibly challenging and busy. When new lieutenant aviators first arrive at their squadron, their priority is learning the fundamentals of being a pilot. Earning their initial qualifications requires intensive studying. Starting out as co-pilots they must earn specific qualifications that enable them to externally carry cargo, utilize different weapons systems, and fly at night. They progress from co-pilots to aircraft commanders, and eventually instructors. Being an instructor is a challenging job that requires long hours. Even if they do not follow the route of becoming an instructor, they are required to maintain their qualifications. Qualifications are heavily focused on proficiency flying at night. By definition alone, they work many hours at night and are unable to focus on the maintenance effort. Their ability to learn the nuance of running maintenance programs such as hazardous material, foreign object or debris, and quality assurance officer is limited. These collateral duties coupled with long hours leads to burnout and retention problems.[11] Pilots cannot dedicate enough time and energy to their craft and fully commit to the conduct of maintenance.

The Air Force conducts its aviation maintenance quite differently than the Marine Corps. According to Air Force Capt Jodi Osbeck, Air Force flying squadrons are only composed of pilots and aircrew. A separate maintenance squadron retains all of the aircraft that supported squadrons utilize for training and operations.[12] The maintenance function and personnel are completely separate from the airmen who fly. However, the maintenance squadron has career professions who worked within the maintenance community their entire

Observing that the maintenance department is the main effort; the Marine Corps should staff it accordingly with competent professionals ...

careers. They are able to retain experience and pool resources and parts to consolidate resources. Maintenance professionals at all levels are able to mentor and be mentored by airmen in their profession. The Air Force only flies aircraft that are FMC versus MC. They are only willing to fly an aircraft when it is fully capable to do every assigned mission set. The Marine Corps is not structured for this type of organization. It fights as a MAGTF and must remain expeditionary in nature. This requires the smallest version of the MAGTF, the MEU, retain a maintenance capability. MEUs would not be able to deploy a squadron reinforced aboard an L-Class ship without the ability to perform organizational maintenance level and attaching an intermediate maintenance level. The Marine Corps must have the flexibility to deploy at the squadron level and retain aviation maintenance capabilities. Implementing a 6002 major at the flying squadron level does not hold all of the advantages that the Air Force is able to capitalize on by massing their maintenance personnel, but it leverages expertise into a critical billet.

Pilots might say that because maintenance is the primary function of a flying squadron, they should hold the AMO department head billet. Eighty percent of a squadron's personnel are within the maintenance department, and very few hours a week are spent flying. A commanding officer with limited experience interacting and participating with the maintenance department might put himself at a disadvantage when compared to other commanding officers who have extensive AMO department head time. Commanding officers who have department head time as the AMO have a better understanding of the maintenance perspective. By having major 6002s serve as flying squadron AMOs, pilots will have to wait longer to serve as a department head, but this is unlikely because of the vast shortages of pilots at the major rank.[13] It is also true that readiness levels are at all-time lows, and because of that training mission essential tasks lists are challenging to meet. The solution that resolves readiness and allows the commanding officer to tap into the experience that he needs is to have seasoned maintenance professionals serve at the department level in flying squadron.

It is also true that readiness levels are at all-time lows, and because of that training mission essential tasks lists are challenging to meet.

Seventeen years of conflict have tested the resiliency of our fighting forces. Continued real-world operations required the deferral of major maintenance for many different types of equipment. Rolling stock, weapons systems, facilities, and shrinking dwell-to-deploy times have taken their toll on the material conditions of our equipment and our personnel. In an October 2017 memorandum, then-Secretary of Defense, James N. Mattis, said, "First, [we must] restore military readiness as we build a more lethal force."[14] Marine aviation must think in innovative ways in order to leverage technical expertise in critical billets if we are to adapt to an ever-increasing operational tempo. Holding onto past protocols only hinders our ability to adapt. The AVLOG community consists of 39,000 Marines. The Marines Corps should leverage their field grade expertise at our point of contention, the squadron maintenance department.

Notes

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3. Commander Naval Air Forces, *COMNAVAIRFORINST 4790.2C, Naval Aviation Maintenance Program*, (Patuxent, MD: January 2017), available at http://www.navair.navy.mil.

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6. Personal email correspondence between author and Forest Rees on 17 September 2017.

7. *2018 Aviation Plan*.

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11. Carl Forsling, "Pilot Retention Is In A Death Spiral. Here's How The Marine Corps Can Fix It," *Task & Purpose*, (Online: January 2017), available at http://taskandpurpose.com.

12. Telephone interview between author and Jodi Osbeck on 8 January 2018.

13. "Pilot Retention Is In A Death Spiral. Here's How The Marine Corps Can Fix It."

14. Department of Defense, Secretary James N. Mattis, "Memorandum to All Department of Defense Personnel," Memorandum, (Washington, DC: October 2017).

The Castle Must Fall

Looking at engineers through a new lens

by GySgt Alfred Negron II

The mark of the combat engineer is the castle; it is representative of our historical military lineage dating back to medieval times. The problem with the castle is that it is immobile, rigid, and sorely outdated. Modern weapons and technology have long extinguished the role of the castle. It is fitting then that we view modern engineering objectively and critically, through the lens of a new era. It is time for the walls of the castle to come down so that we may build Marine Corps engineering up and bring it into the future. Why is this necessary? Several reasons exist, the most important of them being the *Marine Corps Operating Concept*.

The *Marine Corps Operating Concept* identifies five critical tasks and associated issue areas to guide our effort to change how we organize, train, and equip for the future.[1] Traditional engineer command relationships, the scope of engineer missions, aging equipment, and archaic force structures lack the flexibility to rapidly adjust to changing battlefield conditions that could occur at machine speeds. Further, the disaggregate nature of future battle formations will require engineer capabilities to be spread across a broad front. Combined, these issues paint a clear picture that engineers today are not adequately prepared for tomorrow. Increasing the size of engineer forces and modernizing engineer equipment will not address the complexities of the future fight. Therefore, it is posited that significant changes in organization, training, and equipment be implemented to meet the demands of the future operating environment. The following recommendations, based on research of historical data and analysis of current trends, are intended to spark discussions that will lead to positive changes, which will enable the future MAGTF to effectively shape the battlefield.

>GySgt Negron is currently serving as the Requirements Analyst, Capabilities Branch S-3 (Operations), Marine Corps Engineer School.

If a Marine is asked, "Who is responsible for engineering in the Marine Corps?" his answer is likely the combat engineer. This viewpoint, which is accurate to a degree, must be fundamentally adjusted. The future operating environment will require individual Marines to be more tactically and technically proficient, with a higher premium placed on individuals capable of performing multiple, complex tasks assisted by advanced technologies. Marines will likely become increasingly generalized versus specialized as new technologies will be simpler to operate and available to more unit types. Often, engineer capabilities are limited in capacity. Distributed maritime operations (DMO) will stretch those capabilities beyond their limits. Constrained engineer assets will require that small, distributed units possess the ability to conduct engineering tasks without traditional engineer support. This will be achieved through the use of advanced, simple-to-use technologies such as small, autonomous soil excavators. For this reason, engineering must be viewed as the mission of every Marine rather than solely the mission of an engineer.

Shaping the battlefield is a critical function of the MAGTF. To achieve the necessary battlefield effects requires close coordination between intelligence, fires, logistics, and available engineer capabilities. Close coordination must occur early and incorporate available MAGTF assets to mass capabilities at critical enemy gaps. Lacking the appro-

Marines will be more tactically and technically proficient in the future. *(Photo by Sgt Miguel Rosales.)*

priate subject matter expertise within the planning cycle poses significant risks to mission execution and could delay friendly actions. The current alignment of the engineer staff within the G-4/S-4 (logistics) lowers the priority of engineer planning considerations and inhibits efficient, effective employment of limited engineer resources.[2] It is recognized by a broad audience that the engineer staff is an integral part of operational planning; however, the decision to place an engineer staff within the operations section is often personality based.[3] These inconsistencies in staffing lead to engineering shortfalls, negative impacts to operational tempo, and will be compounded when the MAGTF is engaged in DMO.[4] The solution for this is a simple realignment of the engineer staff across all elements of the MAGTF. Aligning the engineer staff to the operations section will improve engineer planning integration and positively impact MAGTF maneuver and movement capabilities. With an appropriately aligned engineer staff, the MAGTF is able to efficiently employ engineer assets, avoid engineer planning shortfalls, and mass or distribute limited engineer capabilities more effectively.

The disaggregate nature of the future operating environment will require tightly integrated support elements to achieve victory on the battlefield. Traditional infantry formations will be extended during DMO and augmented with a multitude of technologies and capabilities to enhance their mobility and lethality. The future operating environment will place a premium on smaller, more agile units capable of controlling their battle space with a reduced logistical tail and within a contested domain. Unit cohesion is critical to success as units will be required to operate isolated from adjacent and supporting forces more frequently. To maximize the effectiveness of the combat engineers supporting future operations, it is recommended that the combat engineer battalion (CEB) be disbanded and their personnel and equipment distributed and integrated amongst the GCE. The central mission of the CEB is not abolished; it is instead deeply ingrained within the fabric of the ground combat forces. The CEB is designed to operate as a distributed unit by providing forces in direct support to the GCE. The battalion's table of organization reflects its disaggregated nature; battalion, company, and platoon force structure align perfectly within the division's force structure (i.e., "habitual relationships" between CEB companies and infantry regiments). Critics lament that without the CEB, a maneuver commander loses the ability to mass or redistribute engineer capabilities and engineer training suffers. On the contrary, by realigning the engineer staff, the MAGTF commander continues to have complete oversight of engineer capabilities and the subject matter experts needed to identify where engineer forces must be employed. Engineer training will not be adversely affected through the dissolution of the engineer battalion. Consider how other non-infantry MOSs within the infantry battalion conduct training. Their training is accomplished by completing tasks nested within the unit's training plans.

The central mission of the CEB is not abolished. *(Photo by Sgt Miguel Rosales.)*

The CEB is designed to operate as a distributed unit by providing forces in direct support to the GCE.

Realign the CEB commander and staff to serve as the division G-3 engineer staff.[5] Placing the senior engineer officer in the division operations section ensures GCE engineering capabilities and considerations are included in the division commander's concept of operations. The former battalion commander, supported by an engineer staff of subject matter experts from across the engineer field, is able to forecast engineer requirements, incorporate engineer considerations into future operations and current operations, and monitor engineer employment throughout the GCE.[6] Supported by engineer staffs at the regiment, battalion, and company level, the division engineer staff officer can coordinate engineer efforts across the division's front and support operations as required.

Realign engineer support company (ESC) to headquarters battalion. ESC will continue to provide heavy equipment and utilities support to the division and remain a single unit within headquarters battalion. Maintaining the ESC structure is required because of the large equipment and maintenance

The engineer community has suffered from multiple internal issues throughout the years. ***(Photo by Sgt Miguel Rosales.)***

footprint. Regimental and battalion maintenance facilities lack the capability to support heavy equipment and utilities maintenance and storage beyond current capacities. Heavy equipment and utilities assets will be employed on an "as required" basis throughout the division. The alignment of the engineer staff to the G-3/S-3 enables forecasting of engineer equipment requirements, coordination of assets, and deconfliction.

Disband mobility assault company (MAC) and distribute assets. Similar to ESC, MAC possesses a large equipment footprint that requires resources to be pooled for efficient maintenance and storage. Many of the capabilities within MAC will be realigned to the tank battalion (assault breacher platoon, assault bridging platoon, and assault maintenance platoon) because of the commonality of mission and equipment platforms. The route clearance platoon will be completely disbanded and its associated personnel distributed to augment combat engineer billets across the GCE or MAGTF. Route clearance equipment is aged and purpose-built for employment against an asymmetric threat in a desert environment. When templated against a peer adversary, subject matter experts agree that it is not feasible to employ the current route clearance equipment. Therefore, the equipment associated with route clearing platoon will be divested or placed in long-term storage. In the future, scalable detection technologies compatible for use with multiple platforms will likely replace the role of the route clearing platoon, and future tactics, techniques, and procedures will adapt to mission requirements.

Just as building the walls of a castle higher will not stop an airstrike, neither will building a single engineer unit prepare our engineers for the future fight.

Distribute combat engineer companies to infantry regiments and individual battalions. The combat engineer company is built to support an infantry regiment. The company commander and his staff are aligned to the regimental staff, and each platoon is tasked direct support to every battalion. This relationship will be made permanent and fully integrate the combat engineer into infantry formations. By permanently incorporating combat engineers into the infantry battalion table of organization, training is further tied to supported infantry units. Combat engineers become intimately knowledgeable on unit SOPs, build better unit cohesion, and improve their infantry skills.[7] As a part of the infantry battalion, the combat engineers become an integral part of the battalion's mission. In addition to improving combat engineer training and cohesion with infantry units, infantry units gain resident engineering capabilities and improved cross training because of the proximity of the engineer platoons. The battalion becomes less reliant on external engineer support and gains an improved engineer capability. To support engineer employment and training, the platoon staff (platoon commander, platoon sergeant, platoon guide) are assigned to the battalion S-3 where they can closely monitor engineer training, integrate engineer considerations into operation planning, and employ engineer capabilities across the battalion. In addition to the infantry battalions, it is possible to incorporate combat engineers into light armored reconnaissance, amphibious assault, and reconnaissance battalions, reinvigorating historical roles and expanding engineering capabilities across the division.[8]

The engineer community has suffered from multiple internal issues throughout the years. There are some who believe the solution to most of our problems and the problem posed by the future operating environment is consolidating engineer forces underneath a single unit, an engineer regiment. Just as building the walls of a castle higher will not stop an airstrike, neither will building a single engineer unit prepare our engineers for the future fight. The future operating environment will demand the flexibility inherent within smaller units. Consolidating engineers within a larger unit for the sake of controlling engineer capabilities obscures a

deeper problem: a lack of trust in supported commanders. There is a belief that non-engineer commanders will fail to ensure their engineers are trained properly and ready to execute their mission. This lack of trust leads to poor decision making and a denial of what the future requires: composite units that are uncommon today. To execute these recommendations requires a holistic view of engineering as a function of the MAGTF. The responsibility of shaping the battlefield is inherent within every Marine and Sailor, not a select group of specialists. Distributed operations require that tomorrow's engineers have a narrow focus on only the most complex and difficult tasks, called upon to execute at the points of friction, and divesting simpler tasks through shifts in doctrine, training, and equipment. The engineer community has atrophied over the years and will continue to do so if it does not stop looking to the past for solutions and, instead, accepts the reality of the coming future. Failing to do this will result in the continued erosion of engineer capabilities, leading to critical mission failure and significant loss of life.

Notes

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Behavioral Health in the Marine Corps

Looking back and moving ahead

by Marta Garrett

Behavioral health (BH) services in the Marine Corps leave behind unique sets of unique footprints. Despite the fact that many BH programs are mandated at the DOD level, there are still distinct differences in how BH services are implemented within the Marine Corps. First and foremost, the distinctive mission of the Marine Corps dictates the need for different BH services and dictates how these services should be implemented. Secondly, there are no uniformed BH providers within the Marine Corps. This creates a need to work closely with "Blue Side" services in all aspects, including setting BH policies, staffing, and implementing services. Finally, the Marine Corps is the only Service to offer community-based BH services that are not recorded in the servicemember's medical record.

Nearly a decade ago, the 35th Commandant, Gen James F. Amos, rededicated Marines to the core value of taking care of their own. In his *Commandant's Planning Guidance,* Gen Amos stated that the Corps must "keep faith" with Marines, Sailors, and their families. The Commandant's guidance gave voice to an evolution of new policies and programs aimed at altering the culture of the Marine Corps and move "left of bang" to focus on prevention.

>Dr. Garrett is a doctoral-level Mental Health Practitioner and Educator with more than three decades of professional work in the mental health field. As a Marine spouse, the author has a deep interest in the mental health needs of military members, families, and veterans. The author is currently working as an embedded Preventive Behavioral Health Asset within 3d Marine Regiment at Kaneohe Bay.

We have the means to get Marines from the field to the hospital. We must also be prepared to deal with follow-on health issues. *(Photo by LCpl Angel Traus.)*

BH Needs in the Marine Corps

As an expeditionary Service, the Marine Corps requires BH support services that are easily accessible, solution-focused, and expedient to support the warfighter and increase the operational readiness of the total force. Today more than at any time in the history of the Marine Corps, there is a plethora of BH services available to Marines, their families, and commanders. The challenge facing commanders today is navigating this complex web of BH services.

BH and Marine Corps Commanders

In the Marine Corps, all BH treatment decisions must be made while balancing the BH needs of the individual with the larger needs of the command. Many BH issues can be managed with prevention—never rising to the level that a Commander might need to be notified or involved. However, because commanders are responsible for unit readiness, they must have an understanding of all issues that could negatively impact the unit's readiness. This critical balance of information evolved into a more transparent BH system in the military community than in the civilian sector.

When commanders are not aware of Marines' BH needs, commanders are forced to make critical readiness decisions without key information. Commanders must constantly assess the safety and readiness of all Marines

in the unit: Is this Marine safe to carry a weapon? Is this Marine a security risk? Is this Marine deployable? When a Marine is deemed not mission capable for a protracted length of time, guidance from the Secretary of Defense now directs commanders to ensure the burden of deployment is equitably distributed across the force.

In the short-term, the readiness of any given Marine struggling with BH issues varies from day-to-day. High operational stress further exacerbates on-going BH issues and causes more stress as a Marine trains and prepares to deploy. The decision to remove a Marine from his duties affects the command and has a possible impact on readiness, especially for Marines in critical occupational specialties (also known as the MOSFL rating). Additionally, a decision to remove a Marine impacts other unit Marines who will need to cover additional duties. Finally, the Marine who is removed from his normal duties and peers may experience feelings of worthlessness and an increased risk of suicidal behaviors.

Because of the potential magnitude of decisions made by commanders, they must be aware of all BH issues that have the potential impact of safety and readiness. Behavioral health providers must balance the need to keep the commander informed with the need to protect patient confidentiality as much as possible. This unique balance requires responsive and close collaboration between the commander and BH providers. During times of peace, commanders and BH practitioners have the ability to meet regularly and resolve issues as they arise. However, during war or in operational units with demanding deployment schedules, complex BH situations that require day-to-day monitoring quickly become problematic for commanders who are not available or for BH practitioners who are carrying too large of a caseload.

BH prevention in the Marine Corps

In an environment that demands ready and deployable Marines at all times, the key is to catch BH issues as early as possible *before* they require demanding treatment and management. Consequently, in recent years the Marine Corps implemented a variety of BH policies, programs, and services to move the Marine Corps BH efforts toward prevention. As in all Marine Corps programs, safety is paramount. BH prevention programming is no different. Loss of life and potential for injury is a central theme of all Marine Corps BH prevention programming. Any discussion of BH prevention must first consider the *target* of prevention efforts. What are the BH-related issues that the Marine Corps is trying to prevent? The answer to this question relates back to the foundational concept of readiness. In other words, how can BH resources be used to improve individual, family, and unit readiness? Or, how can BH *prevention* resources be used to help commanders ensure that all individuals are ready when needed? How can the Marine Corps be sure it is effectively managing this risk?

In a dynamic and fast-paced environment such as the Marine Corps, BH program evaluation data is critical. The Center for Disease Control has long been recognized as the gold standard for BH program evaluation and offers the following framework for considering prevention and BH related programming:

Utility. Does this program serve the information needs of intended users? This is critical in a population that turns over as quickly as the Marine Corps where BH programming is quickly serving new cohorts or generations with differing needs every few years. In the Marine Corps community, this concept of program "users" not only includes the needs of the individual Marines, but also the needs of the commanders. Unfortunately, BH program decisions in the Marine Corps are made at the headquarters level with little or no input from commanders.

Feasibility. Are the goals of the program(s) realistic, prudent, diplomatic, and frugal? A zero-defect mentality in BH programming is neither realistic nor prudent, yet most Marine Corps BH programs operate on this principle. The Marine Corps community has a higher than average risk for many BH issues; thus, there is inherent risk that Marines will not always make healthy or rational decisions. Furthermore, the military lifestyle (relocations, operational demands, etc.), even during times of peace, increases some types of BH risk.

Propriety. Do programs behave legally, ethically, and with regard for the welfare of those affected? This question is often overlooked within government BH programs. While there are specific operational needs for less privacy than may be afforded in the civilian sector, BH providers in the military community must still be held accountable to the *spirit* of the regulations, laws, and guidelines that govern the delivery of BH services across the U.S. This is especially pertinent in the Marine Corps where the average Marine is young and often lacks formal education about BH treatment options. Marines deserve the same quality standards in BH care that would be afforded to them as ordinary U.S. citizens.

Accuracy. Do these programs actually help? This final program evaluation criteria speaks to the need to truthfully inform decision makers by providing them with correct and precise data and formally evaluate all programming. Data is only as good as the system in which it is collected and reported.

Unfortunately, despite the emphasis on evidence-based BH initiatives and outcome measures across the larger field of BH, little to no formalized evaluation has been published about the processes or outcomes of Marine Corps' prevention and BH initiatives to date. Additionally, there has been minimal effort to formally evaluate the effectiveness of long-standing BH-related DOD mandated programs in the Marine Corps (FAP, SAC, and SAPR). This lack of formalized evaluation data makes it impossible for commanders and the Marine Corps to determine which programs are most effective or how they might be improved.

What is the way ahead?

Based on this discussion, the following recommendations are offered to better support the needs of both Marines and commanders today and into the future:

Implement and standardize BH program data collection across the Marine Corps. First and foremost, all BH-related terms must be defined uniformly across the Marine Corps: what constitutes an "alcohol-related incident" in Camp Lejeune should be the same as in Camp Hansen, Okinawa. All BH definitions must be clear and consistent.

Secondly, standardize the collection of BH-related data across all Marine Corps programs and units. Data collected entirely within a unit may be under-reported while data reported by installation-level providers may be over-reported to ensure program manning. Currently, BH-related data in the Marine Corps is gathered from multiple sources at multiple levels but with little collaboration or standardization. Defining a data collection process and mandating what data is critical for each unit to track will help commanders determine where their unique unit risks are and focus on specific prevention needs at the unit level.

Mandate BH program evaluation across the Marine Corps. A comprehensive review of all Marine Corps BH programs and initiatives should be conducted toward the goal of increasing effectiveness, better understanding gaps in efficiency, and identification of duplicative services. This evaluation might be best completed by an outside source to minimize influencing attempts or program gerrymandering by stakeholders. All BH programs and new BH initiatives in the Marine Corps should include a multi-faceted built-in evaluation plan. Finally, these program evaluations should include feedback from commanders, Marines, families, and BH providers—not just headquarters elements.

Expand the measurement of personnel readiness to include additional measures of personal readiness. Maintaining "high quality people" is one of the three pillars of the Defense Readiness Reporting System. However, aside from calculating the number of deployable Marines on-hand and the MOS fill percentage (MOSFL) rating, the Marine Corps does not currently utilize any formal process to measure other intangibles that influence individual readiness (e.g., mental preparedness). Without such measures of individual readiness, it is impossible for commanders to make informed decisions about overall unit readiness.

Consider the need to reset current BH programming to reduce duplication of services, streamline access to BH services, and increase commander input. While some of the need to reset BH programming will be further informed by comprehensive program evaluation data over time, it is also critical to move forward with some initiatives in this area to ensure current needs are being addressed and resources not wasted.

... it is time to consider the removal of all BH services from under the MCCS umbrella.

First, it is essential to add capacity and commander access to embedded BH-related practitioners at all colonel-level commands. Embedded BH assets tend to be more utilized, more efficient at meeting local or unit-specific needs, and more accessible to commander input. Embedded BH services should be the model of BH services moving forward.

Second, The Marine Intervention Program (MIP) should be housed with and administered from the uniformed BH providers rather than the Community Counseling Program (CCP) at Marine Corps Community Services (MCCS). This move will simplify data collection and record-keeping processes, ensure continuity of care (thus decreasing risk of suicide completion), and simplify the referral process and communications with commands. This will create a one-stop shop for all suicide-related evaluations and services to simplify appointment issues for Marines who access MIP services and commanders who need quick information about a Marine who is potentially self-destructive or suicidal.

Third, consolidate short-term, non-medical counseling programs to eliminate waste and to minimize confusion about where to send Marines who need these services. Currently, the CCP program and the Military and Family Life Counselors (MFCL) program both offer short-term, non-medical counseling by licensed professionals. This level of excess capacity is not needed during peacetime. The CCP program could be eliminated as it is the most expensive to run and least responsive to a commander's needs. The MFLC program is more cost effective and can be quickly expanded or contracted to meet location or crisis needs. Additionally, because MFLC services are embedded, they are responsive to commanders needs and more likely to be used by young Marines who are most at-risk. This discussion of the MFLC program does not suggest that the MFLC program is without faults. Minimally, the MFLC contract should be re-written to include the requirement to provide commanders with more prevention-related statistics and the contracts should be lengthened from six months to one year to provide continuity of care.

Finally, regardless of serious consideration of any or all of the suggestions above, it is time to consider the removal of all BH services from under the MCCS umbrella. This suggestion is made based on two critical problems with the current structure of housing BH under the Marine & Family Programs branch of MCCS. First, there is a significant conflict of interest in housing BH services under MCCS whose primary mission was derived from morale and welfare programs and emphasizes selling goods and services to make a profit. Second, there is a distinct lack of content expertise in MCCS human resources to address the selection, hiring, and credentialing needs of BH personnel. This is evidenced by the high turnover rates of these specially qualified BH professionals and the extensive gaps in hiring new BH personnel. There are potentially multiple options for where these BH positions could be housed or how they could be more effectively managed dependent on whether CCP and MIP were reconfigured or relocated.

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Fighting Against, With, and Through Narrative

Developing the reasons why we are there

by Christopher Paul, Capt Kristen S. Colley, USMCR, & Laura Steckman

Over the last several years, the DOD has been repeatedly excoriated for failing to make sufficient and effective use of narrative in support of military operations. Numerous studies, reports, theses, and papers describe the "battle of narratives" or "battle for the narrative" and decry the fact that we are losing the battle, or worse, losing by default through failing to contest the narrative battlespace.[1] Enthusiasts highlight that narratives are foundational to justification, legitimacy, public opinion, and effective influence.[2] Furthermore, legitimacy and public perceptions are essential to success in operations. The strongest statement of this view asserts that "it will not be the military implementation that will determine the success or failure of the present day campaign. The side with the most compelling narrative will succeed."[3]

What are Narratives?

Despite the constant refrain of the importance of narratives and the repeated demand that we become better at fighting against, with, or through narratives, there is alarmingly little agreement about how exactly to accomplish this. Additionally, there is little consensus on the definition of narrative. One scholar notes that while there is a substantial amount of existing theory on narratives, "this body of literature is poorly organized."[4] Another notes that the "discussion of stories and narratives

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Face-to-face engagements may prove invaluable in establishing a positive narrative of the event. *(Photo by Cpl Alejandro Sierras.)*

is hampered by the fact that there is no widely accepted definition regarding just what a story is."[5] Concerningly, this confusion leads the term "narrative" to be conflated with "message" or "theme," which are indeed related to narratives but lack the depth, complexity, and relation to context of narratives.[6]

Different views of what narratives are and should be are not just matter of semantics. There are real and consequential differences about what different advocates want to accomplish when they talk about improving how we handle narratives. So, where is there agreement about the nature of narratives? Our synthesis of the existing discussion suggests three things about which there is consensus and are essential to explaining narratives and understanding why they are important to operations. First, they are about stories and they maintain the element that make up a story, such as settings, characters, plots, resolutions, beginnings, middles, and ends. Second, stories are how humans understand and make sense of the world and their place in it. Finally, the stories that get told about (or get used to make sense of) the events of military operations and conflicts affect perceptions and understandings of those operations. These in turn affect the perceived legitimacy of those operations and the extent to which one side or the other receives an individual or group's support. Remember, one man's rebel is another man's freedom fighter.

In this article, we explain what is important about narratives before discussing what operational commands must try to accomplish with narratives: internal coordination, offering a positive or alternative explanation to external audiences, and competing with narratives at odds with mission objectives. We conclude with a short list of things that U.S. forces must accomplish in order to begin to fight against, with, and through narratives.

What Is Important About Narratives?

What about narratives do commanders, planners, and operators need to understand? There are three facts about narratives that are particularly relevant to DOD efforts to use narratives in support of operations:

- People use narratives to make sense of the world and their place in it.
- Compelling narratives have consistency, familiarity, and proof.
- Narratives already exist, and although they can be shaped over time, they cannot always be changed or replaced.

People use narratives to make sense of the world. Narratives and other mental shortcuts help to make sense of the things we see and experience in the world. Research shows that people use stories to help structure memory, cue certain approaches to problem-solving, format new information, and define our identities.[7] Narratives often suggest how we should feel about an event based on the emotional content of the narrative and might imply a value judgment or suggest a course of action, perhaps based on the moral of the story, "Narratives make sense of the world, put things in their place according to our experience, and then tell us what to do."[8]

Part of making sense of the world is making sense of our place in it. When exposed to compelling narratives, we subconsciously identify with the actors and struggles explained in them. When we relate to the characters or their struggle, we use the outcomes in the narrative to give us purpose or suggest courses of action. For example, many Marine Corps recruiting commercials tell a story about a young man facing difficult personal challenges or defending innocents from "chaos." Potential recruits personally identify with the individual in the commercial and both the struggles he faces and the goals he pursues, making them more likely to join. ISIS similarly offered opportunities for recruits to protect the "persecuted" and for young men to be a part of an organization not afraid to act in the face of "oppression," but in their stories, they used characters, struggles, and goals chosen to resonate with their target audiences. In both cases, potential recruits identify personally and emotionally and see a path of action to address key events in their worldviews; thus, narratives are both explanatory and mobilizing.

What happens when we cannot make sense of events witnessed or accounts heard? The human brain wants the information it receives to make sense. When the brain cannot make sense of incoming information, that information is more likely to be discounted, ignored, or recombined with previous information until it does make sense.[9] So, if something new happens (say, the arrival of U.S. troops to provide humanitarian aid), it is interpreted based on the existing stories or overarching narratives held by the observing audience or individual. If the dominant existing narrative about American troops is negative (they are villains and only come to hurt, belittle, and occupy us), then the new facts will predominantly be interpreted in a way that is consistent with that narrative, even if this requires the omission of some of the details leaving the audience with a negative view.

These narrative-based perspectives are referred to in the academic literature as *narrative frames*.[10] Such frames are not necessarily derived from a single story but from an audience's whole collection of stories, created and transmitted within societies over time. These narrative frames (or lenses) influence how we view the world and help with our sensemaking. For example, the Marine Corps has a number of memorable and important specific narratives: Tripoli, Chesty Puller, Guadalcanal, Iwo Jima, etc. However, there is also a Marine Corps narrative frame, a way of seeing the world and the Marines' role in it, so that it is consistent with all of those stories and is generally shared by all Marines.

This is true of other peoples as well. Narratives and narrative frames will vary widely in different cultural contexts because *different groups of people have different collections of stories*. This is important because different groups of people will perceive the same events differently and make different sense of them, based on their different narrative frames. Just because our narrative frame suggests events be interpreted in a certain way does not mean that frame, perspective, and interpretation are shared by other audiences.

For example, there was a story circulating in Iraq that the U.S. supports ISIS. This makes no sense to Americans because we do not share a narrative frame which suggests that as possible; the idea is contrary to our sensemaking. A U.S. military spokesman described this idea as "ridiculous" and attributed it to only a small segment of the population.[11] But, a 2015 poll showed that nearly one-third of Iraqis believe that the U.S. supports terrorism in general or ISIS specifically.[12] Clearly, narrative frames available to many groups in Iraq are consistent with perceptions of the U.S. as an enemy or supporter of enemies and terrorists. It is through this narrative lens that those Iraqis view U.S. actions, despite the fact that the U.S. narrative ensures that it does not support extremist or terrorist actions.

Compelling narratives have consistency, familiarity, and proof. Compelling narratives have at least three characteristics: consistency, familiarity, and proof.[13] *Consistency* refers both to the internal consistency of a story (whether the outcome follows logically from the action described, whether the characters' behavior is true to type, etc.) and to the story's consistency with other salient narratives or narrative frames. *Familiarity* is about how well known a story or narrative is. More than just awareness of the story, familiarity also implies a level of comfort with the story which comes from sharing themes in common with stories within a broader narrative frame. *Proof* is about the evidence available in support of the narrative and can vary widely. Proof hinges on the perceived credibility of what is claimed, perceived credibility of the narrator, eye witness accounts, or recorded pictures or video. Note that what constitutes proof varies considerably by context and medium. For example, in the U.S., the facts in stories presented by television news anchors are accorded high degrees of credibility and generally accepted as strong proof. Elsewhere in the world, however, state-run television news reports are not considered much proof at all, while a story repeated from a friend of a friend might count as strong proof, despite less-compelling evidence.

Narratives already exist, and you cannot always just change or replace them. As much as different audiences will ascribe different levels of consistency, familiarity, and proof to different narratives, different audiences also have a different collection of stories and narratives available to them and prefer to interpret new events in a way that is consistent with their existing collection of stories. Because of the substantial body of pre-existing stories available to any audience, most events they witness or experience immediately fit within at least one of those pre-existing narratives: "Audiences will without exception always interpret stories in their terms."[14] This makes it difficult to present a new or alternative narrative that will have any traction.

In most cases, when U.S. forces act in foreign lands, there will already be multiple narratives in place that will be the dominant narratives of those events for relevant foreign audiences, regardless what themes, messages, and images accompany those actions. So, if pre-existing narratives drive the understanding of events in most cases, when and how can U.S. forces oppose, counter, or offer alternatives to those narratives? Succinctly, when are there narrative opportunities, and what kinds of opportunities are they?

When something happens which people notice and care about, relevant audiences will become aware of it and try to make sense of it. In any given instance, one of three things will happen:

- The event fits perfectly within one existing narrative, reinforcing the old one, and connecting to all the other content (negative or positive) from that narrative. That narrative becomes the dominant account for this event.
- The event fits reasonably well within more than one available narrative, or it can be viewed through the lens of more than one relevant narrative frame. The event will be understood through one or more of the available narrative frames, but which one(s) will be dominant is unclear (and perhaps shapeable).
- The event does not fit well within available narratives or mobilized narrative frames. The event will end up connected to one or more narratives (perhaps new, perhaps old) and viewed through narrative frames, but which ones and how it will be interpreted is an open question.

Each of these three possibilities corresponds to a different level of narrative opportunity.

- If the event fits perfectly within an existing mobilized narrative, there is limited narrative opportunity and few options. These include: accept and embrace all or part of that narrative (if it is positive, or has positive or at least tolerable aspects); adjust planned actions so that they are not so easily connected to that narrative (if the planned action is going to connect directly to an unfavorable narrative, consider not doing that action, or finding a way to do it that will be perceived and framed differently); or try to emphasize aspects of the action that suggest an alternative narrative frame (basically try to make a situation #1 into a situation #2). *Sometimes the only way to create an opportunity to change the narrative is to change the actions.*
- If events fit reasonably well within one or more alternative narratives or frames, there is some narrative opportunity. Those trying to fight with, through, and against narratives can pick the available narratives that are most favorable or beneficial to the joint force and try to emphasize aspects of the action that are consistent with those narratives, or otherwise try to frame the event so it is viewed in that way. Provided there is an alternative narrative, there might be an opportunity to emphasize how the event is unlike what happens in an unfavorable narrative. However, this is *not* a sufficiently wide-open narrative opportunity to make up a wholly new narrative, just an opportunity to push toward and emphasize favorable available narratives, and perhaps push away from unfavorable narratives.
- If the event is something new or different, people are still going to try to understand it and connect it to existing frames, but there may be greater opportunity to shape which ones or to introduce new ones. "Since narratives are neither fixed nor infinitely

We can present favorable narratives. *(Photo by Cpl Alejandro Sierras.)*

malleable, each side has a window of opportunity in which they may choose to change their narrative in order to address changing circumstances effectively."[15] Thus, narrative opportunity is greatest as a much wider range of available narratives or narrative frames can potentially be mobilized to help observers understand the event. It may even be possible to promote a wholly new narrative; however, it would be easier to try to mobilize some dormant pre-existing narrative or lens than to create a wholly new one. A dormant narrative is more likely to be consistent and somewhat familiar, whereas a wholly new narrative, even if there is an opportunity for one, will need to build its consistency, familiarity, and proof from scratch.

When comparing competing narratives or narrative frames, audiences consider and weigh the consistency, familiarity, and proof of each. This subconscious or conscious comparison of competing narratives operates following cognitive processes, similar to those used by a jury during deliberations.[16]

Once a given narrative or narrative frame is associated with an event or series of events, it will be difficult to change that connection. However, there may be opportunities to emphasize different aspects of that narrative (or frame) and to try to combine it with another salient narrative with more favorable characteristics. Again, in most situations, a wholly new narrative is unlikely to gain much traction when compared with other available narratives; it will lack external consistency be unfamiliar, regardless of how much proof is associated with it (and especially if that proof is more compelling to Western audiences than to relevant audiences).

What Can Commands Try to Accomplish with Narratives in Support of Operations?

Much of the discussion of narratives surrounds the "strategic narrative" that should accompany U.S. strategy in general as well as for any region or theater. Such strategic narratives are important but need to be anchored to effective highest-level strategy, an area in which the United States has particularly struggled.[17] Rather than trying to solve both the problem of strategy and the problem of strategic narrative, which is being discussed elsewhere within DOD, we will modestly focus on narrative at a lower level; the narratives that will help relevant audiences makes sense of U.S. military operations and the actions and events that take place as part of those operations ("operational-level narratives" if you like). These narratives must nest with higher-level narratives in the same way that subordinate objectives and goals must nest with goals, objectives, and end states prescribed at higher levels.[18]

What should commands hope to accomplish with narratives in support of military operations? First, is *internal coordination*. If humans make sense of events through narrative, then a clear mission narrative will be useful for our troops. Such a narrative needs to fit with existing military and Service-specific narrative frames (avoid a narrative that tries to make the Marine Corps feel like the Peace Corps), but done correctly, a mission narrative makes it easier for everyone to understand and remember mission objectives as well as their role in the story that will lead to achievement of those objectives. A clear mission narrative helps troops avoid the "say-do gap" that often opens between actions and communications, promotes unity of effort, and diminishes the likelihood of information fratricide. A good mission narrative guides follow-on planning, targeting, and execution, and enables mission command because subordinates will be better able to judge whether an available course of action is consistent with the narrative and thus preferred.

Second, commands can use narrative to *offer a positive or alternative explanation to external audiences*. Relevant audiences are going to find narratives and narrative frames to help them make sense of U.S. operations. Left to rely solely on their own histories and experiences, many of these narratives will support views and actions that are contrary to U.S. operations. Countering these existing perceptions is a core challenge of narrative in operations. Commands should seek to promote narratives of their operations that ascribe positive meanings to their actions so that they add up to something that should be supported, or at least patiently tolerated, rather than being viewed negatively. The extent to which this is possible is constrained by the level of narrative opportunity available, as described in the previous section. Done well, promotion of a favorable narrative increases understanding of, tolerance of, and support for U.S. operations. This increased tolerance

can increase the likelihood of desired behaviors (non-interference, cooperation, etc.) and all for greater freedom of maneuver because U.S. force actions occur within the confines of a locally-accepted narrative of legitimacy.

Third, the command may want to *compete with or undermine narratives at odds with mission objectives* when there is sufficient narrative opportunity to do so. Many operating environments contain narratives or narrative frames that do not support U.S. force presence or objectives, or such narratives may be introduced or mobilized by adversarial groups whose interests do not align with those of the United States. In order to reap the benefits of having a broadly accepted legitimating narrative and achieve desired levels of support, U.S. forces will need to find a way to "defeat" these alternative narratives. There is a growing body of literature on methods to attack narratives head-on, but that is outside the scope of this article.[19]

Defeating hostile narratives must cooperate the promotion of positive narratives. Audiences *will* find a narrative or narrative frame for events, and they will make sense of them—one way or another. It is impossible to defeat a narrative and just leave a narrative vacuum. There must be an alternative narrative that replaces it, "The one thing that replaces [or modifies] a story-based belief … is a better story."[20]

Moving Forward

With these three objectives—internal coordination, offering a positive narrative, and competing with opposing narratives—in mind, how can U.S. forces go about this in practice? Here, we offer advice aimed at the operational command level, such as a joint task force, U.S. Army brigade combat team, or USMC MAGTF. We describe three types of narrative (a command's mission narrative, a command's external narrative, and the desired narrative among the relevant audiences) and offer suggestions for the development and promotion of those narratives. Further, we offer these suggestions following a crawl, walk, run progression based on the effort and expertise required to accomplish each. Thinking at all about

An alternative explanation can be offered. *(Photo by GySgt Eric Alabiso.)*

narrative is at the *crawl* level, as is preparing and disseminating an internal mission narrative for internal coordination. Identifying how the command's actions are likely to be perceived by external audiences and building an external narrative to project alongside those actions is at the *walk* level, as it requires some knowledge of relevant populations and their narrative frames. Understanding the nuance of available and likely narratives and narrative frames and planning ways to get external audiences to talk (narrate) favorably about the command is more challenging still, and on the way to the *run* level.

Develop a Command's Mission Narrative

The command's mission narrative is the simple orienting story the commander will offer to troops to convey the objectives of the mission and their role in accomplishing them. We believe that the same process that produces the commander's intent will also produce the command's mission narrative with very slight adjustment. Extra thinking will be required to transform the language to better portray a story in which the troops of the command are among the characters, and the essential tasks are their actions. As a staff concludes mission analysis and prepares the commander's guidance and intent, they should also prepare the mission narrative as part of that intent. Ultimately, the mission narrative is just a restatement of the commander's desired endstate as the conclusion of a story, and the role the commander expects troops to play in bringing that endstate about: it captures the essence of the "why" and the "how" of the mission as envisioned by the commander.

An example of an excellent summary phrase for a command's mission narrative is, "No better friend, no worse enemy," as used by then-MGen James Mattis with 1st MarDiv beginning with commencement of Operation Iraqi Freedom I (OIF I) in March of 2003.[21] This headline captured two facets of his intent: that his Marines be aggressive and flexible in taking the fight to the enemy, but that civilians and prisoners be treated with chivalry and spared unnecessary harm. It gave clear roles to his Marines—the best of friends, the worst of enemies. It tied into the existing Marine Corps narrative frame, with the same narratives that confirm "every Marine a rifleman" being highly consistent with the "no worse enemy" portion. When he returned to Iraq in 2004 for OIF II, he kept, "no better friend, no worse enemy," but also added, "first, do no harm," to emphasize the relief and reconstruction emphasis of the new mission.[22]

Not every command's mission narrative will be as straightforward and short as Mattis' masterpiece, but every such narrative should connect with the narrative frames and identities of the troops addressed, describe the roles those troops will play as the operation unfolds, and state the desired conclusion of the story of the operation.

Develop a Command's External Narrative

Developing a narrative to try to impart to external audiences is significantly more challenging. Ideally, the command's mission narrative and the command's external narrative will be one in the same. It is much easier to offer the same story of justification, explanation, and purpose to the troops executing the mission and to the audiences witnessing that execution. Unfortunately, a quick and easy narrative that resonates with U.S. troops because it connects to their existing narrative lenses and identities may fall flat with relevant foreign audiences because it is inconsistent with their pre-existing narratives, is unfamiliar to them, and lacks proof that they find compelling.

Developing a command's external narrative necessitates work and effort not currently part of operational planning routines, though it may certainly be nested within existing processes. Preparing a command's external narrative requires a fairly robust understanding of the relevant audiences (those people whose behavior is instrumental to the success or failure of the campaign), their narrative frames in terms of their history, worldview, and recent events, and the available narratives about the United States, U.S. forces, and their operations and actions. To plan effectively for a command's external narrative, intelligence preparation of the information and operating environment must include attention to these kinds of issues. This preparation may require (or benefit from) media and social media monitoring or available behavioral, cultural and linguistic subject matter experts who have sufficient knowledge of the operational context to meet the need. We also recommend seeking existing intelligence products and building collection requirements that focus on the groups and cultures in the operating environment. If available information is lacking, the kinds of information required are most closely akin to the output of target audience analysis as conducted by military information support operations (MISO) personnel.

The command's external narrative needs to be planned as a separate but integrated part of the planning process. If narrative is important to the commander, needed information can be prioritized as part of commander's critical information requirements. Available information about the "narrative landscape" of any operational context is likely to be insufficient to understand it wholly and completely.[23] Still, an earnest effort to begin to understand relevant audiences, their desires and motivations, their style of narration, their core myths, legends, and narrative frames, and the existing narratives about the U.S. and U.S. forces will likely provide a foundation from which to start.

Identify and Promote Desired Narratives

The story that U.S. forces tell is about what they are doing is important, but what is even more important are the stories relevant local groups tell each other and themselves about what U.S. forces and their adversaries are doing. The high art of fighting with, through, and against narratives at the *run* level involves getting external narrators to tell and repeat favorable stories about U.S. forces and reducing the prevalence of narratives favorable to adversaries.

If the command's external narrative is perfect, then it will be adopted by relevant audiences as the prevailing narrative. However, while that level of perfection is an aspirational goal, it may be only partially achievable due to numerous variables in the battlespace that are beyond the command's control. More likely, the command's external narrative is heard and becomes part of the local discourse but is subject to counter-narratives that start with the question: "Why are the Americans *really* here?" Selectively promoting or discouraging specific narratives or narrative elements within the broader relevant narrative landscape requires deep understanding and a deft touch. Doing so requires both additional understanding and additional capability. Shaping and fighting narratives at this level requires extensive cultural and linguistic inputs; deeper understanding of available myths, memes, and other narrative elements; intelligence about key influencers; capabilities for persuasion and influence (like MISO); and better understanding of the cultural and cognitive aspects of narrative generation and promulgation than we can get to in this short article. Further, even if analysts are able to identify paths to adjusting the balance of narratives in use by relevant groups, the command must be willing to adjust and fine tune its operations to provide proof for the desirable stories and stop supporting undesired ones. This concept is at the core of the notion of narrative-led operations as advanced by Thomas Elkjer Nissen.[24] If we do not like the stories being told about our actions, we need to be prepared both to work to adjust the stories *and* to adjust the actions to be consistent with the stories that we need in place to accomplish our objectives.

Conclusion

In conclusion, we join the chorus and exhort U.S. military formations to increase their efforts beyond messaging and improve their ability to fight with, through, and against narratives. We recognize that this should begin at the highest levels, but believe that there are opportunities to make consequential improvements at the operational and tactical levels. Such improvements should follow a crawl, walk, run progression, with the very first shuffle toward crawling beginning with a willingness to address narratives and to recognize that how others make sense of U.S. operations both depends on narratives and matters for the outcomes of those operations.

In order to begin moving on the crawl, walk, run progression toward being able to fight effectively within narrative terrain, U.S. forces need to be able to:

Military forces must improve their ability to fight through narratives. *(Photo by author.)*

- Identify available salient narratives and narrative frames already present in the operating context.
- Anticipate which of those narratives are likely to be connected to planned U.S. actions and undertakings.
- Identify which narratives or aspects of narratives are favorable or neutral to U.S. objectives and which are unfavorable.
- Recognize when altering planned actions can create opportunities for more favorable narratives.
- Push on and into the information environment to promote more favorable alternatives (when available), or more positive/favorable aspects of unavoidable narrative frames.

Addressing narratives is difficult, but doing so will ultimately allow Marines to operate more effectively in complex modern environments. It is only by embracing the complexities of human understanding of conflict, and affecting them through narratives, that we will truly be able to fight and win in the information age.

Notes

1. For examples of such discussions, see DOD, "Decade of War, Volume I: Enduring Lessons from the Past Decade of Operations," (Suffolk, VA: Joint and Coalition Operational Analysis, June 2012); David Sadowski, "The Battle of Narratives—A Proposal," *IOSphere*, (Online: December 2012). United States Joint Forces Command, *The Joint Operating Environment 2010 (JOE),* (Suffolk, VA: February 2010), available at http://www.jfcom.mil. Col Mark C. Neate, *The Battle of the Narrative*, (Fort Leavenworth, KS: School of Advanced Military Studies, United States Army Command and General Staff College, Monograph AY 09-10, June 2010); Lars Ruth, *Battle of Narratives*, (Monterey, CA: Naval Postgraduate School, Thesis, June 2012); John DeRosa, "Revising the Battle of the Narrative," *Small Wars Journal*, (Online: July 2015).

2. Thomas Elkjer Nissen, "Narrative Led Operations: Put the Narrative First," *Small Wars Journal*, (Online: October 2012); Amy Zalman, "Narrative as an Influence Factor in Information Operations," *IO Journal*, (Online: August 2010).

3. Mary Crannell and Ben Sheppard, "Achieving Narrative Superiority to Succeed in Afghanistan," A *Light Year Group Study Paper*, (Online), available at https://www.ideasciences.com.

4. Steven R. Corman, "Understanding Extremists' Use of Narrative to Influence Contest Populations," Position paper submitted to Workshop on Mapping Ideas: Discovering and Information Landscapes, (San Diego, CA: San Diego State University, June 2011).

5. William D. Casebeer and James A. Russell, "Storytelling and Terrorism: Towards a Comprehensive 'Counter-Narrative Strategy,'" *Strategic Insights*, (Online: March 2005).

6. The Joint Staff J7 has released guidance for communications synchronization, explicitly stating the differences between narratives, themes, and messages. Whereas a narrative focuses on "context, reason, and desired results [and] … enables understanding for external stakeholders," messages are "narrowly focused communications that support a specific theme … to create a specific effect." Also see DOD, *Joint Doctrine Note 2-13, Commander's Communication Synchronization,* (Washington, DC: 2013).

7. Darcia Narvaez, "The Influence of Moral Schemas on the Reconstruction of Moral Narratives in Eighth Graders and College Students," *Journal of Educational Psychology*, (Online: 1998); Lila San Roque, Alan Rumsey, Lauren Gawne, Stef Spronck, Darja Hoenigman, Alice Carroll, Julie Colleen Miller, Nicholas Evans, "Getting the Story Straight: Language Fieldwork Using a Narrative Problem-Solving Task," *Language Documentation & Conservation*, (Online: 2012).

8. Mark Laity, "NATO and The Power of Narrative," *Beyond Propaganda*, *Information at War: From China's Three Warfares to NATO's Narratives*, (London, UK: Legatum Institute: September 2015).

9. Gregory S. Seese and Kendall Haven, "The Neuroscience of Influential Strategic Narratives and Storylines," *IO Sphere,* (Online: Fall 2015).

10. For more on frames and framing see Erving Goffman, *Frame Analysis: An Essay on the Organization of Experience,* (Cambridge, MA: Harvard University Press, 1974); Robert D. Benford and David A. Snow, "Framing Processes and Social Movements: An Overview and Assessment," *Annual Review of Sociology*, (Online: 2000). A similar concept is called "schemas" in cognitive psychology. See, for example, the discussion in Mary B. McVee, Kailonnie Dunsmore, and James R. Gavelek, "Schema Theory Revisited," *Review of Educational Research*, (Online: Winter 2005).

11. Liz Sly, "Iraqis Think the US is in Cahoots with the Islamic State, and it is Hurting the War," *The Washington Post,* (Washington, DC: December 2015), available at https://www.washingtonpost.com.

12. U.S. Department of State, *Evaluation of Embassy Baghdad's Implementation of Line of Effort 6 in the President's Strategy to Counter ISIL: Exposing ISIL's True Nature*, (Washington, DC: Office of Inspector General, March 2016).

13. Dean J. Case II and Brian C. Mellen, *Changing the Story: The Role of the Narrative in the Success or Failure of Terrorist Groups*, (Monterey, CA: Naval Postgraduate School, Thesis, December 2009).

14. "Narrative as an Influence Factor in Information Operations."

15. *Changing the Story: The Role of the Narrative in the Success or Failure of Terrorist Groups.*

16. Ibid.

17. See, for example, the criticisms discussed in Richard Weitz, "The U.S. Strategy 'Deficit': The Dominance of Political Messaging," Second Line of Defense: Delivering Capabilities to the Warfighter blog, (Online: March 2008; Robert Haddick, "Why is Washington so Bad at Strategy?" *Foreign Policy*, (Online: March 2012); Andy Zelleke and Justin Talbot Zorn, "United States: Where's the Strategy?" *The Diplomat*, (Online: February 2014).

18. Ideally, the president or National Security Staff provide the DOD with strategic-level guidance that includes the strategic narrative. In the event the narrative is not provided or unclear, JDN 2-13 (2013) suggests several ways to extract the strategic narrative from other high-level documents.

19. For instance, see Sara Cobb, "Narrative Assessment of the 'Cognitive Space' to Support 'Influence.'" Briefing presented to the Strategic Multilayer Assessment SOCOM Gray Zone Telecon series, (Washington, DC: May 2016).

20. "The Neuroscience of Influential Strategic Narratives and Storylines," *IO Sphere*.

21. MajGen James N. Mattis, Commanding General, "1st Marine Division (REIN) Commanding General's Message to All Hands," memorandum, (Washington, DC: March 2003).

22. ---, "Letter to All Hands," (Washington, DC: March 2004).

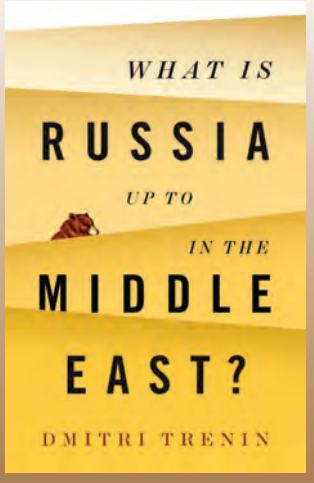
23. "NATO and The Power of Narrative," *Beyond Propaganda*.

24. "Narrative Led Operations: Put the Narrative First," *Small Wars Journal*.

Books

What is Russia Up To in the Middle East?

reviewed by 2ndLt Sam Sasser, Co E, TBS



WHAT IS RUSSIA UP TO IN THE MIDDLE EAST?: By Dmitri Trenin. Cambridge, UK: Polity Press, 2018.
ISBN: 978-1-5095-2234-7
144 pp.

Following the exit of the Golden Horde from the Russian steppe in the 1300s, Russia adopted the role of bridging the vast cultural divide between Europe and Asia. It has never completely ascribed to the norms of either culture, instead choosing to be a conglomeration of the two to form its socio-political identity. Consequentially, Russia's path to modernity was inconsistent with any of the Asian or European great powers. This is apparent in the way Russia conducts its relationship with the Middle East and Southeast Asia. Throughout its complicated history, Russia has endeavored to assert territorial, economic, or political control over parts of this region—such as Iran at the turn of the 19th century or Afghanistan during the Cold War.

To this day, Russia's development as the Eurasian bridging point informs the manner in which it interacts with the world, in particular the West. In his book titled, *What is Russia Up To in the Middle East*, Dmitri Trenin utilizes this historical context to analyze the strategic calculus of the Putin/Medvedev/Putin administrations toward the region over the past eighteen years. The picture he paints is one of astounding flexibility, political and military foresight founded in a desire to avoid the pitfalls of the West in polarizing the region (in choosing one side of the Shia/Sunni divide, for instance), and a surprising amount of engagement with the domestic Russian populace—particularly the Muslim contingent—in making its Middle Eastern policies.

The structure of the book is categorical. Trenin divides the exposé into five sections, beginning with the history of Russian engagement in the region to provide a strong foundation for comprehension of its modern mindset. The focus of the book henceforth (three sections, entitled "War," "Diplomacy," and "Trade," respectively) is firmly rooted in the manner in which the Syrian civil war revitalized Russian interest and involvement in the region—following a near three decade, post-Soviet lull—and places Russia squarely at odds with the prevalent, Western-oriented power structure. The author emphasizes the way the Russians perceive themselves, the social and political direction in which their society is moving, and the dexterity of how Russians have managed their relations in the region. Trenin argues that the flexibility through which the Russians developed a system of tenuous alliances has worked in its favor; however, success in this region is not assured. Although the Russians have been successful at pitting their allies against one another, so too have their allies succeeded in exploiting the Russians to their own advantage.

The book's conclusion emphasizes how the Russians are too pragmatic to see themselves as the global replacement for the U.S. but, rather, that they wish to assert themselves as the regional hegemon—both to further their economic and security interests and to challenge the status quo of the liberal institutionalist international system. Having been published in 2018, this book is incredibly relevant to today's global issues and should be considered by anyone who wants to understand the complexities and future challenges of the re-engagement of Russia in the Middle East/Southwest Asia.

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