Today's Naval Supply Chain

Sourcing and distribution options for near-term conflicts

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

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

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

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

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

Overcoming Predictability Through Diversified Distribution

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

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

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

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

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

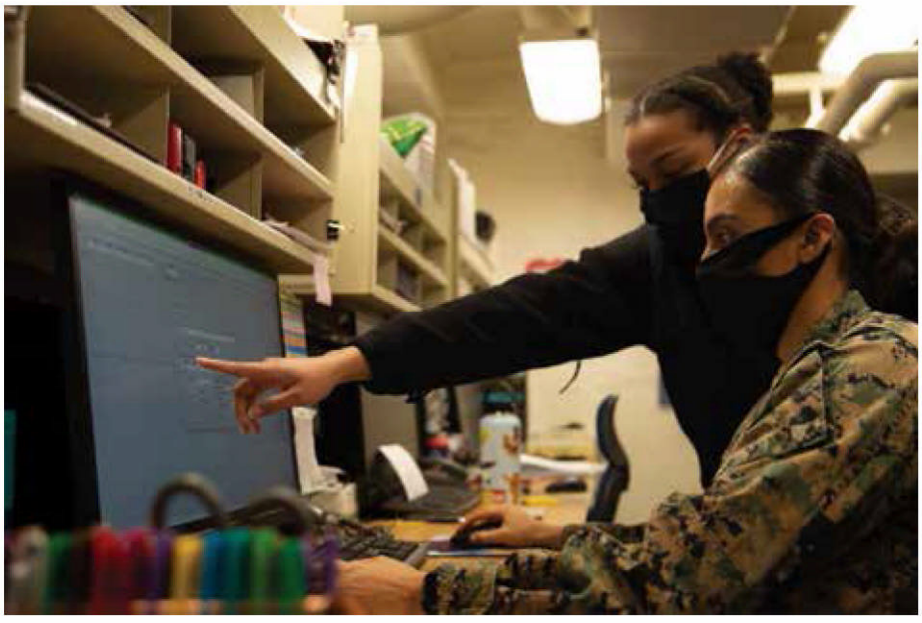
Non-traditional sourcing and distribution methods afforded by existing GCSS-MC functionality can support optionality in how supplies are moved. And using implicit communication resident to existing requisitioning systems allows the Marine Corps to achieve mass in positions not anticipated by the enemy.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

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

Shipments to Non-Traditional Distribution Nodes

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

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



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

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

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

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

DLA Distribution Centers

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

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

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

Sourcing Diversification within GCSS-MC

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

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

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

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

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

DSI Inventory

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

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

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

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

U.S. Forces

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

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

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

Sourcing Outside of GCSS-MC

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

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

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

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

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

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

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

Way Forward

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

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

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

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

Notes

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6. Brian Donohue, "Chinese Penetrate TRANSCOM Amid Lack of Data Sharing," *Threat Post,* (September 2014), available at https://threatpost.com.

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8. Guo Yuandan, "Chinese Navy Sees Broadened Horizon, Enhanced Ability through 10-Year Escort Missions," *Global Times,* (December 2018), available at https://www.globaltimes.cn.

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

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

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

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

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

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

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

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

17. Staff, "Navy Next-Generation Logistics Ship (NGLS) Program: Background and Issues for Congress," (Washington, DC: Congressional Research Service, October 2021).

18. *Increasing Lethality Through Sustainment.*

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20. Anthony Lakavage, "Covid-19 Has Exposed Cracks in the Global Medicines Supply Chain. We Need to Fix Them," *STAT,* (June 2020), available at https://www.statnews.com.