

INTERMODAL WAR: ASSESSING CONTAINERIZED POWER PROJECTION

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USAWC CLASS OF 2009

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REPORT DOCUMENTATION PAGE				Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing this collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.					
1. REPORT DATE (DD-MM-YYYY) 27-05-2009		2. REPORT TYPE Program Research Paper		3. DATES COVERED (From - To)	
4. TITLE AND SUBTITLE Intermodal War: Assessing Containerized Power Projection				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S) Lt Col James L. Evenson				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army War College 122 Forbes Avenue Carlisle, PA 17013				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) COL(Ret) Walter J. Wood Department of Distance Education				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION / AVAILABILITY STATEMENT DISTRIBUTION A: Unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT The successes of American military power in recent years relied greatly on the effective movement of massive quantities of materiel. Trucks, trains, and ships carrying intermodal containers delivered most of this materiel. The commercial transportation industry developed this intermodal support capability over time beginning with the introduction of the railroads in the early nineteenth century. The military quickly adapted the various ongoing developments for martial purposes. Since those earliest developments in transport, intermodal shipping, as a continuation of a revolution in military affairs related to the Industrial Revolution, progressed from piece loads, to break-bulk, to the intermodal containers of today. The power projection capability of the modern American military directly benefited from the convergence of these ongoing developments in logistics-related technology, organization, and doctrine. With this capability come certain limitations and risks. This paper assesses containerization and the strategic implications for CONUS-based power projection by the United States military in the future.					
15. SUBJECT TERMS Intermodal, Containerization, Ports, Power Projection, Strategic Lift					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			19b. TELEPHONE NUMBER (include area code)
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	UNLIMITED	30	

USAWC PROGRAM RESEARCH PROJECT

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ABSTRACT

AUTHOR: Lieutenant Colonel James L. Evenson
TITLE: Intermodal War: Assessing Containerized Power Projection
FORMAT: Program Research Project
DATE: 27 May 2009 WORD COUNT: 5,473 PAGES: 30
KEY TERMS: Intermodal, Containerization, Ports, Power Projection, Strategic Lift
CLASSIFICATION: Unclassified

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INTERMODAL WAR: ASSESSING CONTAINERIZED POWER PROJECTION

The successes of American military power in recent years relied greatly on the effective movement of massive quantities of materiel. Trucks, trains, and ships carrying intermodal containers delivered most of this materiel. The commercial transportation industry developed this intermodal support capability over time beginning with the introduction of the railroads in the early nineteenth century. The military quickly adapted the various ongoing developments for martial purposes. Since those earliest developments in transport, intermodal shipping, as a continuation of a revolution in military affairs related to the Industrial Revolution, progressed from piece loads, to break-bulk, to the intermodal containers of today. The power projection capability of the modern American military directly benefited from the convergence of these ongoing developments in logistics-related technology, organization, and doctrine. With these developments also came new risks and limitations. This paper examines intermodal containerization from a historical perspective, reviews the present day capabilities to move materiel, considers the risks and limitations associated with containers, and assesses the impact of intermodal transport on the ability of the United States military to project power from the continental United States.

Historical Significance of Intermodal Containers¹

Modern land transportation evolved over a long period with its roots in the animal drawn wagon of ancient times. Developed from these early carts, the Industrial Revolution saw the debut of the steam-powered railroad. This innovation overcame many of the obstacles faced by other forms of wheeled, ground transportation, such as unprepared roads, mud, and uneven grades, but did so at a great cost for

infrastructure.² The development of containers capable of moving between transportation modes took many forms since the first wooden boxes and barrels made their way from wagon to ship to railcar. Movers of bulk cargo, like grain, coal, or gravel, never required the packing or sorting other individual commodities required. These loose loads easily filled the various cramped irregular spaces of early ships and barges. Break-bulk cargo made up of many discrete items (especially heavy or hazardous types) required special handling or storage considerations, often wasting space and, therefore, money. Early efforts aimed at containing break-bulk cargo with larger crates helped in handling the load, but offered limited solutions to offset the storage inefficiencies.³ Seeking to overcome the challenges of moving freight between wagons and ships and railroad cars, nineteenth century transporters innovated further, increasing in size the holds and railcars to accommodate the ever-increasing sizes of crates hoisted aboard the various forms of transport. Slow advances in the still-primitive materiel handling equipment governed further development of these break-bulk movement efforts.

During the early part of the Industrial Revolution, developments in transportation, in particular the railroad, offered some intriguing promises to commercial transporters and their customers, including the military. Railroad boxcars and flatcars offered a means to move large quantities of discrete items efficiently to points along a given rail line. Like ships and barges, the railroads economically moved large quantities of goods. Unlike ships and barges, railroads offered speed and greater access to inland destinations. The military employment of the early railroads played upon these benefits as military commanders attempted to leverage the railroads in support of early land campaigns in

America and in Europe to move men and supplies.⁴ This kind of operational employment of the railroads would continue in some form through to the middle of the next century, only to slowly give way to the movement of purely materiel support of the military.

The innovations of the Industrial Revolution gave rise to the profession of logistics as men adapted various commercial inventions to overcome transport deficiencies in military applications. The military recognized many of these innovative solutions and sought to employ them for war. The railroads, originally conceived to move coal, soon moved men and many other kinds of freight.⁵ The American Civil War clearly demonstrated the effectiveness of railroads at these tasks.⁶ This effectiveness continued to improve until the Spanish-American War when the railroads, so good at moving significant quantities of materiel in short order, helped to build-up a massive logjam of supplies, animals, and men at the Port of Tampa that actually threatened the Cuban invasion. As historian David Rutenberg noted, "There was no shortage of supplies – only a totally inadequate system of accountability."⁷ Unloading railcars by hand in Tampa resulted in mixed supplies on the dock. Loading the first available ships closest to the berth with those assorted supplies spelled chaos for the units expected to fight ashore in Cuba. The military clearly needed a better means to manage and move this materiel faster. Changes made in the military organization after the Spanish-American War sought to find this means.⁸

As the Industrial Revolution continued to unfold in the twentieth century, the demand for the movement of greater quantities of materiel emerged in support of advancement in weapons and instruments of war. Motorized vehicles, with their

requisite consumables, added to the load of the Quarter Masters. Larger quantities of supplies, such as food, fuel, and ammunition, demanded more space aboard railcars and ships.⁹ Managing these mountains of materiel demanded better ways to store and distribute the items. Failing to do so threatened terminals and ports with congestion that would hamper military plans.¹⁰ Relief for this congestion came eventually at the hands of professional logisticians armed with some of the latest inventions the Industrial Revolution could offer: forklifts, pallets, and conveyors.¹¹ The militaries of World War I benefited directly from these innovations, but other problems soon arose. In particular, massive amounts of materiel again clogged ports due to the inability of the organizations involved to flow goods from rail to ship in a timely manner. The continuing demand for war materiel far outstripped supply as congested ports reached saturation points as empty railcars remained stuck in crowded, dockside rail yards.¹² The military clearly needed to address how the organization, tactics, and technologies fit together. Their chance to prove it came in late 1941.

During World War II, further technological innovations failed to stem the rising demand for even more material. Additional motorized inventions, like mass-produced aircraft, added to the problem of material demands. The economic law of diminishing returns took over as organizations and technology struggled to maintain the materiel movement effort over vast distances. Different ideas to streamline logistics operations, such as the “block load” (pre-packaged supplies for one thousand men for twenty to thirty days) in 1943, only yielded waste.¹³ Despite all the difficulties, the amounts of materiel shipped during World War II reached their peak.¹⁴ By the end of World War II, further development in logistics led to the trials of various methods to move more goods

over different modes even faster. The military attempted to streamline the movement of goods using small steel containers called Conex boxes in the early 1950s.¹⁵ (One Conex would fit in the bed of the standard 2½-ton truck.)¹⁶ Similarly, railroads explored the movement of trucks and trailers as early as 1935, but the various efforts struggled with the marketplace as well as equipment employment well in to the mid-1950s.¹⁷ In 1955, an American businessman, named Malcom P. McLean, succeeded in employing large metal trailer bodies without wheels to move cargo that until this time moved in break-bulk fashion.¹⁸ His idea quickly caught on as it proved economical, and soon commercial and military cargos began to move in similar containers. Before long, a new industry was born as containerships began to ply the coastal and international waterways. By the time the Viet Nam War buildup reached a peak in the late 1960s, significant portions of the war materiel moved in containers.¹⁹ The Department of Defense Joint Logistics Review Board publicly recognized in 1970 that, “Containerization [moving materiel in containers] offers the Services a major opportunity for a breakthrough in simplifying and speeding logistic support to deployed forces. Therefore, the use of containers should be developed and exploited as rapidly as possible.”²⁰ The course for containers in the military was now set.

The peacetime culminating point for the military shift from break-bulk to containers began in the early 1980s with the retirement of older forty-foot boxcars in the domestic railroad industry.²¹ While some railroads replaced the older boxcars with larger ones, other railroads and some customers looked to containers instead.²² The deregulation environment of the time “set in motion the move to deregulate all container transshipping” in 1984. This action spurred increased investment in containers.²³ In

1990 and 1991, Operations Desert Shield and Desert Storm again tested the military use of containers in war with mixed results due to a lack of theater infrastructure to handle them.²⁴ Despite this experience, moving materiel in containers between modes of transport, intermodal, continued to accelerate until in the 1992 when the military formally adopted intermodal containers for the movement of ammunition, the last break-bulk holdout in the Army Strategic Mobility Plan.²⁵ Since then, the United States military continued to develop doctrine, organizations, plans, and equipment for the loading, movement, and unloading of intermodal containers that provide the factory-to-foxhole supplies the modern American military now required. Despite all these efforts, logisticians involved in operations in the twenty-first century continually noted ongoing problems in moving materiel due to a fundamental lack of a formal intermodal container transportation strategy.²⁶ Clearly, this revolution in military affairs continues to progress.

Intermodal containerization was the result of converging technologies with changes in organization and doctrine over a long period. Modern military capabilities required a means to support mass movements of materiel over vast distances using different means of transport, and only intermodal containers met this need. This complex mix of innovations, linking various logistical capabilities, took time to develop the supporting organizations and doctrine required for successful employment, but the impact upon the militaries, particularly the United States Department of Defense in 2006, is nothing short of revolutionary.²⁷ Of all of the modern logistical feats associated with the mass movement of materiel, historian John Lynn noted, "These great demonstrations of production, shipment, and distribution came at the price of wedding military success to the uninterrupted flow of industrial bounty. Armies and Navies became more powerful,

but also more vulnerable, since they could not afford any break in their essential lifelines of supply. Logistics moved ever more to the center of gravity.”²⁸ In the context of a revolution of military affairs, intermodal containerization is a culmination of innovation, organization, and doctrine that deployable militaries simply cannot ignore if they expect to win wars in the future. The ability of the United States to project power today fails without containers to move the materials required to sustain forces abroad. An examination of this present-day capability is necessary in order to assess the limitations associated with this means of power projection.

Present State of Intermodal Capabilities

If the military of tomorrow seeks to avoid the clogged ports and the congested rail yards of the past, a keen understanding of intermodal containerization as a strategic mobility enabler is in order. The present-day factory-to-foxhole path of military logistics is a series of interconnected capabilities employing common hardware standards and practices. Each of these capabilities, in turn, relies on various equipment and information technologies, civil and military organizations, and doctrine and policies for the conduct of operations. These technologies include transportation-related entities such as standardized containers, container handlers, container ships, specialized railcars and trucks, and all of the supporting infrastructure and information technology to provide the overall management of the end-to-end process. Organizations supporting intermodal container operations include specialized military logistics units, civilian workers, railroads, shipping lines, trucking companies, and all of the supporting activities required to make these groups function. Each of these organizations also bring with them business strategies and operating practices that make the supply chain

work as a whole. To understand the strategic implications of each of these elements, a summary of their contribution to the overall concept of military power projection using intermodal containerization is required.

Modern day intermodal containerization is the most significant means by which the U.S. military goes to war. In fact, over 85% of military cargo goes by containerized military sealift.²⁹ In this capacity, the ability to transfer the most amount of cargo in the least amount of space via the fastest method possible adds to the building of combat power on foreign shores. To get there, however, one must have the containers, the means to convey the containers from one mode of transport to the next, the ships, trucks, or railcars capable of handling containers, and all of the supporting command and control mechanisms to manage the thousands of containers that might be located at a single location. To illustrate this point of magnitude, the civilian port of Long Beach handled 6.7 million 20-foot equivalent containers in 2006 alone.³⁰ Only the convergence of all of this technology made this feat possible.

In 2009, the most common container in use by the military is the 20-foot International Organization for Standardization (ISO) container. This particular container is 20-foot long by 8-foot high by 8-foot wide and serves as the backbone for current military shipping.³¹ While larger containers, such as 40-foot versions, are common in commercial enterprises and in some limited military applications, military loads, particularly ammunition are often very heavy and tend to 'weight out' the container long before the space is 'cubed out.' These small, though sometimes very heavy containers are also easier to handle aboard vessels and on rough terrain where larger containers containing proportional weight become impractical to maneuver, usually constrained by

the ability to move the larger size with the container handling equipment (CHE) available in forward areas.³² As a case in point, all Marine Corps ammunition shipped today from depots in the U.S. move overseas in 20-foot containers since the Marines lack the organic ability to handle any larger size in an expeditionary environment.³³

Supporting containers are the modes of transport, namely trucks, railcars, and vessels of various types. The trucks in question range from commercial tractor-trailers outfitted with a flatbed or special container chassis to military vehicles capable of retrieving a container from the ground.³⁴ Railcars come in several forms including standard multi-purpose flatcars, intermodal flatcars (with hardware for blocking and bracing containers), or well cars where the container rides closer to the rails, often stacked two high, though these cars are not common in military movements.³⁵ Vessels include ships of numerous types to carry containers externally, internally, or a combination of both, and some types of barges, though the latter is usually a secondary transfer means for military purposes.³⁶ Each of these modes presents challenges in the power projection equation, particularly ocean shipping given the critical low density of the assets. Potential adversaries of the U.S. are well prepared to break this link in the overseas military supply chain.³⁷

In the continental United States (CONUS), the other key physical element required in the conduct of container operations is infrastructure. This element is comprised of the intermodal seaports, rail yards, and truck lots with all of their supporting assets including docks, ramps, cranes, storage yards, and operations and maintenance facilities. Despite the ability to stack containers in some cases five high, the real estate requirement for the off- and on-loading of these boxes is enormous.³⁸ Add to this mix

the requirement to handle hazardous material like ammunition and the physical space requirement to accommodate the explosive arc alone limits the number of ports capable of moving this commodity. Case in point, only one port on the west coast of the United States and three ports on the east coast are capable of this type of container handling for shipping any significant amounts of military arms, ammunition, and explosives (AA&E) given the quantities of net explosive weight (NEW) involved.³⁹

Keeping containers, their contents, and their location under control requires more than simply paper manifesting the boxes. Containers today move with automated information technology (AIT) supporting both total asset and in-transit visibility through the employment of radio frequency identification (RFID) systems.⁴⁰ These systems support the movement and storage of containers and their contents with RFID tags. These RFID tags vary by application and capability, but all generally operate under a similar scheme of interrogation by a transceiver that provides information about the RFID tag, the container, and the contents to a server that makes the data available to other applications.⁴¹ Through this technology, the marshalling, loading, and unloading of containers occur in intermodal ports, rail yards, and truck lots without the congestion and gridlock that might otherwise occur without these systems. This technology also represents a critical vulnerability to the overall system in the event of loss or compromise, such as a cyber attack or hacker intrusion on the application servers.

Organizationally, the movement of military-related containers relies upon commercial industry and Department of Defense-related groups, in particular the Surface Deployment and Distribution Command (SDDC) [formerly the Military Traffic Management Command (MTMC)] under the United States Transportation Command

(USTRANSCOM).⁴² Commercial interests generally include those required to provide certain operational activities that the military does not directly support in CONUS, namely off-base storing, loading, driving, and maintenance of the containers and the supporting vehicles and infrastructure. Most military containers move to port by rail, and, today, the U.S. military has little organic capability, outside of loading activities, to support this mode.⁴³ On the other hand, the military provides those on-base activities (though sometimes through civilian contractors) required to receive or ship containers by truck or rail stateside. The U.S. Army, in particular, is well suited for the base handling of containers through the Transportation Corps and the various logistics support units in CONUS through Installation Transportation Offices.⁴⁴ The handling of containers outside of CONUS often falls to the Army, under its Title X responsibilities, to oversee the infrastructure and contracted workforce to keep the containers moving. In these scenarios under wartime conditions, the assumption is that most theaters of operation will have ports that are capable and willing to handle this military cargo. Willingness and capabilities are important particularly when considering the previous discussion of AA&E since container ports that handle such explosive cargo are much less numerous than those ports supporting general goods. Given the weight and hazardous nature of AA&E, airlifting of mass quantities is impractical. For those military operations without the direct support of ammunition-capable ports, the U.S. Army and, to some extent, the U.S. Marine Corps must employ other slower, more cumbersome means to bring containers ashore from ocean-going vessels for transfer inland.⁴⁵ This cargo handling constraint for overseas container operations is a significant strategic logistics planning consideration.

Bringing together all the equipment, infrastructure, and organizations and making the intermodal system work requires doctrine. From the perspective of policy, the U.S. Army espouses six principles of containerization. According to FM 55-80, *Army Container Operations*, these six are:

1. Seamless Flow of Materiel and Information
2. Mobility and Readiness
3. Throughput Distribution
4. Standardization
5. Container Status/In-Transit Visibility
6. Cargo Integrity, Security, and Safety⁴⁶

Commercial container-related businesses likely share these six principles, but their respective business strategies must include other ideas related to return-on-investment for shareholders and similar financial motives that the military does not share. Civilian entities represent these kinds of financial considerations as a measure of risk that manifests itself in the tariffs the shippers charge for their services relative to the nature and conditions of the services rendered. A civilian cargo ship delivering supplies into a port supporting a military action will usually charge more as a risk premium than one delivering cargo where no fighting is present.

Examining each of these principles relative to the ability of the U.S. to project power from CONUS, one finds a common focus on the support for the overseas war fighter through disciplined logistics. As a whole, these principles seek to “to optimize use of strategic lift, focusing primarily on sealift, to improve force closure time for unit equipment and sustainment supplies and meet national defense objectives.”⁴⁷ Each

principle clearly has roots in the past when wartime conditions stymied the movement of material, precluded timely information on the location of stores, or denied support for operations due to lack of supplies. Take these principles and project them onto possible military actions in the future and the enormity of the logistics effort required soon emerges.

In summary of this section, intermodal containerization clearly requires the same kind of strategic thinking and planning as other elements of the profession of arms. While the doctrine, organization, training, materiel, leadership and education, personnel, and facilities (DOTMILPF) construct applies, the level of involvement of commercial support can hide the strategic significance of the topic. Lessons learned from history clearly show the importance of effective strategic lift, and leaders of the U.S. military of today must fully grasp the extent to which power projection and sustainment relies on the simplest of concepts, like containers, taken to orders of magnitude well over that experienced on a retail unit level. This strategic supply chain imperative is fraught with limitations and risk that can adversely affect strategic plans supporting national interests. A review of some of these possible threats and ways to mitigate them is now in order.

Limitations and Risks of Containerization

The review of present-day intermodal containerization alluded to a number of limitations and risks inherent in the organization, facilities, and equipment required to make the factory-to-foxhole supply chain operate as intended. As a dynamic system of individual actions, the intermodal scheme works well in peacetime. Military units and civilian companies together demonstrate their abilities to forecast resource

requirements, position equipment and people, manage workloads in a relatively static and secure environment on a daily basis; however, the real test of the system to meet demand is not an everyday occurrence. Mobilization of the military beyond the levels experienced since the start of the Long War is the true gauge. Surge shipping and material sustainment levels like those of World War II, Korea, and Viet Nam are the litmus test of intermodal containerization. Mobilization levels exceeding the partial one the U.S. now operates in are the real-life measure that containerized operations must meet. Failing to do so might preclude the ability of the U.S. military to protect national interests abroad.

“For want of a nail,” began a verse posted on the wall of the Anglo-American Supply Headquarters in London, England during World War II.⁴⁸ Like then, the containerized supply chain of today finds similar circumstances, not just with the supplies themselves, but also with the actual equipment required to move the goods. Containers, handlers, cranes, trucks, trailers, rail cars, barges, and ships all play a role in the strategic lift equation. Each of these assets is a finite resource, and most are not government owned. While the U.S. military does possess some amount of containers, handling equipment, trucks, rail cars and ships, commercial interests own the vast majority of the assets, and, in many cases today, those interests are foreign.⁴⁹ The actual quantities of these resources controlled by the Department of Defense represent a small fraction of the total required to mobilize and sustain a significant overseas force. Various mobility requirements studies cite the need for additional organic capacity to move material, particularly containers, though usually in the context of intratheater operations.⁵⁰ Domestically, the availability of containers, particularly those certified for moving AA&E,

as well as rail cars, continue as an on-going concern to strategic planners. To this point, the Department of Defense maintains some level of on-hand capacity for lift through the container fleets of the services and the container-capable rail cars of Defense Freight Railway Interchange Fleet (DFRIF).⁵¹ The limitations associated with all of this kind of equipment are primarily quantity and location, and the Department of Defense wrestles continuously with the cost versus benefits under various mobilization scenarios. Having the right amount of equipment in the right place when needed remains an unending balancing act of limited resources and time-consuming actions.

After intermodal equipment, the next significant limitation is infrastructure and related facilities. At any given transfer node, certain physical elements must exist in order for the equipment to move containers. Most CONUS defense installations in use today predate widespread use of containers. In fact, the rail layout of most bases supported rail operations using 40-foot boxcars that have long stopped running.⁵² In order to conduct intermodal operations today from most bases, updated rail yards on flat terrain with access to storage yards and other support structures is necessary to conduct wholesale movements of units. In the absence of such a layout, commercial container yards, if located in proximity to the source of material, offer some relief. Ammunition depots, on the other hand, require significant space to account for explosive arcs related to stored and containerized ammunition. Few commercial intermodal activities offer large-scale support for off-base handling of this particular class of supply. Most significantly, port facilities prove the single largest constraint in the intermodal equation. Surging of military supplies through civilian ports competes with global commercial activities.⁵³ The few military ports left in CONUS constrain the

quantities of ammunition containers allowed on-hand due to NEW considerations.⁵⁴ On the receiving end of the ocean voyage, similar, if not worse, conditions are likely. Not all conflicts in the future will benefit from near-by deep-water ports with container handling capabilities. Nor will likely competitors allow the shipping of vast military supplies to go unmolested. From the perspective of strategic planners, these risks remain significant and enduring.

The final large risk in the intermodal containerization equation is a perishable one: skilled people. Never before have relatively few operators moved more cargo than is the case today. The efficiency gains of containerization pose job security risks in the eyes of many a union member whose personal interest may not align closely with the national ones the U.S. military is seeking to protect. As far back as 1928, unions bedeviled plans to move freight in innovative ways.⁵⁵ In 2002, port workers in California walked off the job, citing employer demands to implement technology to improve container-handling efficiency, effectively shutting down container operations at several of the largest ports in the U.S.⁵⁶ More troubling in many respects is the fact that organization responsible for the most recent West Coast strike in 2008, which shut down 29 ports, cited opposition to the Iraq War as the reason for the work stoppage.⁵⁷ Add to this mix the increased requirement for qualified drivers to move heavy equipment and hazardous materials during a mobilization surge as well as the need to crew civilian ships potentially destined for hostile waters, and the risks increase further. Given the nature of these risks and the limitations they present, strategic planners must continue to balance competing demands of time and capacity to move cargo against the

willingness of the people supporting the efforts to operate in a manner conducive to the war effort.

Taken in total, intermodal containerization provides flexibility in the deployment and sustainment of forces, but remains acutely vulnerable to limitations and risks related to equipment, facilities, and people. The efficiencies in cargo handling gained over time reduced capacity to allow for and recover from significant disruption. While the clogged ports of the twentieth century are unlikely to reoccur, the prospect of delayed or denied strategic movements under a mobilization scenario remains a real threat unless otherwise countered.

Recommendations to Reduce Strategic Risks

To counter the limitations and risks associated with intermodal containerization, the U.S. government should consider actions that maintain or expand capacity of the overall supply chain in support of national defense under conditions of increased total throughput due to total mobilization or decreased speed resulting from actions of an enemy. Equipment, facilities, and organizations all have a role to play in this effort. Given this assessment, several recommendations emerge.

The first recommendation involves increasing the overall capacity of equipment by boosting the number of containers, rail cars, and container-capable ships available on short-notice to the U.S. government. Though the U.S. Army owns a considerable number of International Organization for Standardization (ISO) containers, the total available ready to load at any given base of each branch of service or defense agency must support a mobilization surge. Newer versions of this container, called Joint Modular Intermodal Containers, are now available that collapse down for easier reverse

logistics handling.⁵⁸ An on-hand quantity of these government-owned containers and handlers required to ship supplies or ammunition should exceed the quantity required to load out, according to mobilization plans, all of the required materials less the quantity available on an on-going basis from commercial sources in the immediate area. Similarly, the assets required to move these new containers must increase proportionally to ensure the least amount of delay.⁵⁹ Case in point, the government-owned flatcars of the DFRIF today number less than 2,000, not all are container-capable, and many are better suited to carry vehicles and equipment other than containers.⁶⁰ The positioning of these strategic lift assets must consider the expected container quantities on-hand or readily available as well as the conditions of container off-load. While leasing such assets is preferable, some commercial rail cars capable of moving containers are not well suited for on- or off-loading at facilities other than commercial intermodal ones. The last area, ocean shipping, is the most expensive capacity to increase. In early 2005, the world container-ship fleet was 3,478 vessels.⁶¹ Eighteen foreign companies owned most of these ships.⁶² In supporting national defense, Congress should consider financial incentives for American companies to enter into this competitive marketplace. With such an arrangement, the ocean shipping equivalent of the Civil Reserve Air Fleet, where U.S. airline companies make available equipment and crews on a pre-negotiated short-notice basis during wartime, becomes possible.⁶³ This mechanism would further increase the number of ships available to the government when needed most. These actions in total offer one feasible approach to address the constraints placed upon power projection by available equipment.

The next recommendation is oriented on the facilities and infrastructure required to support military mobilization. While the current global economic downturn in business frees up capacity to surge through commercial ports, the larger concern is for those facilities required to support the movement of large quantities of AA&E. The current constraint on operations relative to ammunition-capable ports is significant, particularly on the West Coast where a single primary active port exists for loading large ships with significant quantities of AA&E. Mobilization considerations warrant a second active port on the West Coast with equivalent capabilities for such activities. On the East Coast, remedial action in 2003 averted further encroachment of commercial interests into the explosive arc of Blount Island, Florida.⁶⁴ A similar action taken by the Department of Defense to build out a current military-related port, such as the U.S. Navy Bangor, Washington Trident Base, is necessary given the time and negotiations required to address the explosives safety measures and extend the facilities. Without such an arrangement, a single point of failure for westbound strategic surface movement exists for moving large quantities of AA&E.

The final recommendation to reduce the strategic risks associated with intermodal containerization is related to on-going organizational education and training. The groups involved in the strategic supply chain are unlikely candidates for nationalization as was the approach taken by the U.S. government in World War I.⁶⁵ Since the all-volunteer U.S. military no longer contains significant numbers of personnel well-versed in the trades of commercial business, such as running railroads, a means to familiarize members of the military is important. The establishment of permanent part-time liaison billets with major domestic railroads and multinational shipping companies for members

of USTRANSCOM would open the lines of communication with important industries where few exist today and offer opportunities for military members to cross-train with corporate partners. These roles would further serve to strengthen the cooperative relationships between the U.S. military and these commercial entities. During mobilization, these liaison jobs would increase to full-time positions to ensure open lines of communication for all parties concerned and would remain active until hostilities reach a level where strategic movement plays a less important role.

These three recommendations provide options to address some of the inherent limitations and resulting risks associated with intermodal containerization. While not complete in any sense, the proposals provide a framework for understanding the issues the military faces with regard to the developing world of containers and the ability to mobilize and sustain operations from CONUS.

Conclusion

Future success on the battlefield will continue to rely on the fast power projection and reliable sustainment capabilities. Optimizing the use of the available equipment, facilities, and people will remain a challenge for strategic planners as the intermodal container revolution in military affairs continues. The efficiencies associated with the commercial economies of scale in this global supply chain will continue to refine the employment of containers, though not always in a manner suitable for use by the military. Only through on-going innovation and active cooperation with commercial intermodal interests will the U.S. military remain prepared to mobilize in a containerized world.

Endnotes

¹William D. Middleton, George M. Smerk, and Roberta L. Diehl, eds., *Encyclopedia of North American Railroads*, (Bloomington, IN: Indiana University Press, 2007), 549. "Intermodal transport is the movement of cargo ... using more than one type of vehicle." Intermodal containers are specially designed containers intended for use on trailers, railcars, and ships.

²John A. Lynn, ed. *Feeding Mars: Logistics in Western Warfare from the Middle Ages to the Present* (Boulder, CO: Westview Press, Inc., 1993), 184.

³Marc Levinson, *The Box: How the Shipping Container Made the World Smaller and the World Economy Bigger* (Princeton, NJ: Princeton University Press, 2006), 19-20.

⁴Christopher R. Gabel, *Railroad Generalship: Foundations of Civil War Strategy* (Fort Leavenworth, KS: Combat Studies Institute (CSI), United States Army Command and General Staff College, 1997), 1-24. This citation refers to American employment of railroads in support of operational movement of troops and materiel in war.

Hojo Holborn, "The Prusso-German School: Moltke and the Rise of the General Staff," in *Makers of Modern Strategy*, ed. Peter Paret (Princeton, NJ: Princeton University Press, 1986), 292. This citation refers to Europe for a similar usage of railroads.

⁵Randy Houk, "Railroad History," Pacific Southwest Railway Museum website, 1 April 2008, available from <http://www.sdrm.org/history/timeline/>; Internet; accessed 27 May 2009. This webpage complements the previous endnote with regard to the early developments of railroads in Europe and the US.

⁶Gabel, 1-24.

⁷David C. Rutenberg and Jane S. Allen, ed., *The Logistics of Waging War: American Logistics 1774-1985 Emphasizing the Development of Airpower* (Washington, D.C.: Air Force Logistics Management Center, Gunter Air Force Station, AL, U.S. Government Printing Office, 1986.), 49.

⁸Rutenberg, 50-51.

⁹Lynn, 185.

¹⁰Rutenberg, 49.

¹¹Levinson, 18

¹²Richard Saunders, Jr., *Merging Lines: American Railroads, 1900-1970* (DeKalb, IL: Northern Illinois University Press, 2001), 35-38.

¹³Jerome G. Peppers, Jr. *History of United States Military Logistics: 1935-1985: A Brief Review*. (Huntsville, AL: Logistics Education Foundation Publishing, 1988), 81.

¹⁴Lynn, 188.

¹⁵Levinson, 31.

¹⁶*Ibid.*, 191.

¹⁷Saunders, 126-127.

¹⁸Levinson, 48-49.

¹⁹Rutenberg, 154. See also Levinson, 171-188. This chapter of Levison's book provides an excellent review of the military transition from break-bulk to containerized cargo during the Viet Nam War.

²⁰Charles R. Shader, ed., *United States Army Logistics, 1775 – 1992: An Anthology* (Washington, D.C.: Center of Military History, United States Army, United States Government Printing Office, 1997), 704.

²¹Richard Saunders, Jr., *Main Lines: Rebirth of the North American Railroads, 1970-2002* (DeKalb, IL: Northern Illinois University Press, 2003), 190.

²²Brian J. Cudahy, *Box Boats: How Container Ships Changed the World* (New York, NY: Fordham University Press, 2006), 162-167. This citation includes information about how the shipping lines began to enter the container rail car market, though not with types readily usable by the military.

²³Saunders, 207.

²⁴James K. Matthews and Cora J. Holt, *So Many, So Much, So Far, So Fast: United States Transportation Command and Strategic Deployment for Operation Desert Shield/Desert Storm* (Washington, D.C.: Joint History Office, Office of the Chairman of the Joint Chiefs of Staff and Research Center, United States Transportation Command, Superintendent of Documents, U.S. Government Printing Office, 1996), 181-188.

²⁵United States Department of Defense, Joint Chiefs of Staff, *Mobility Requirements Study (U)* (Washington, D.C.: Joint Chiefs of Staff, 23 January 1992), VII-2–VII-4. This study did not explicitly state that boxcars were less preferred. Rather, the study, citing the Army Strategic Mobility Plan, emphasized the benefits of twenty-foot intermodal containers with regard to strategic shipping. The decreased use of boxcars was a result of the shift in mode. The context of the study was ammunition movement from depots to ports to theater.

²⁶Douglas Tastad, "Containerized Logistics Imperatives," *Proceedings* 132, no. 9 (September 2006), 58-63.

²⁷MacGregor Knox and Williamson Murray, ed. *The Dynamics of Military Revolution, 1300-2050* (Cambridge, UK: Cambridge University Press, 2001), 12-13. The discussion of a revolution in military affairs (RMA) in text draws from the descriptions offered by these authors.

²⁸Lynn, 188.

²⁹U.S. Department of the Army, *Army Container Operations*, Army Field Manual 55-80 (Washington, D.C.: U.S. Department of the Army, 13 August 1997) [manual on-line], no page numbers cited; available from <http://www.globalsecurity.org/military/library/policy/army/fm/55-80/ch1.htm#c1p1>; Internet; accessed 2 May 2009.

³⁰Ted Smith-Peterson, "The Spigot: How commerce flows from Southern California ports onto U.S. rails," *Trains* 66, no. 9 (September 2006), 35.

³¹"Containers," GlobalSecurity.org website, undated, available from <http://www.globalsecurity.org/military/systems/ground/container.htm>; Internet; accessed 4 May 2009.

³²*Ibid.*

³³Ibid.

³⁴"Palletized Load System (PLS)," GlobalSecurity.org website, undated, available from <http://www.globalsecurity.org/military/systems/ground/pls-relatedsystems.htm>; Internet; accessed 9 May 2009. This particular citation described a multi-purpose vehicle that provides container handling as one of several functions.

³⁵Michael W. Blaszak, "Intermodal equipment," *Trains Magazine* website, trains.com, 1 May 2006, available from <http://www.trains.com/trn/default.aspx?c=a&id=219>; Internet; accessed 9 May 2009.

³⁶Cudahy, 27-229. The author documents the historical development of the containership in detail throughout this book, beginning with steamship lines in the 1920's and 30's, through the creation of the first true containerships in the 1950's.

³⁷Andrew S. Erickson and David D. Yang, "On the Verge of a Game-Changer," *Proceedings* 135, no. 5 (May 2009), 26-32. This article describes China's efforts to develop and deploy an anti-ship ballistic missile capability. Though the essay focuses on U.S. Navy aircraft carriers, the idea of targeting containerships supporting U.S. military forces is reasonable.

³⁸Smith-Peterson, 35-37.

³⁹Military Traffic Management Command, Transportation Engineering Agency, *MTMCTEA Capability Study: Military Ocean Terminal, Concord (MOTCO)* (Newport News, VA: Military Traffic Management Command, Transportation Engineering Agency, September 2002), 5-6. See also, Military Traffic Management Command, Transportation Engineering Agency, *Naval Magazine Indian Island and Subase Bangor, WA Container Throughput Analysis* (Newport News, VA: Military Traffic Management Command, Transportation Engineering Agency, July 2002), 3-5. The Indian Island throughput rate is, at best, one third of MOTCO. The prerequisite conditions, facilities, and equipment required to achieve the maximum throughput rate at Indian Island precludes its consideration as a primary West Coast AA&E port for mobilization purposes.

⁴⁰"What is RFID?" Association for Automatic Identification and Mobility website, undated; available from http://www.aimglobal.org/technologies/rfid/what_is_rfid.asp; Internet, accessed 10 May 2009.

⁴¹Ibid.

⁴²U.S. Department of the Army, *Army Container Operations*, Army Field Manual 55-80 (Washington, D.C.: U.S. Department of the Army, 13 August 1997) [manual on-line], no page numbers cited; available from <http://www.globalsecurity.org/military/library/policy/army/fm/55-80/ch1.htm#c1p10>; Internet; accessed 2 May 2009.

⁴³James L. Evenson, *Capability in Decline: A Historical Analysis of the Post-World War II Degradation of Domestic Railroads and the Impact on the United States Military*, Master's Thesis (Fort Leavenworth, Kansas: United States Army Command and General Staff College, 2006), 45-46, ADA495249.

⁴⁴"Containers," GlobalSecurity.org website, undated, available from <http://www.globalsecurity.org/military/systems/ground/container.htm>; Internet; accessed 4 May 2009.

⁴⁵Mark D. Huntzinger, "Phib Seabee Battlebook," 6 February 1998, available from <http://www.fas.org/man//dod-101/sys/ship/docs/phibcb-battle.htm>; Internet; accessed 8 May 2009.

⁴⁶U.S. Department of the Army, *Army Container Operations*, Army Field Manual 55-80 (Washington, D.C.: U.S. Department of the Army, 13 August 1997) [document on-line], no page numbers cited; available from <http://www.globalsecurity.org/military/library/policy/army/fm/55-80/ch1.htm#c1p15>; Internet; accessed 2 May 2009.

⁴⁷"Containers," GlobalSecurity.org website, undated, available from <http://www.globalsecurity.org/military/systems/ground/container.htm>; Internet; accessed 4 May 2009.

⁴⁸"For want of a Nail Rhyme," Nursery Rhymes - Lyrics and Origins website, undated, available from http://www.rhymes.org.uk/for_want_of_a_nail.htm; Internet; accessed 9 May 2009.

⁴⁹Cudahy, 231-250. This citation includes tables listing major carriers, quantities of containers moved, and port volumes for the period of 1998-2004.

⁵⁰United States General Accounting Office, Report to Congressional Requesters, *DOD'S Mobility Requirements: Value of Intratheater Lift Analysis Can Be Enhanced* (Washington, D.C.: General Accounting Office, 30 January 1998 [on-line document], no page numbers cited, GAO/NSIAD-98-53, available from <http://fas.org/man/gao/nsiad98053.htm>; Internet; accessed 9 May 2009.

⁵¹"Containers," GlobalSecurity.org website, undated; available from <http://www.globalsecurity.org/military/systems/ground/container.htm>; Internet; accessed 4 May 2009. For a brief written description of the Defense Freight Railway Interchange Fleet, see Surface Deployment and Distribution Command, "Customer Advisory," 6 December 2007 [on-line document], available from http://www.sddc.army.mil/sddc/Content/Pub/10977/CustAdv_RailCars.pdf; Internet; accessed 9 May 2009.

⁵²Evenson, 60.

⁵³Tom Murray, "The China Factor," *Trains* 66, no. 8 (August 2006), 31-33. This article highlights the changes the ports and railroads experienced between 2003 and 2006. In 2006, many U.S. civilian ports operated near capacity. The downturn in the economy in 2007 and 2008 decreased the pressure on port capacity, but this condition is likely to change in the future.

⁵⁴Military Traffic Management Command, Transportation Engineering Agency, *MTMCTEA Capability Study: Military Ocean Terminal, Concord (MOTCO)*, 5-6. See also Endnote #37 for additional information on another West Coast port considered in this assessment. The East Coast ports include Earl, NJ, Sunny Point, NC, and Charleston, SC. Additionally, Blount Island, FL provides significant AA&E support to Maritime Prepositioning Ship squadrons, but these containers join with other supplies and equipment for the U.S. Marine Corps. MTMC reports on several of these other ports are readily available.

⁵⁵Cudahy, 73-74.

⁵⁶David Armstrong, "Strike looms at seaports," *San Francisco Chronicle*, 27 June 2002 [newspaper on-line], available from <http://www.sfgate.com/cgi-bin/article.cgi?file=/chronicle/archive/2002/06/27/BU65541.DTL>; Internet; accessed 9 May 2009.

⁵⁷Jill Serjeant and Bernard Woodall, "West Coast ports closed by worker protest," *Reuters.com*, 1 May 2008 [on-line article], available from <http://www.reuters.com/article/domesticNews/idUSN0144367220080501?feedType=RSS&feedName=domesticNews&rpc=22&sp=true>; Internet; accessed 9 May 2009.

⁵⁸Mark Edward Johnson, "The Joint Modular Intermodal Container, is the future of Naval Logistics?" Graduate Research Paper (Cambridge, MA: Massachusetts Institute of Technology, June 2005), 29-35.

⁵⁹Dwight C. Sones, "Can the Rail Industries Flatcar Inventory Support Two Major Theater Wars?" Graduate Research Paper (Wright-Patterson Air Force Base, OH: Air Force Institute of Technology, June 2000), 59-66, AFIT/GMO/END/00E-11.

⁶⁰Ibid., 24-30.

⁶¹Cudahy, 243.

⁶²Smith-Peterson, 40.

⁶³"Civil Reserve Air Fleet," Federation of American Scientists website, available from <http://www.fas.org/programs/ssp/man/uswpns/air/cargo/craf.html>; Internet; accessed 6 May 2009.

⁶⁴Devan Stuart, "Jaxport, Marine Corps reach \$20 million agreement," Jacksonville (FL) Business Journal, 24 June 2003 [newspaper on-line], available from <http://jacksonville.bizjournals.com/jacksonville/stories/2003/06/23/daily8.html>; Internet; accessed 9 May 2009.

⁶⁵Saunders, 37.

Glossary

AA&E	Arms, Ammunition, and Explosives
AIT	Automated Information Technology
CHE	Container Handling Equipment
CONUS	Continental United States
CRAF	Civil Reserve Air Fleet
DFRIF	Defense Freight Railway Interchange Fleet
ISO	International Organization for Standardization
JMIC	Joint Modular Intermodal Container
MHE	Material Handling Equipment
MTMC	Military Traffic Management Command
NEW	Net Explosive Weight
OHE	Ordnance Handling Equipment
RF Tag	Radio Frequency Tag
RFID	Radio Frequency Identification
SDDC	Surface Deployment and Distribution Command
TAV	Total Asset Visibility
USTRANSCOM	United States Transportation Command