

Logistics: The Lifeblood of Military Power

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The end for which a soldier is recruited, clothed, armed, and trained, the whole objective of his sleeping, eating, drinking, and marching is simply that he should fight at the right place and the right time.

—Major-General Carl von Clausewitz, *On War*

The term “logistics” was not commonly used until shortly before World War II, but the concept and understanding of logistics have been around since the earliest days of warfare. In Clausewitz’s words, getting the force to the “fight at the right place and the right time”¹ is the true essence of military logistics.

The Merriam-Webster online dictionary defines logistics as “the aspect of military science dealing with the procurement, maintenance, and transportation of military materiel, facilities, and personnel.”² The Joint Chiefs of Staff’s *Logistics* elaborates on this definition and quotes Rear Admiral Henry E. Eccles’s 1959 statement that “Logistics is the bridge between the economy of the Nation and the tactical operations of its combat forces. Obviously then, the logistics system must be in harmony, both with the economic system of the Nation and with the tactical concepts and environment of the combat forces.”³

This simple two-sentence statement effectively captures both the complexity and far-reaching implications of military logistics. From the farthest tactical edge to the economic system of the nation, military logistics has far-reaching implications for the nation and the military element of national power and

therefore affects every aspect of organizing, training, equipping, deploying, and employing the force.

Logistics is perhaps the most complex and interrelated capability provided by today’s military. Unfortunately, to those unfamiliar with its intellectual and technological breadth, depth, and complexity, it can be considered an assumed capability—something that simply happens—or, worse yet, a “back office” function that is not connected to warfighting capability.

The success of military logistics during the past 16-plus years of overseas combat operations is partly to blame for anyone’s assumption that continued logistical success in the ever-changing national security environment is a given across the entirety of the military logistics enterprise. This dangerous assumption tends to exclude logistics from the conversation regarding the nation’s current and future warfighting needs. As a result, the logistics enterprise is rarely debated outside the logistics profession with the same intensity as other more publicized warfighting needs, especially the need to regain our military technological advantage over major competitors like China and Russia, are debated. Failure to understand the implications of *not* modernizing logistics in a time of great technological change potentially spells doom for the success of the modernized force.

In addition to ensuring that modernized logistics capabilities are appreciated as central to regaining our military advantage, logistics

capabilities must be considered in the ongoing discussion of solutions to overcome the current readiness shortfalls of today’s military. Logistics is nearly absent from the recent testimonies by military leaders, members of congress, and industry.⁴ While all of the testimonies highlight the need to modernize the U.S. military in order to regain our technological advantage, few specifically highlight the need for modernized logistics capabilities.

Alan Estevez, former Principal Deputy Under Secretary of Defense for Acquisition, Technology and Logistics and a career Department of Defense Senior Executive Service logistics leader, recently stated, “Logistics isn’t rocket science...it’s much harder!”⁵ Logistics is fundamental to the readiness of the entire Joint force—those at home, deployed in operational settings, and permanently stationed abroad—given that it must operate around the world and across every domain of activity in spite of enemy efforts to frustrate its operations. Consequently, it is far more complex than even the most sophisticated global business enterprises.

The Logistics Enterprise

You will not find it difficult to prove that battles, campaigns, and even wars have been won or lost primarily because of logistics.

—General Dwight D. Eisenhower

Logistics touches every aspect of military strength and is the sum of the capabilities brought to bear by all of the U.S. military services and those of a wide array of international partners.⁶

The core functions within logistics are supply, maintenance, deployment and distribution, health services, logistic services, engineering, and operational contract support (OCS).⁷ Logistics includes planning and executing the movement and support of forces as well as those aspects of military operations that deal with:

- The acquisition, storage, distribution, use, maintenance, and disposal of materiel;

- Medical services including patient movement, evacuation, and hospitalization for U.S. and partner personnel as well as indigenous personnel affected by operations;
- Facilities and infrastructure acquisition, construction, use, and disposition;
- Provision of food, water, and operational hygiene and sanitation support;
- Operational contract support including contract management;
- Infrastructure assessment, repairs, and maintenance;
- Common-user logistics support to other U.S. government entities, intergovernmental and nongovernmental organizations, and other nations;
- Establishing and sustaining large-scale and enduring detention compounds;
- Planning, coordinating, and integrating host-nation support from overseas partners;
- Disposal operations that deal with the removal and remediation of waste and unusable military property;
- In-transit visibility of sustainment and asset visibility of all major military end items; and
- Engineering support including horizontal and vertical construction of ports, airfields, and other military support infrastructure.⁸

Thus, military logistics’ defining attributes—agility, survivability, responsiveness, and effectiveness—are measured by the breadth and depth of these core functions, which affect the military from force generation to training

to the readiness of units stationed at home and abroad.

Logistics is the oxygen that allows military muscle to function, grow, and strengthen. Just as DNA represents “the fundamental and distinctive characteristics or qualities of someone or something,”⁹ logistics planning and modernization define the distinctive characteristics or qualities of the military force and ultimately provide the military commander the freedom of action, endurance, and ability to extend operational reach that are necessary to achieve success. Logistics is the foundation for the success of military operations from entry-level training to the most complex operations across the spectrum of conflict. From providing the facilities that house the members of the force and the ranges where they train, to sustaining the equipment warriors operate and wear, to providing fuel and ammunition in operations and training, the interconnectedness of logistics inextricably links logistics to military combat power.

U.S. Transportation Command (USTRANSCOM) provides daily examples of what it takes to keep U.S. forces and their sustainment moving around the world. USTRANSCOM conducts more than 1,900 air missions during an average week and has 25 ships underway and 10,000 ground shipments operating in 75 percent of the world’s countries. It does this with a total wartime personnel capability of 45,945 active-duty soldiers, sailors, airmen, Marines, and Coast Guardsmen; 73,058 Reserve and Guard personnel; and 19,104 DOD civilian personnel—numbers that do not include the significant contributions of USTRANSCOM’s commercial partners or the contributions of foreign entities.¹⁰

Utilizing its people, trucks, trains, railcars, aircraft, ships, information systems, and distribution infrastructure, as well as commercial partners’ 1,203 aircraft in the Civil Reserve Air Fleet (CRAF) and 379 vessels in the Voluntary Intermodal Sealift Agreement (VISA), USTRANSCOM provides the U.S. military with highly responsive strategic mobility.¹¹ Its handoff to service logistics personnel around

the globe creates a distribution pipeline that moves critical sustainment from the factory to the tactical edge of U.S. military operations.

In coordination with USTRANSCOM’s distribution functions, the actions of the Defense Logistics Agency (DLA) as supplier for the military are equally staggering in scope and scale. During fiscal year (FY) 2017, DLA provided more than \$35 billion in goods and services, coordinating the actions of 25,000 military, civilian, and contract personnel who provided food, clothing, fuel, repair parts, and other items across nine supply chains distributing approximately 5 million distinct consumable, expendable, and repairable items. DLA’s activity is spread across 48 U.S. states and in 28 different countries.¹²

These are far from “back office” functions and are truly what sustain the force and support its warfighting readiness. The criticality of logistics is not a new phenomenon, however; logistics has a significantly more complex nature today because of its integration across air, land, sea, space, and the information and cyber environments.

The Timelessness and Ever-Changing Nature of Logistics

Amateurs think about tactics, but professionals think about logistics.

—General Robert H. Barrow, USMC

Alexander the Great noted with dark humor the importance and complexity of logistics during his campaigns of conquest nearly 2,400 years ago: “My logisticians are a humbler lot...they know if my campaign fails, they are the first ones I will slay.”¹³ Alexander’s ability to move a force from Greece to India and back, conquering adversaries in Europe, Africa, the Middle East, and Central Asia and leaving functioning outposts along the way, attests to his logistical prowess.

In the modern era, the appreciation of logistics by Admiral Ernest J. King, Commander in Chief of the United States Fleet and Chief of Naval Operations during World War II, is equally telling: “I don’t know what the hell this

‘logistics’ is that [General George C.] Marshall is always talking about, but I want some of it.”¹⁴ Similarly, in his timeless treatise on warfighting, *Defeat into Victory*, British Field Marshal Viscount Slim commented that building his theater’s logistical infrastructure and supply reserves and maintaining his army’s health were two of the three “foundations of victory” in his campaign in Burma and India. The third foundation, the morale of his troops, was directly affected by the first two.¹⁵ Slim’s ability to innovate in planning, organizing, and sustaining his logistics enterprise was critical to his logistics success.

These historically rooted truths of the centrality of logistics to success in war are reflected in the 2018 National Defense Strategy (NDS) in which Secretary of Defense James Mattis notes the criticality of logistical preparation to the resilience and agility of U.S. forces in any setting. For the U.S. to be able to sustain effective combat operations in the modern era, it must “prioritize prepositioned forward stocks and munitions, strategic mobility assets, partner and allied support, as well as non-commercially dependent distributed logistics and maintenance to ensure logistics sustainment while under persistent multi-domain attack.”¹⁶

Demands of Today and Tomorrow

Logistics is critical not only to employing the force, but also (and perhaps even more importantly) to building the everyday readiness of the force. At the tactical level, one need only look at the various elements of readiness reporting reviewed by senior leaders to discern that the fundamentals of logistics directly affect the majority of elements that define readiness across the services—personnel, equipment, and supply readiness—which in turn directly affect the ability of the services to meet the recurring needs of ongoing deployments and generate the forces needed for war.

For example, Secretary of Defense Mattis’s recently announced intention to reduce non-deployable personnel is one aspect of force readiness that is affected by the health services component of logistics.¹⁷ Large

numbers of non-deployable personnel reduce the available strength of military units, and without the full complement of personnel, teams cannot be trained effectively, whether they are ground units, ship’s crews, or aviation formations. Personnel readiness is also affected by other logistics-related issues such as the lack of training throughput caused by insufficient, inadequate, or nonfunctional training facilities or the disruption caused by manpower transitions across the force that limit the availability of ready personnel.

Equipment readiness is another area of concern. Military units cannot perform their mission without the equipment needed to do so. Availability and delivery of parts and spare components, maintenance capability and the capacity to surge increased maintenance volume on short notice, the ability to contract additional support when necessary—all of these logistical elements are essential to military effectiveness.

Within logistics, the supply function is critical to equipment readiness. Simply stated, supply readiness is the ability to have the right types and amount of equipment available for a ground unit, a ship, or an aviation unit. Perhaps not so obvious is the interconnectedness of supply readiness to all other aspects of unit readiness. Without the right equipment, units cannot train to the full complement of their mission sets. Lacking something as simple as power generation capability on a ship, on the ground, or on an aircraft can prevent a unit from establishing the command and control capabilities that are vital to modern warfighting. As cyber and electronic warfare capabilities are introduced to the forward edge of the battlespace, individual capabilities represented by on-hand quantities of various technologies and trained personnel will truly define a unit’s ability to execute the mission-essential tasks demanded in the complex warfighting environment of a peer adversary.

Supply readiness has been the subject of various testimonies to Congress regarding the readiness of the force on land, in the air, or on the sea. Shipyard capacities and the impact of deferred maintenance due to shortages of

parts in the Air Force, Army, and Marine Corps have been highlighted as factors in the need for improved force readiness.¹⁸

The impact of logistics beyond readiness grows exponentially when taken in the context of the larger complexities of strategic logistics capabilities such as national and international highway, rail, port, and sealift capacities. Reductions in the size and capability of the industrial base, limitations on our national sealift capacity, and aging of the infrastructure needed to move personnel, weapons systems, ammunition, and fuel all directly challenge the ability of the United States to project military power.

Port facilities capable of handling critical munitions movements are critical to force deployment and sustainment. The U.S. has only 23 designated Strategic Seaports—17 commercially operated and six under military control—that make it possible to sustain overseas forces daily and keep them sustained during wartime. Airlift, composed of the Civil Reserve air and cargo fleets¹⁹ and thus a critical capability that directly affects our ability to move large portions of our force and their associated sustainment to points of crisis around the globe, is similarly limited.

At first glance, the challenges of military logistics may appear to be the same as, or at least very similar to, those experienced by FEDEX, Walmart, Amazon, DHL, or any other major supply chain operation supporting vast numbers of customers both internationally and across the United States. On deeper inspection, however, the differences are profound.

- Military logistics involves the interaction of military and government entities with private, commercial, foreign, and multinational organizations worldwide.
- Unlike commercial companies with global distribution operations, the military faces conflicts that usually erupt with very little warning and immediately create enormous demands for support akin to the Christmas rush, the Black Friday crush, and Cyber Monday rolled into one.

- Unlike commercial firms that can prepare by the calendar, the military must operate without knowing when the date of each event occurs and still have the ability to respond to a sudden change in the “latest hot item” within hours, if not minutes.
- Military forces must receive such support regardless of how limited or intermittent their access to the Internet may be, and supporting logistics forces must meet the demand while an enemy is trying to kill the customers, both at home and in the parking lot, and is destroying the delivery fleet at every opportunity.

To say the least, the challenges of military logistics are unique. Although many of industry’s best practices and technologies are relevant and even vital to the modernization of military logistics, the agility, survivability, responsiveness, and effectiveness of military logistics require another level of integrated innovation in technology and operational concepts.

The Challenge

To appreciate the challenge confronting America’s logistical capabilities, imagine having to execute a future operation similar in scale to the major deployment of U.S. combat power to Kuwait in preparation for Operation Iraqi Freedom (OIF) in March 2003. Now imagine doing this in an environment devoid of modern infrastructure in a manner that defeats an adversary’s desire to prevent our use of air, land, sea, space, and cyberspace to project military power, all in consonance within the complex interrelationships and intricacies that support current collective defense arrangements. Imagine further that this must be accomplished against a force that has near-parity with our technological capabilities and the ability to engage us from fixed, friendly facilities with engagement timed on their terms.

While significant force-protection requirements affected the deployment of military capability to Kuwait for combat operations in Iraq, the U.S. and partner-nation forces did not

have to “fight their way to the fight” in Kuwait. Additionally, U.S. and partner-nation forces had significant time to deploy military capability, ultimately using a single point of entry with mature facilities and infrastructure and Internet access.

In preparation for combat operations in Iraq, logisticians had six months to deploy the force and its associated sustainment. U.S. forces initiated the deployment with Military Sealift Command (MSC), a USTRANSCOM subordinate command, prepositioning assets moving to Kuwait beginning in October 2002, with the off-load of increased military capability beginning in earnest in January 2003 and wrapping up in April 2003, completing the six-month force buildup.

Six months may seem a long time, but the volume of activity was immense. According to one account:

In January 2003, MSC began the build-up for what would become Operation Iraqi Freedom. In January 2003 momentum was really gaining and APS-3 down-loaded several ships of equipment into theater. In late March 2003 MSC reached a peak of 167 ships in the “Steel Bridge of Democracy”, carrying “the torch of freedom to the Iraqi people” in the words of Rear Admiral D. L. Brewer III, Commander, Military Sealift Command.

The span of that bridge was literally a ship every 72 miles from the US to Kuwait. That was more than 78 percent of the total MSC active fleet of 214 ships that day—ships dedicated to supporting the US forces.... The mix of ships encompassed all four of MSC’s programs, and included the U.S. Maritime Administration’s Ready Reserve Force, and more than four times the normal daily number of commercial ships. Twenty-five of 33 Naval Fleet Auxiliary Force ships were providing combat logistics for the carrier strike groups and amphibious strike groups involved in Operation Iraqi Freedom. Three of 25 Special

Mission ships were directly supporting Navy combatants with telemetric, hydro-graphic and acoustic data....

During the height of Operation Iraqi Freedom, MSC had 167 of its 214 active ships directly supporting the war. Of these ships, 26 were operated by federally employed mariners and 141, or 84 percent, were crewed by merchant mariners employed by commercial companies under contract with MSC. Of the 141 ships, 127 ships were carrying combat equipment and cargo from the U.S. or Europe into the theater of operations or were en route to load cargo for the operation.²⁰

The same account further reflects that from January 2003 through the end of April 2003, MSC delivered more than 21 million square feet of warfighting equipment and supplies, 260 million gallons of fuel, and 95,000 tons of ammunition to the Persian Gulf area for the Army, Marine Corps, Air Force, and Navy warfighters involved in Operation Iraqi Freedom. More than 90 percent of the military cargo to support OIF was delivered by MSC ships. While 10 percent of the cargo was delivered by other means, primarily aircraft, understanding the magnitude and significance of sea-based sustainment is critical to understanding what it takes to deploy and employ the U.S. military.

At the same time, Naval Fleet Auxiliary Force oilers pumped more than 117 million gallons of fuel to Navy combat ships for bunkering and aircraft fuel. Of the 42 ships in the Prepositioning Program, 33 were underway or had already off-loaded gear for warfighting forces in the Persian Gulf area.

In the MSC Sealift Program, 106 of 115 ships, including government-owned surge sealift ships, Maritime Administration Ready Reserve Fleet ships, and chartered commercial ships, were carrying equipment and supplies for the Army’s 3rd and 4th Infantry Divisions, 82nd and 101st Airborne Divisions, and V Corps and the Marine Corps’ I and II Marine Expeditionary Forces. Additionally, two of

the three Maritime Prepositioning squadrons supporting the U.S. Marine Corps were unloaded at the Ash Shuayba Port in Kuwait. By late April 2003, more than 150 MSC ships had off-loaded in Kuwaiti ports.²¹

It should be noted, however, that in the years since these tremendous accomplishments, the size of the force available to execute these missions has shrunk considerably.

Admiral Brewer put these accomplishments into context: “The amount of cargo we delivered could fill all 119 Division 1-A college football fields three times over.”²² Specifically:

From November 2002 to May 2003, nearly 85,000 pieces of cargo and 4,000 containers of ammunition, requiring 16 million square feet of cargo space, were loaded aboard MSC ships under MSC Atlantic’s operational control. This was enough military cargo to fill the deck space of 58 Nimitz class aircraft carriers.

These figures comprised equipment loaded in Texas, Georgia and Florida for the U.S. Army’s 3rd and 4th Infantry Divisions and 101st Airborne Division, which included thousands of Abrams main battle tanks, Bradley fighting vehicles, humvees and helicopters....

In February, MSC Pacific provided direct support in the activation of 10 MSC cargo ships at various West Coast ports. They also coordinated the loading of another 10 MSC ships at Tacoma, Wash., and San Diego, Calif., which resulted in the movement of over 1 million square feet of military equipment for the U.S. Marine Corps 1st Marine Expeditionary Force and the U.S. Army’s 101st Airborne Division....

MSC normally operates 120 civilian-crewed, non-combatant ships for a variety of missions around the world. The number of ships expanded to about 214 in mid-March as additional ships were activated from reduced operating status

or chartered for the command’s support of U.S. forces in OIF.²³

While the immensity of this undertaking is staggering, it pales in comparison to the requirement laid out for the future military force in the National Defense Strategy (NDS). The future fight will require significantly greater responsiveness and diversity in the face of a greater threat. The NDS requires a military that will “be able to strike diverse targets inside adversary air and missile defense networks to destroy mobile power-projection platforms. This will include capabilities to enhance close combat lethality in complex terrain.”²⁴ With regard to mobility and resilience, our military will be required to field “ground, air, sea, and space forces that can *deploy*, survive, *operate*, maneuver, and *regenerate* in all domains while under attack. Transitioning from large, centralized, unhardened infrastructure to smaller, dispersed, resilient, adaptive basing that includes active and passive defenses will also be prioritized.”²⁵

These challenges become infinitely harder when considering the vastness of the Pacific or the intricacies of meeting challenges across the depth and breadth of Europe. The force of tomorrow must be ready to defeat a peer competitor in a broad battlespace that requires security for each logistics movement, the ability to off-load across various widely distributed locations, with minimal infrastructure, and in a communications-degraded environment.

The ability to meet the NDS requirements requires a significantly more agile force. It must be able to dictate the time and tempo of its buildup and control the massive capabilities of the U.S. military. It must coordinate with allies and partners to place combined force capabilities against the adversary’s weakness and develop and sustain a broad array of overseas advanced bases that will change frequently and provide the responsiveness and effectiveness needed to prevail despite enemy efforts to prevent U.S. forces from getting to or operating within the theater of combat. The U.S. military has not had to “fight its way to the fight” since World War II. Equally absent since that time

has been the need to apply combat power to preserve logistics capabilities.

Given the evolution of competitors' abilities to threaten the logistical underpinnings of U.S. combat power, force logistics planning now requires innovation in both technology and operational concepts. In a time of constrained fiscal resources, this means doing differently with less. There is no option to fail, and there is no hope of unlimited resources. The combination of innovation and new technology is therefore critical to maintaining the competitive logistical advantage that U.S. forces have enjoyed since World War II.

The NDS focuses on investments needed to improve the ability of forces deployed abroad to maneuver against an enemy and ensure that the posture of those forces (how they are arrayed in theater) has resilience (the ability to sustain losses and remain effective). Not explicitly addressed in the NDS but fundamentally implied is the equally daunting challenge of winning the "home games" by having the critical military-industry partnerships and dedicated infrastructure that serve as the preparation and launching pads for our forces.

The shrinking military-industrial base that provides the wherewithal of national power faces significant challenges because of unpredictable budgets and inconsistent program funding. During World War II, from 1939 to 1945, the United States delivered 1,089 warfighting ships to the fleet that today would be classified as battle force ships. These 1,089 ships included 32 carriers, 10 battleships, 62 cruisers, 442 destroyers, and 563 frigates and destroyer escorts.²⁶ Compare this to the Navy's *Report to Congress on the Annual Long-Range Plan for Construction of Naval Vessels for Fiscal Year 2019*, which proposes the construction of 54 battle force ships during the five years from 2019 to 2024.²⁷

It should be noted that the current shipbuilding plan projects 11 more battle force ships than were projected in the 2017 plan. This trend is very similar across the industrial capacity capabilities that produce aircraft and major land-component warfighting systems.

While procurement is not exclusively a function of logistics, the country's industrial capacity affects the availability of spare parts, the availability of technical support for contract maintenance, and the ability to replace warfighting platforms that are well beyond their service life, be they ships, aircraft, or major land-component systems (tanks, artillery, reconnaissance vehicles, personnel carriers, radars, ground vehicles, etc.).

When the instability of funding that results from continuing resolutions and an inability to pass budgets on time is added to these challenges, one can see that the problems confronting the industrial base are magnified at a time when they most need to be reduced so that our ability to supply the force is responsive and resilient. Perhaps counterintuitively, a constrained ability to build "new iron" (ships, aircraft, and major ground weapons systems) actually increases the logistical burden and budget because the cost of maintaining older systems necessarily increases.

The problem is made worse by the complexity of dealing with both old and new technologies in a single logistics enterprise. Add to these challenges the reduction of skilled manpower in the active and reserve forces, the increased difficulty of retaining seasoned military personnel, and a decreasing number of civilian and contractor artisans in the logistics workforce, and the need for modernizing the logistics force, from training to developing new concepts, becomes even more obvious.

Modernizing "home game" infrastructure must also include improved, state-of-the-art ranges and maintenance facilities, which are critical to supporting the readiness of new platforms that are being acquired in every service. Such facilities must also be made resilient in the face of cyber challenges, now a common feature of modern conflict. Integrating simulators and virtual reality capabilities into range design will also help to reduce the logistical impact of home-station training and generate much-needed efficiencies in major range training opportunities while also improving overall warfighting readiness.

Success Now and in the Future

New principles must be embraced to achieve the requirements for successful logistics capabilities in support of operational commanders and the National Defense Strategy. Many have written on the challenges of logistics in the 21st century, but Lieutenant General Michael Dana, Marine Corps Deputy Commandant for Installations and Logistics, has captured the requirement succinctly in his term “hybrid logistics,” which he defines as the era “where ‘old’ meets ‘new.’”²⁸ This is a period in logistics operations in which the combination of old and new technology and innovative concepts will provide precise logistics support to a widely distributed force instead of a large logistics footprint that delivers through a central hub.

The hybrid logistics attributes that Dana describes are a mixture of legacy and evolving technologies. They are delivered from the sea by means of modern connectors, platforms, processes, and concepts with the flexibility to enable multi-domain fires and maneuver. They are innovative in thought and practice, with a command and control architecture that is immunized against cyber and electronic warfare threats, and data-driven through predictive analytics. They also are applicable across the entire U.S. military from the strategic level to the tactical level. Ultimately, the effectiveness of any logistics capability is determined at the tactical level, but sustained success at the tactical level requires effectiveness further upstream at the operational and strategic levels.

Success at the operational level requires the integration of logistics capabilities contributed by all entities involved in military affairs, to include service, coalition-partner, interagency, governmental, private/commercial, and host-nation capabilities. The operational integration of these various capabilities provides the linkage between the tactical and strategic levels: a means to leverage the “Arsenal of Democracy”²⁹ in the hands of the men and women who serve in harm’s way around the globe.

In assessing the true value of logistics, however, one needs to distinguish between efficiency and effectiveness, even though the former

certainly affects the latter. Effectiveness is ultimately what matters at the tactical edge. Efficiencies should be pursued to free resources for use elsewhere, but those efficiencies must never be taken at the expense of the soldiers, sailors, airmen, or Marines who have been committed to battle. Many logistical challenges will remain unchanged in the near future because of the sheer physics of distributing ammunition and bulk liquids and the requirement to move major ground warfighting equipment and personnel. Nevertheless, changes that positively influence the agility, survivability, responsiveness, and effectiveness of logistics systems can and must be made.

Change must be made that ensures logistics agility by designing procedures and acquiring systems that adjust to changing requirements across a widely distributed force constantly and with domain-wide visibility, highlighting the needs, resources, and capabilities of the force. An understanding of the changing requirements must be achieved in the absence of direct input from the supported force through predictive capabilities that are enabled through improved artificial intelligence and machine learning capabilities.

Future logistics command and control systems can ensure agility by operating despite an enemy’s efforts to disrupt communications through cyber and electronic warfare. This can be done by developing the means to transfer logistics data systems seamlessly from digital-based processes to analog-based processes and back. This requires both technological and training/conceptual change across the force, not exclusively in the logistics enterprise.

The use of unmanned platforms will be critical to the future of agile logistics. Unmanned platforms that support ground distribution will complement unmanned aerial platforms that deliver vital sustainment to widely distributed forces. In addition, unmanned platforms that can evacuate the injured from the point of injury without sacrificing high-cost combat platforms and additional combat capability will be critical in the dispersed battlefield. Every facet of military logistics must embrace unmanned platforms, from

unmanned sea-based ship-to-shore connectors to platforms for the refueling of ships to the use of unmanned platforms for aerial refueling.

Logistics survivability upgrades can achieve reduced targetability of the logistics force through development of manageable electronic signatures, a reduced logistics footprint, and improved distribution with reduced static inventory. Static inventory is distribution moving at zero miles per hour, and anything that is static on the modern battlefield has little chance of remaining survivable.

The ability to make the force more survivable requires both technological improvements that reduce the need for large footprints in bulk liquids and ammunition and refocused training and logistics concepts. Technologies such as additive manufacturing, improved man-machine interfaces, and advanced robotics will contribute significantly to improved survivability. Ultimately, change must ensure both speed and reliability of logistics systems that build trust from the tactical level to the strategic level. Improvements in munitions and energy systems will directly improve the speed and reliability of the force and, thus, its logistical survivability and effectiveness.

Responsiveness can be improved by leveraging industrial-base support from the point of manufacture to the tactical edge forces. Improved responsiveness through domain-wide visibility and predictive logistics capabilities driven by improved artificial intelligence capabilities will provide sustainment based on finely tuned metrics that eliminate the need to request support. In short, we need to have the ability to autonomously anticipate the needs of the commander, not simply respond faster to bottom-up needs identification.

Improvements in logistics effectiveness require improved integrated capabilities and authorities that allow logistics challenges to be resolved at the lowest levels, leveraging shared awareness, and focused on effectiveness. The ability to measure effectiveness against

efficient performance is critical. This focus on effectiveness will prioritize the force's critical logistics needs by evaluating all requirements against mission success and differentiating the critical requirements from the multitude of inputs: in essence, providing the nail at the right time and place that prevents having to build a complete inventory of shoes, horses, and riders in order to win the battle.³⁰

Conclusion

Logistics is critical to success on the battlefield. To remain a vital contributor to military success, logistics must adapt continuously so that it bridges old systems and capabilities while embracing new technologies and concepts. In addition, the success of every new system and concept, every new technology and military organization, must be evaluated against the commensurate evolution and revolution in logistics sustainability.

While not a new consideration in designing a force for tomorrow that remains relevant today, the development of integrated, agile, technologically advanced, and effective logistics systems that drive efficiencies into every corner of the military is increasingly essential in today's dynamic, fast-paced, and ever-changing national security environment. The shift in our military focus to competing in an era of great-power competition demands an even greater understanding of logistics and highlights the breadth of the requirement to support the entirety of the force in innovative ways, from training in the United States to deploying far from home.

Whether the unit engaging the enemy is in the air, on land, at sea, or in space or cyberspace, it must embrace innovation in logistics that not only integrates new technology, but also innovates in the "hybrid" environment of old and new in order to retain our military's true advantage as the world's only force that can "prevail in conflict and preserve peace through strength,"³¹ both today and well into the future.

Endnotes

1. Carl von Clausewitz, *On War*, ed. Michael Howard and Peter Paret (Princeton, NJ: Princeton University Press, 1989), p. 95.
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