Architecting Naval Supply Chains

A quest to build holistic thinking

by Maj Julie Aho

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

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

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

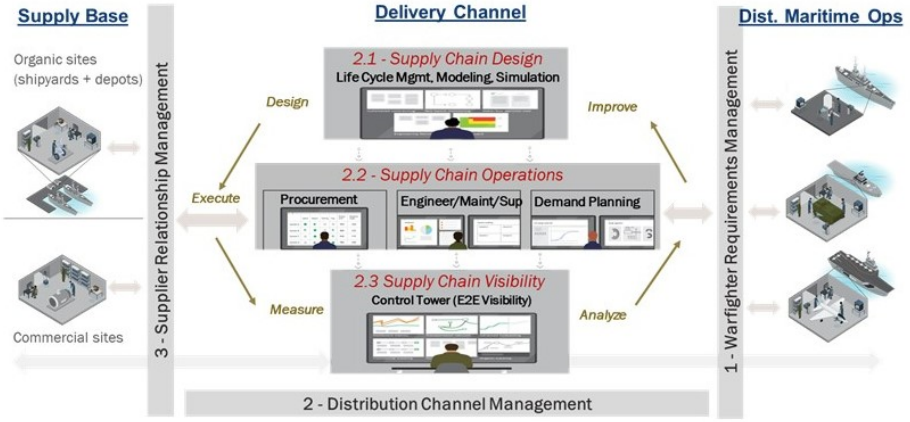
To connect warfighters with the sustainment needed, a dynamic supply chain architecture must be constructed across theaters, in conjunction with the cyber domain, overlaid across institutional brick and mortar, strategic supply nodes, and distribution channels to guarantee logistics as a pacing function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

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

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

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

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



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

confidence in the ability to embrace math and science through computer simulation in sustainment planning.

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

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

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

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

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

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

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

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

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

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