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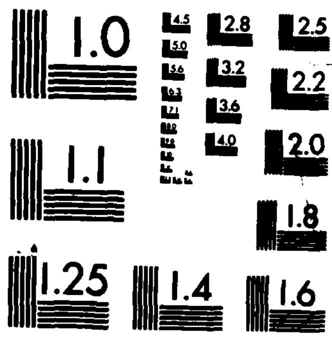

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CONTAINERIZATION IN THE ASSAULT FOLLOW-ON ECHELON (AFOE)
-POST J-LOTS II PERSPECTIVE-

by

William F. Thompson
Lieutenant Colonel U.S. Marine Corps

AD-A160 389

NAVAL WAR COLLEGE
Newport, Rhode Island

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PREFACE

As a logistician I advocate "containerization" and the enhanced productivity offered by dimensional standardization; as a Marine and combat engineer I am concerned that increased throughput rates and productivity (both virtually unproven measures of system effectiveness) do not necessarily equate to better fighting capability--at least not until the warriors become educated in the design and implementation of that system.

As there exists neither published official doctrine nor a concept of operations directly relating to containerization, the sources for this paper consist primarily of contractor studies and reports, laboratory technical reports, planning documents to support the Navy/Marine Corps Amphibious and Field Logistics Systems (ALS/FLS), and, when available, operational test reports on hardware performance. As such, there is not yet an absolute authority (CNO/CMC) for any of the positions taken by respective documents.

In that logistical procedure for the MPS have recently received a significant amount of attention, this paper will focus on the challenges afforded by the instream offload of the AFOE in a conventional amphibious operation.

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EXECUTIVE SUMMARY

During the final stages of the war in Vietman and even more so after U.S. withdrawal, DOD strategic planners once again turned their attention to large-scale exercises and determined, quite correctly, that a changing economic strategy in the shipbuilding industry, a political and public outcry against inflated defense spending, and the aging platforms within the fleet had generated some distinct problems in strategic mobility and, consequently, global readiness. Our vital interests, now primarily economic, were more global in nature and required third world presence. The loss of nuclear superiority returned strategic thinking to the "long" conventional war--one which demanded sustainability through strategic mobility, maritime superiority, and innovative tactics. It was also a time when new weapons and communications systems under development would require tremendous quantities of ammunition and support material. Increased productivity and throughput rates were demanded for the very survival of combat forces.

Competition for defense dollars at the Federal level was strong and would only intensify with increased inflation. Within the DOD, interservice competition would follow suit, promoting joint-service systems acquisition in both the development and procurement cycles. Lastly, internal to each service's acquisition program, where concentration has always been on weapons systems and tactical improvements, emphasis now had to be placed on programs to enhance strategic mobility, logistic supportability, productivity, throughput, and sustainability. The stage was set for some fairly revolutionary (or at least evolutionary) defense policy decisions and implementing strategies.

At the DOD level two major policy decisions were made: the first promoting the evolution of programs such as NTPF/MPS, the Rapid Deployment Force, and POMCUS; and the second defining a rather new concept called "Dimensional Standardization." This second solution, first mandated by DOD in 1968, called for the development of packaging, materials, hardware and equipment compatible with commercial non-self-sustaining containerships. It called for the use of leased, commercially-owned containers to be loaded in CONUS and shipped to the AOA in the holds of deep draft containerships in support of recently redefined assault follow-on echelon (AFOE) and resupply operations.

Dimensional standardization or "containerization" had a potentially significant impact on each of the respective services, although all were extremely slow to react. Because strategic transportability by airlift was drastically limited, new concepts such as "fly-in echelons," "light" divisions, and prepositioning--all designed to impact the outcome of the first day of battle--had to be developed. A redefinition of assault echelon (AE), assault follow-on echelon (AFOE), and resupply was required and new doctrine, concepts of operation, and procedures had to be developed to handle the quantum leap from a 200 lb. pallet to the 44,500 lb. container. There were new requirements in ship-to-shore operations; i.e., moving heavier loads over greater distances in reduced time frames. There was a need to develop an intermediate-size container system more easily handled in the expeditionary mode, by existing material handling equipment (MHE), and by forward displaced troop units of the assault echelon. There was a need to develop new material handling equipment for shipboard, ship-to-shore, and beachhead operations, especially in areas where no port facilities existed. And, lastly, there was a need to develop an entirely new breed of high-mobility transport vehicles to maintain the throughput rates inland and insure ultimate delivery of critical supplies and equipment to forward units.

In response to DOD directives to move in the direction of dimensional standardization, the services, very reluctantly at first, established programs in the 70's designed to satisfy the requirements...programs which continue today. The Army concentrated on POMCUS, new and larger material handling equipment, an improved bulk fuel system, a high mobility motor transport fleet, an an exercise designed to operationally test their ability to project forces, equipment, and containerized supplies across an undeveloped beach—an exercise called Joint Logistics Over the Shore (J-LOTS).

The Navy developed two primary systems to complement their newly-devised Amphibious Logistics Support Ashore (ALSA) program: the Off-Shore Bulk Fuel System (OBFS) and the Container Off-Load and Transfer System (COTS). COTS included concepts and hardware such as motion compensated cranes, new types of lighterage, the elevated causeway, the powered causeway system, new container transport systems, and the side-loadable warping tug. Everything got bigger, heavier, more sophisticated, more time-sensitive, and more vulnerable. Most items were manpower intensive. The Seabees worried about where they would find active forces to accomplish the deluge of new missions.

The Marine Corps devised the Field Logistics System (FLS) which, at its inception, consisted of fifty-seven separate items of hardware designed to increase throughput and productivity inland from the high-water mark. The FLS included such individual developments as expeditionary shelters, intermediate-size containers (PALCON and QUADCON), air-bearing castors, container marshalling concepts, the logistical vehicle system (LVS), and an entire new family of material handling equipment ranging from 75 ton cranes to 50,000 lb. container handlers to 4,000 lb. forklifts. The Marines also worried. They worried about how the Navy was going to get them to the beach.

The fact of the matter is that everything done and being done has one final purpose--to ensure delivery of the contents of a container from point of origin to the user. The majority of these containers will be leased commercial containers, 20 to 40 feet in length, and weighing up to 50,000 lbs. A few will be MILVANS, and others will be a complex array of intermediate-size containers (HALFCON, TRICON, QUADCON, SIXON, PALCON, etc.). All will arrive in merchant shipping, each representing a logistic challenge unparalleled in previous wars.

The problem as addressed by this paper, is: given that (1) the DOD community is now aware of the strategic limitations imposed, (2) that most of that community concurs with dimensional standardization as a solution, and (3) that appropriate defense dollars have been available to support systems acquisition, we would, nonetheless, suffer considerable embarrassment and confusion, attrition of supplies and materials, and, most assuredly, loss of human lives should we find it necessary to mobilize for the "long" conventional war in the near term.

The reasons are numerous and varied. Those who research, develop, and procure new systems are, as usual, working primarily within their own respective enclaves. There is less than sufficient coordination in either inter- or intra-service communities, and less still with the operational field commands. This all results in inefficiency, duplication of effort, and an extended systems acquisition cycle to procure what, in some cases, does not meet the real requirement. Combat support and combat service support equipment has not been successfully fielded in the quantity and quality required to get the job done. There has been only limited operational testing, such as J-LOTS, of new logistics systems, and, as a result, there is virtually no expertise resident in the field commands. There exists no formal doctrine, no concept of operations, and no established policy or procedural guidance. The words "dimensional standardization" and "containerization" do not appear in FM's, nor do TM's cover new material handling equipment designed specifically to transport a container. Lastly, there unfortunately, remains a distinguishable lack of concern by those very commanders the systems are desinged to support. Few are anxious, in a real world of trade-offs and compensory reductions, to give up a tank, artillery piece, or aircraft for a new forklift.

This paper is an assessment of the policy of dimensional standardization, specifically containerization, as a function of both strategic and tactical mobilty--to determine if the requirement for the former precludes the success of the latter, and to offer conslusions and recommendations for incorporation as approved doctrine.

CONTAINERIZATION IN THE ASSAULT FOLLOW-ON ECHELON (AFOE)

-A POST J-LOTS II PERSPECTIVE-

CHAPTER I

INTRODUCTION

The Problem. Containerization, as a distinct military program and sub-system of both the Marine Corps Field Logistics System (FLS) and Navy Amphibious Logistics System (ALS), is the product of three principal driving forces since World War II: (1) the unparalleled growth in the logistic burden to adquately support modern weapons and communications systems in the field, (2) the relatively rapid and inevitable depletion of the Navy's amphibious shipping, and (3) the disappearance of commercial breakbulk shipping assets. Taken collectively these three factors have caused the DOD to adopt new strategic planning initiatives and hardware systems to maintain global readiness. Systems such as FLS/ALS have been developed and concepts for maritime force projection now include such logistical terminology as the "AFOE."

Since the late 40's, there has been a dramatic shift in strategic sealift capability. In the early 1950's, the U.S. merchant fleet consisted of over 900 ships[1], the dry cargo lift capability for which was resident in "breakbulk" ships. That breakbulk fleet, which gave the nation a maritime superiority commensurate with its Naval strength, has subsequently all but disappeared and has become a matter of national security concern.

The physical composition of the cargo fleet has changed dramatically. Containerships, barge carriers, and roll-on/roll-off (RO/RO) ships have proven more efficient and economical and, therefore, constitute a larger proportion of the fleet than yesterday's breakbulk vessels. During this decade, over one-half of the dry cargo will be shipped by means of containerships. In view of these trends, the use of containerships as part of the amphibious task force (specifically the follow-on echelon) has been mandated. The lack of adequate amphibious lift capability acts as a stimulus for augmentation planning involving commerical shipping.

The Purpose. The purpose of this paper, first of all, is to investigate the effectiveness, measured in terms of productivity and throughput, of the concepts, doctrine, and system hardware of the Navy/Marine Corps Container Program. The program, to prove successful, must necessarily promote increased global readiness, force projection, and sustainability; for if, in fact, it does not better prepare the Landing Force Commander to wage war, and increase U.S. capability to project amphibious forces ashore at the onset of that war, and improve our ability to sustain the "long" conventional war and survive while doing it, then the program is misguided.

Secondly, the paper will identify deficiencies in the container program from the development (R & D), systems acquisition (procurement), and operational (user) perspectives - all three environments requiring simultaneous and well-coordinated analysis and concurrence prior to proceeding with development/fielding of any component of the system.

In addition to the above focus on the operational effectiveness of system concepts and hardware, the paper will focus specifically on the tactical impact of a strategically-driven system on the supported combat commander. If improved strategic sealift throughput and productivity results in reduced mobility for the ground commander, then the ends are not justified by the means. The logistical and tactical solutions must be compatible.

The paper will also examine the ability of the ALS/FLS to support the AFOE requirements for the ground (GSE), air (ACE), and combat support (CSSE) elements of the Marine Amphibious Force (MAF).

Lastly, the paper will offer conclusions and recommendations designed to effect future doctrinal development, organizational structure, and hardware procurement.

The Scope. The paper will address Navy/Marine Corps issues only with the exception of transition of responsibility to Army units within the AOA at that point during a given operation when the Navy/Marine Corps team departs the area or at least shifts command to the Army. It will concentrate on Naval Amphibious Task Force (ATF) and Marine Amphibious Force (MAF) level operations witnin the Amphibious Operations Area (AOA), smaller units not adequately testing the logistic capabilities of the program and larger scale operations not lending themselves well to an amphibious scenario. The focus will, therefore, trace container throughput from the in-stream ship to the ultimate user ashore. The issues of mobilization and transport of materials and equipment from manufacturer to point of embarkation within CONUS will not be within the scope of this paper. The paper will concentrate on concepts of operations for leased commercial containers, 8' x 8' x 20' and larger, and service-owned intermediate size containers expandable or complexible to the 8' x 8' x 20' envelope. Rigid and knock-down shelters in the 8' x 8' x 20' mode, while normally not a worst case problem from the weight perspective, do require a significant amount of cube (aboard ship and ashore) and material handling assets. Material handling capability, certainly the key to throughput, will be addressed as a system of hardware where each individual piece of equipment is dependent upon the other for overall success.

Background. As mentioned earlier in the problem statement, the art of conducting and sustaining amphibious warfare has been a dynamic process since inception. For the purpose of this paper, with its concentration on logistics, the majority of significant activity did not occur until the late 60's with the development of the AFOE concept. To make that concept work in an environment void of required shipping assets in the 70's through the present time, three factors were essential: (1) The formulation of the Amphibious and Field Logistics Systems, (2) Dimensional Standardization, and (3) Containerization.

Transport of Marine Corps units prior to the 1960's was primarily accomplished in U.S. Navy shipping, with little differentiation between that cargo assigned to assault units and that to supporting forces. Supporting equipment and supplies were brought ashore during the "general offload" phase of an amphibious operation. All battalion and regimental landing team organic equipment and up to 30 days of supplies were embarked in amphibious shipping, as either breakbulk or mobile loaded cargo. The terms "assault echelon" (AE) and "assault follow-on echelon" (AFOE) had not yet been established. In those situations where amphibious shipping assets fell short of lift requirements, the Military Sealift Command (MSC) was available to provide vessels which were normally World War II breakbulk or troop ships similar in design to state-of-the-art amphibious shipping.[2]

During the early 1960's, the strategic lift capability of both commercial and amphibious shipping began a gradual reduction as World War II vintage ships were retired. The growing gap between requirements and capability was, however, blunted by the onset of U.S. involvement in the Vietnamese conflict which shifted emphasis from large-scale exercises to smaller-sized operations where the lift capability approximated the requirement and little need or attention was placed on follow-on supplies. During this time, however, planners recognized that amphibious lift capabilities could not support large-scale unit deployments, even when augmented with available contract shipping, and the AE and AFOE concept was developed.[3]

In the 70's, the Navy continued to retire amphibious ships. Reliance upon the Merchant Fleet was, initially, a viable consideration for augmentation; however, an industry trend that had begun during the Vietnamese conflict had radically altered the composition of that fleet.

The container revolution had been generated by competition to promote an equipment-intensive environment while concurrently reducing the burdensome costs of manpower. The shipbuilding industry, driven by the profit motive, ceased construction of the breakbulk carrier and focused virtually all their concentration upon large tankers, containerships, and Roll On/Roll Off (RO/RO) vessels. . . a trend which has recently forced military planners to adopt the containership as the principal AFOE carrier. Interestingly enough, the AFOE has now grown larger in size than the AE for large unit deployments such as a Marine Amphibious Force (MAF).[4]

The reluctance with which these military planners accepted the advent of containerization has perhaps put the respective services behind the power curve with respect to state-of-the-art technology and material handling hardware. The Navy/Marine Corps systems acquisitions community has, however, been instrumental in developing new programs to ensure that, where possible, newly-procured equipment has been designed and built as container compatible, dimensionally standard equipment - equipment that may, therefore, remain as part of the amphibious task force.

The focal point of this effort by the Navy/Marine Corps team has been resident in the jointly-coordinated Navy Amphibious Logistics System (ALS) and Marine Corps Field Logistics System (FLS) programs.

As a direct response to the shipping situation previously discussed, and to reflect the increased logistics requirements during the mid-term, the Navy/Marine Corps program emphasizes the development of equipment compatible with both commercial and naval amphibious shipping. Operational employment of equipment in the amphibious objective area (AOA) is coordinated with strategic transportability considerations to formulate the design of new and modified items of tactical equipment. Transport considerations naturally promote the necessity of surface lift via commercial containership.

To ensure compatibility with these ships, equipment design must comply with the international standards currently in use by the commercial industry. With emphasis on dimensional standardization and American National Standards Institute/International Organization for Standardization (ANSI/ISO) compatibility, the acquisition of combat service support equipment under ALS/FLS is designed to ensure a fully intermodal transport capability. Those features of the program most germain to this paper are as follows:[5]

* Use of dimensionally-standard commercial containers.

* Use of service developed, dimensionally-standard intermediate-sized containers for the transport and warehousing of equipment and supplies in AE, AFOE, and resupply.

* Use of dimensionally-standard shelters which can be erected and complexed to meet varying user requirements.

* Use of motor transport and material handling equipment in an optimum quantity and mix to ensure responsive throughput from ship (in-stream) to ultimate user.

Whereas yesterday's contract ships could physically out-load and sail with the Navy's amphibious task force, commercial shipping of today cannot guarantee such responsiveness to calls for support or mobilization. As a result, the AFOE constitutes a separate shipment entity, apart from the AE. Further, points of origin of the AFOE could be widely scattered as well as their ports of embarkation.

While types and quantities of equipment and supplies for the AFOE are known or specified, there is no guaranteed method of insuring that everything planned is, in fact, in the AFOE shipping after it sails. Furthermore, budget and shipping constraints have not permitted the Marine Corps to quantify/validate specific operational procedures involving a total MAF's movement under a mobilization scenario. Because of these constraints there have not, with the exception of J-LOTS II, been any operational exercises wherein cargo and equipment designated for the AFOE have been loaded in merchant shipping and transported to an amphibious objective area. In short, Marine Corps operational procedures and concepts to monitor AFOE cargo is based primarily upon theory and hypothetical scenarios and not upon actual experiances.[6]

CHAPTER II

SYSTEM DEFINITION

For the purpose of this paper, the overall "system" is defined as all of those elements of the Navy Amphibious Logistics System (ALS) - i.e., ships, cranes, lighterage, and causeways - plus all of those elements of the Marine Corps Field Logistic System (FLS) - i.e., containers, material handling equipment, and motor transport assets - which directly impact the movement of AFOE containerized cargo for a notional MAF from ship to user within the confines of the AOA.

This chapter will further discuss the assault follow-on echelon (AFOE) and then, very briefly, set forth a notional MAF in a scenario designed specifically for a maximum throughput using state-of-the-art hardware from the ALS and FLS.

The AFOE is an integral part of the amphibious task force and, as a tactical entity within the landing force, should never be confused with "resupply". Quite often entire units, normally from combat service support elements, will be found in the AFOE as a result of the shortage of amphibious shipping. Certain elements of the AFOE will even commence offloading before the AE is completely ashore.

About 95 percent of all dry cargo in the AFOE needed to support an amphibious operation is transported by sealift. As shown by Table II-1, seventy percent of the bulk cargo and supplies are suitable for containerization. If the maximum use of containers is made and the more than 4,300 twenty-foot containers are loaded, then five "lightning class" or equivalent containerships will be required. Ideally, the lift requirements of the rolling stock and the remainder of the breakbulk/outsized cargo would be "spread loaded" within Roll-On/ Roll-Off (RO/RO) ships, LASH or SEABEE barge carriers, converted SL-7's (TAKR), and breakbulk ships. The use of this type of non-self-sustaining containerships also generates the requirement for an offshore discharge facility such as the crane ship (TACS). Past experience indicates that the optimum mix of shipping should not be expected, and that a more complex deployment of the AFOE can be expected.[1]

	FY85	FY88	FY91
AFOE Lift Requirement	5,265,011 FT^3 786,000 FT^2	5,334,005 FT^3 826,000 FT^2	5,402,998 FT^3 856,000 FT^2
Percent of FT^3 to be Containerized	70% (3,685,508)	70% (3,733,804)	70% (3,782,099)
Containerized in CEUs*	4,346	4,403	4,460
Breakbulk (FT^3) Not Containerized*	1,579,503	1,600,201	1,620,899

* ± 10%

TABLE II-1. MAF Containerization Schedule

Source: Northrop Services, Inc., Review of Current Marine Corps Concepts and Operational Procedures for Monitoring AFOE Cargo, September 1983, p. 6.

For the purpose of clarity, the AFOE can be considered as two elements. The first element consists primarily of combat service support units, their organic equipment and fifteen days of supply. The second element is a forty-five day supply block for the entire landing force.

The second segment in the system definition is the organization to be supported, in this case the task organized Marine Amphibious Force (MAF) shown in Table II-2.

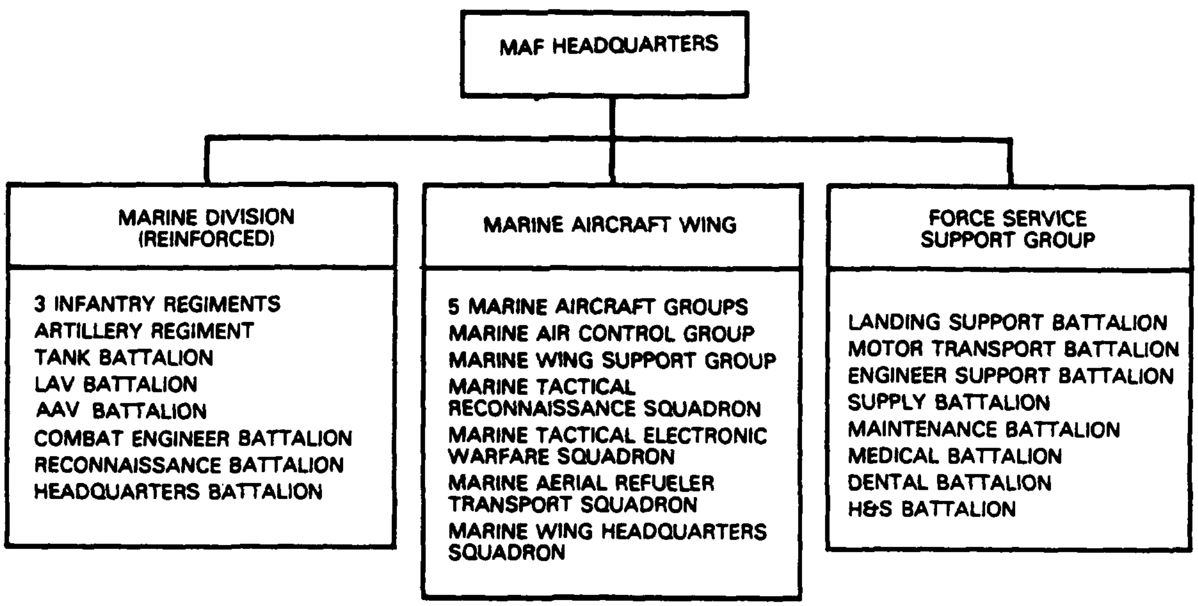


TABLE II-2
NOTIONAL MAF ORGANIZATION

Source: System Planning Corporation, Marine Corps Containerized Ammunition Study (1985-1995), Draft Final Report, p. III-2.

There are approximately 55,000 personnel in the notional MAF: 34,950 in the assault echelon, 10,740 in the AFOE, and 9,310 in the fly-in echelon (FIE).[2] The Naval Support Element (NSE) is included in the AFOE.

The correlation between the Field Logistics System (FLS) and the organizational equipment of the notional MAF can best be shown by discussing the two sub-systems of FLS directly associated with container handling within the MAF - the Material Handling Equipment Sub-System and the Motor Transport Sub-System (see Table II-3.). The Container Sub-System will be discussed later.

Containers

* Container, 8' x 8' x 20' (commercial)
* PALCON, 41" x 40" x 48"
* QUADCON, 6'10" x 4'9½" x 8'
* Insert, 10" x 17" x 45"
* Shipping frame, 8' x 8' x 10'
* Shipping frame, 4' x 62/3' x 8'

Materials Handling Equipment

* RTFLT, 4,000 lb.
* RTFLT, 6,000 lb.
* Tractor, rubber-tired, articulated steer, 10,000 lb.
* LACH, 22.5 ton
* RTCH, 50,000 lb.
* Rough terrain crane, 30 ton

Motor Transport

* HMMWV, 5/4 ton
* HHMTT, 5 ton
* MK 48, LVS Front Power Unit (FPU)
* MK 14, LVS Rear Body Unit (RBU)
* MK 17, LVS RBU with crane

TABLE II-3. Field Logistics System

Source: System Planning Corporation, Marine Corps Containerized Ammunition Study, Second Interim Report, March 1984, p. 45.

In the Motor Transport Sub-System of the FLS, the Marine Corps is standardizing its vehicle fleet using common chassis and power units to reduce maintenance and enhance interoperability. The location and approximate quantities of motor transport assets within the MAF are shown in Figure II-1.

ASSET TYPE	NUMBER BY UNIT: GCE								ACE				CSSE								
	HQ BN	INFANTRY REGT	ARTY REGT	COMBAT ENGR BN	RECON BN	TANK BN	AAV BN	LAV BN	MACG	MWSG	MAG (VF/VA)	MAG (VH)	H&S BN	SUPPLY BN	MAINT BN	LANDING SPT BN	ENGR SPT BN	MOTOR TRANS BN	MEDICAL BN	DENTAL BN	TOTAL
Trucks																					
HMMWV, Cargo, M998, 5/4 ton	134	386	347	37	48	49	25	35	178	61	36	24	64	10	17	32	65	28	7	4	1567
HMMWV, Tow, M1045, 5/4 ton		72				72									2						146
HHMTT 5-ton cargo	131	9	324	10	8	38	17	10	158	104			18	12	36	10	18	117	10		1030
LVS-MK48 front power unit			4	3						27					9		12	184			239
LVS-MK14 container hauler										13								132			145
LVS-MK17 dropside cargo																		41			41

SOURCE: U.S. Marine Corps Field Logistics System Equipment Distribution, 30 Dec 83

MAF TRANSPORTATION ASSETS

FIGURE II-1. MAF Transportation Assets

Source: U.S. Marine Corps Field Logistics System Equipment Distribution, 30 December 1983.

The high-mobility multipurpose wheeled vehicle (HMMWV) replaces the M151 jeep and 1/4-ton trailer, the M561 Gamma Goat, and the M792/M718A1 ambulance. Although not useful for moving containerized dry cargo, it will be useful for forward displacement of material once removed from the container.

The heavy high-mobility tactical truck (HHMTT) replaces 5-ton and 2 1/2-ton trucks currently in the FMF and is the primary transporter of palletized cargo from the CSSA to using units. The LVS-MK48/MK14 container hauler combination and the logistical vehicle system (LVS)-MK48/MK17 dropside cargo combination consist of a common MK48 front power unit (FPU) and a mission-specific rear body unit (RBU). The MK14 will be the primary transporter of 8' x 8' x 20' containers in the AOA once containerized cargo is brought ashore. MK17 dropside cargo RBU's (which have an onboard crane) can accommodate breakbulk cargo and small or intermediate containers. It is interesting to note (Figure II-1.) that within the GCE there is no capability to transport 20-foot containers, whereas within the ACE there is a limited ability to transport containers using the thirteen (13) MK14 container haulers located in the MWSG. Most of the transport assets for hauling 20-foot containers are found in the CSSE. In particular, the Motor Transport Battalion will contain approximately 91 percent of all MK14 container haulers allocated to the MAF.[3]

The MHE sub-system for MAF-sized organizations is shown in Table II-4. The 30-ton rough terrain crane (RTC) is used in marshalling yard operations and is limited to handling empty or lightly loaded containers due to low boom ratings at shallow angles. The 7 1/2-ton crane is not useful for handling containers, but could be used for lifting and handling pallet-sized loads in the CSSA.

MHE TYPE	NUMBER BY UNIT*										TOTAL
	GCE					ACE	CSSE				
	ARTILLERY REGIMENT	TANK BATTALION	COMBAT ENGINEER BATTALION	AAV BATTALION	LAV BATTALION	MARINE WING SUPPORT GROUP	H&S BATTALION	MAINTENANCE BATTALION	LANDING SUPPORT BATTALION	ENGINEER SUPPORT BATTALION	
CRANE, RT, 30 ton			4			6		1	18	7	36
CRANE, WHEEL MTD 7½ ton (SP and RT)						25**			6**	12**	43
TRUCK, FORKLIFT, RT, 10,000-lb	1		8	1		17	6	1	15	15	64
TRUCK, FORKLIFT, RT, 6,000-lb		1	8		1	56	35		12		113
TRUCK, FORKLIFT, RT, 4,000-lb	41		5			20	25	1	24		116
ROUGH-TERRAIN CONTAINER HANDLER									6		6
LIGHTWEIGHT AMPHIBIOUS CONTAINER HANDLER									12		12

*SOURCE: U.S. Marine Corps Field Logistics System Equipment Distribution, 30 Dec 83
**SOURCE: N-Series Table of Equipment (N-8744, N-3240, N-3250)

MAF MATERIAL HANDLING EQUIPMENT

TABLE II-4. MAF Material Handling Equipment

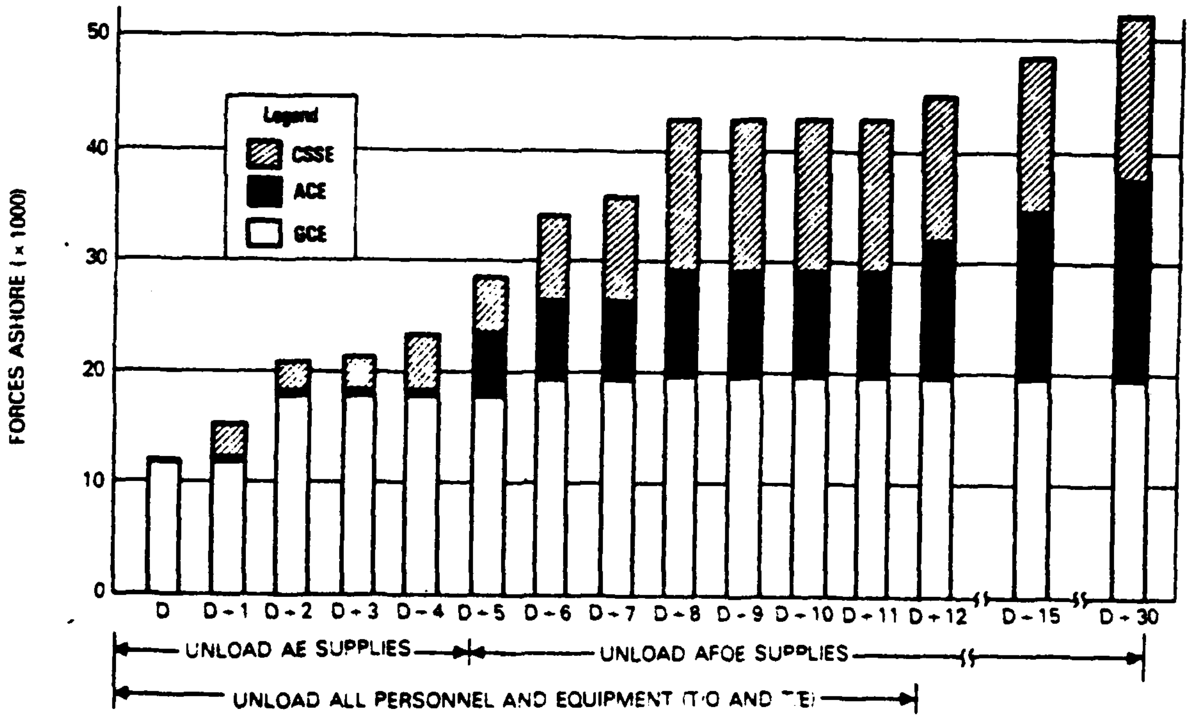
Forklifts are the most numerous items of MHE in the MAF. The 10K Rough Terrain Forklift (RTFL) is a diesel-powered, four-wheel drive, rubber-tired tractor with articulated steering. It can operate in up to 5 feet of surf and is primarily used in handling shipping frames and other components of the FLS. The 6K RTFL can also operate in up to 5 feet of surf and is similar in design to the 10K vehicle, but has less weight-lifting capability. The 4K RTFL is a pneumatic-tired, helicopter-transportable vehicle for direct support of combat, combat support, and combat service support units. The 4K RTFLs are found in all units, with the exception of the tank battalion. It is intended to be used primarily to unstuff 8' x 8' x 20' containers in the AOA. However, in the artillery regiment, the 4K RTFL serves as an auxiliary prime mover for the M198 howitzer.[4]

Handling of loaded containers is to be performed by the 50,000 lb. Rough Terrain Container Handler (RTCH) and the Lightweight Amphibious Container Handler (LACH). The RTCH is the principal means in the FLS for container handling in marshalling and storage area applications. The LACH requires a prime mover, such as a medium crawler tractor, and operates by straddling the container. It can function in up to 5 feet of surf and is primarily used to offload containers from landing craft and place them on the ground or on container haulers. Also, within the ACE, there are approximately 156 CH-53 cargo helicopters that can handle intermediate size containers and palletized cargo. While these helicopters may be useful in emergency resupply, they are pooled assets with the primary mission of troop movement.[5]

Figure II-2 details the MAF buildup ashore, and was constructed using the landing priority table and troop list data shown in MARCORS-1A to estimate unit arrival times. Figure II-2 reflects approximate numbers of personnel ashore, and, as such, is useful only in illustrating the early buildup of ground combat units and the somewhat later phasing of the aviation units. The darkly shaded areas of the graph indicate that the buildup of the ACE is small through D+4. Air units arriving during this period are HAWK missile batteries, Marine air support squadron elements, and forward anti-air defense batteries. On or about D+5, the first MAG(VH) comes ashore, and the second arrives on D+8. For planning purposes, the study team assumed that one MAG(VA) arrived on D+12, a second on D+15, and the final one on D+30.[6]

Naval support forces are included in the CSSE buildup ashore, which is indicated by the cross-hatched portions of the chart. Through D+2, the CSSE consists largely of landing support battalion, supply battalion, and division beach party elements. Elements of the motor transport battalion are ashore by D+3, and engineer support battalion detachments follow around D+4. The H & S Battalion, FSSG, is completely ashore by D+6. The maintenance battalion, medical battalion, dental battalion, and remaining supply battalion elements complete most of the CSSE buildup by D+8. Final elements of the Navy's mobile construction regiment move ashore about D+30.

During the force buildup, supplies are offloaded (commensurate with available MHE) to ensure continuing support for the advancing combat and combat support units. Thus, AE supplies (15 days of supply) are in breakbulk form or in small or intermediate containers; AFOE supplies (45 days of supply) also include ISO containers. The MMROP provides planning guidance for this offload, as shown at the bottom of Figure II-2; i.e., that AE suppplies are offloaded by D+5 and AFOE supplies between D+5 and D+30. Thus, by D+5, one or more CSSAs should be established with supply points for various classes of supply.[7]



NOTES (1) Consistent with MMROP AND MARCORS
(2) Assumes one VA MAG arrives on each of the following days: D+12, D+15 and D+30, and one VH MAG arrives on D+5 and D+8.
(3) CSSE segments include Naval support personnel.
(4) GCE segments include command element personnel.

MAF BUILD-UP ASHORE

FIGURE II-2. MAF Build-Up Ashore

CHAPTER III

CONCEPT OF OPERATIONS

This chapter will address containerization from the perspective of the operational phases within the AOA, the throughput design to promote maximum productivity from ship to forward deployed unit, and the key items of hardware directly involved in the process.

There are four basic phases in the AFOE offload of containerized cargo: (1) ship-to-shore, (2) beach operations (surf zome), (3) marshalling and storage, and (4) forward displacement.

Navy ship-to-shore operations, the heart of the Amphibious Logistics System, include the movement of containers on-board and on/off the containership itself; the functions of the crane ship (FACS); and the use of all forms of lighterage to include the LCM, LCU, causeway ferry, and powered causeway section. Floating causeways (beached) and elevated causeways will be discussed in the beach operations phase. Operational testing of the T-ACS by both Army and Navy forces during J-LOTS II indicated that the most significant impact on throughput was environmental, in the form of sea state. When the significant wave height rose above 3 1/2 feet (sea state 3), system productivity approached zero and the entire operation was forced to close down due to lack of containers at the source (see Figures III-1 and III-2). The simple fact that logistic support of the war "ceases" above sea state 2 would appear to pose a challenge for engineers seeking hardware improvements to the system.

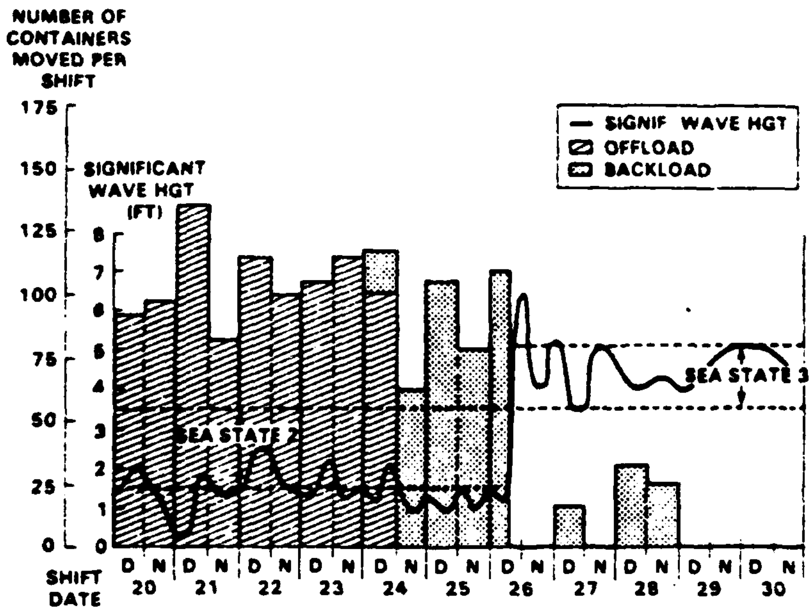


Figure III-1 NAVY/T-ACS OPERATIONS - SEPT 1984

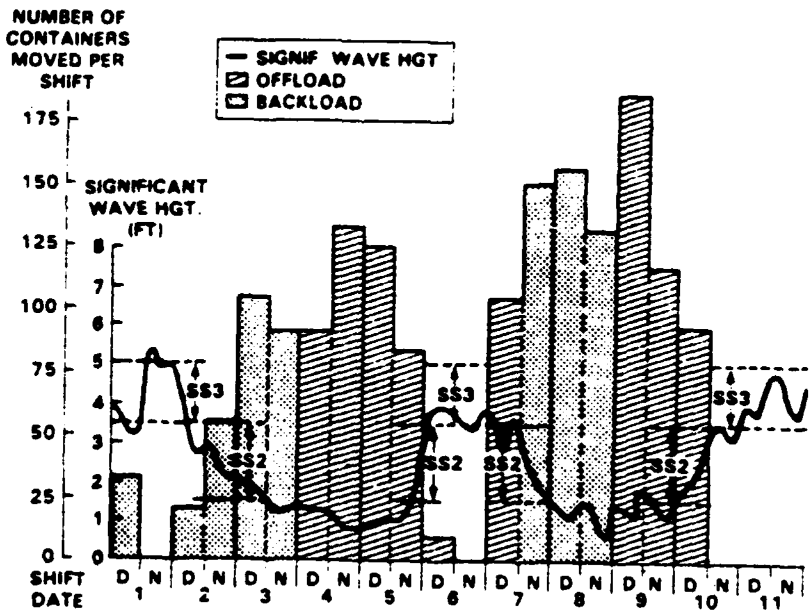


Figure III-2 ARMY/T-ACS OPERATIONS - OCT 1984

Source: Joint Test Directorate, J-LOTS II, Operational Test Report, Throughput Test, 1 March 1985, p. 21.

J-LOTS II has also given us the first real operational comparison of ship-to-shore lighterage rates for the types of lighters shown in Table III-1. There were advantages and disadvantages resident in each type of lighter based on their individual operational capabilities to transfer containers; but, as the table shows, the causeway ferry and powered causeway section (CSP +3) shared the overall advantage in productivity due to payload (containers per trip).

LIGHTER TYPE	TOTAL TRIPS	CONTAINERS PER TRIP		AVG LOAD TIME	AVG MIN/ CONT *	TRANSIT TIME **
		MAX	AVG			
CSP +1	11	10	9	68	8	20
CSP +2	8	18	16	82	5	21
CSP +3	10	30	26	106	4	23
CAUSEWAY FERRY	17	29	23	84	4	24
LCU 1610	69	5	4	36	9	12
LCU 1466	28	8	6	49	8	15
LARC-LX	71	4	2	19	9	15
LACV-30	201	2	2	18	9	7

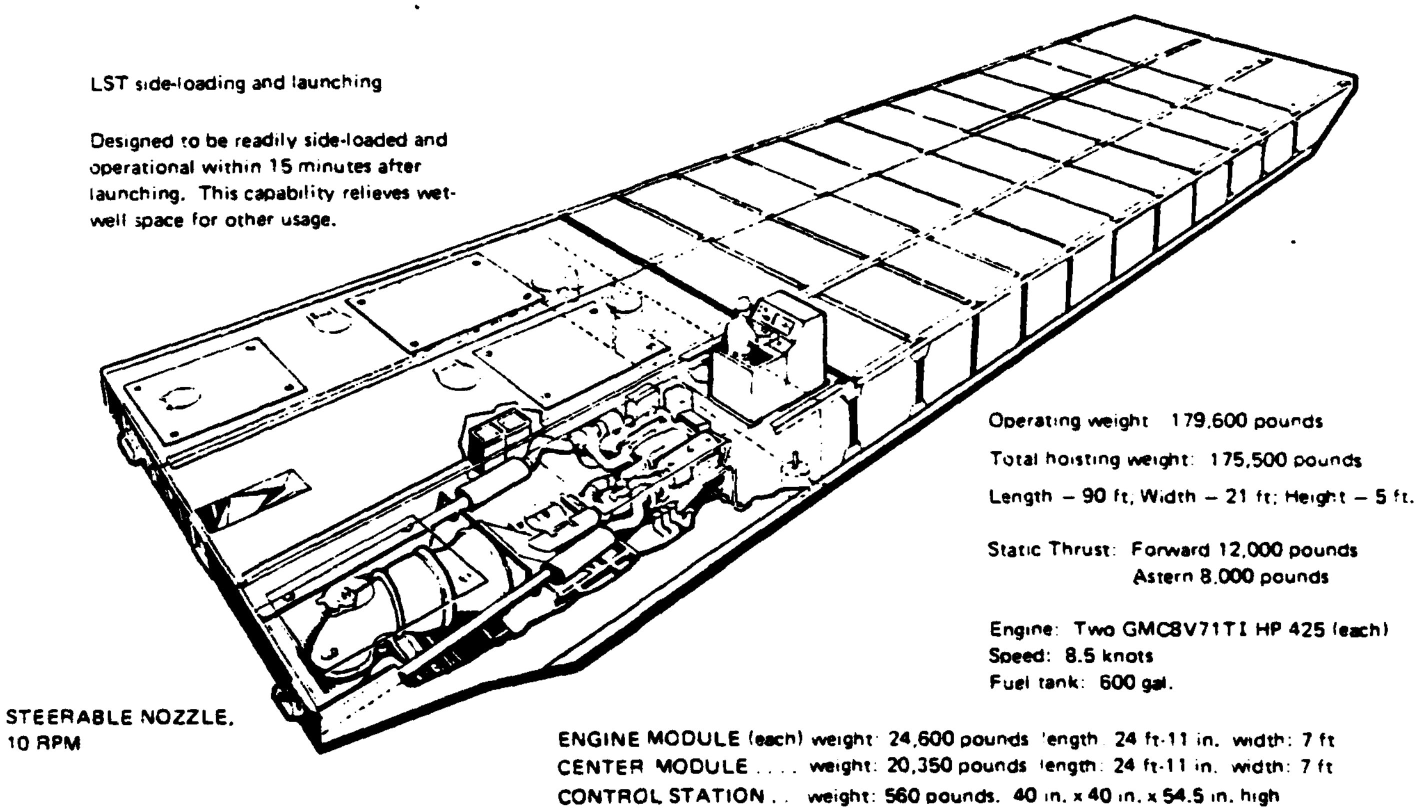
* Average Load Time: Approach, Moor, Load & Clear (Time in Minutes)

** Transit Time: Average time to travel ship-beach (one mile)

Table III-1 **JLOTS II LIGHTER TRANSFER RATES AT T-ACS**

Source: Joint Test Directorate, J-LOTS II, Operational Test Report, Throughput Test, 1 March 1985, p. 37.

The self-powered causeway section (CSP), Figure III-3, was the only "new" type of lighterage used during J-LOTS II. Using waterjet propulsion, the CSP can function as a causeway ferry when connected to standard pontoon sections or can be converted to a side-loadable warping tug by adding a winch and A-frame. The CSP can operate and maneuver at full power in the surf. It can beach and retract even when functioning as a loaded causeway ferry. Its positive steering control eliminates broaching. It can reach speeds of 9.5 knots, can stop within its length in 10 seconds, and can execute a 180 turn in 18 seconds. The CSP has superior thrust power - 21 percent greater than conventional outboard units - and can maneuver at right angles to berthing space alongside vessels. The self-powered causeway section provides a new systems concept for Amphibious Construction Battalions and Amphibious Follow-on Echelon support for amphibious operations.



Operational characteristics of the causeway section, powered (CSP).

FIGURE III-3. Self-Powered Causeway Section

Source: Naval Civil Engineering Laboratory, Self-Powered Causeway System, Operational Characteristics, November 1983.

The second phase in the AFOE offload of containerized cargo is the surf zone beach operation where a number of methods have been employed to remove containers from lighterage and transport them some distance inland, over or through the critical surf zone area. As shown in Figure III-4, the beach offload facility can consist of the elevated causeway with cranes, DeLong Pier (Army) with crane, Lightweight Amphibious Container Handler (LACH), Rough Terrain Container Handler (RTCH), or cranes alone. Each facility can then be operated with a specific type lighter to optimize throughput, measured in minutes/container, for that "system". During J-LOTS II, the elevated causeway, due to its single fixed location crane, was used solely with the LCU, as was the Army's DeLong Pier with its two crane sites. The LACH, due to its unique ability to enter a landing craft to retrieve a container, was also used with the LCU. The RTCH was used in conjunction with the powered causeway sections and causeway ferries. The productivity of this system was increased by sheer payload (average number of containers per offload). Only the Army experimented with cranes and amphibians in the logistics role. The Marine Corps considers its amphibians (LCAC) to be solely assault-oriented troop carriers.

BEACH OFFLOAD FACILITY	LIGHTER [Trips]	AVG NUMBER OF CONTAINERS PER OFFLOAD	OFFLOAD CYCLE TIME (MIN) [Approach Moor, Offload & Clear]	MIN/ CONT*
ELCAS	LCU [22]	4	54	12
DELONG PIER	LCU [52]	5	47	10
LACH	LCU [12]	4	45	11
RTCH AREA	CSP+1 [11]	9	48	5
	CSP+2 [8]	16	74	4
	CSP+3 [9]	26	102	4
	CF [16]	23	97	4
AMPHIB AREA	LARC-LX [59]	2	7	3
	LACV-30 [19]	2	7	3

*Minutes per container transferred at each lighter slot or mooring position.

JLOTS II BEACH DISCHARGE SYSTEMS

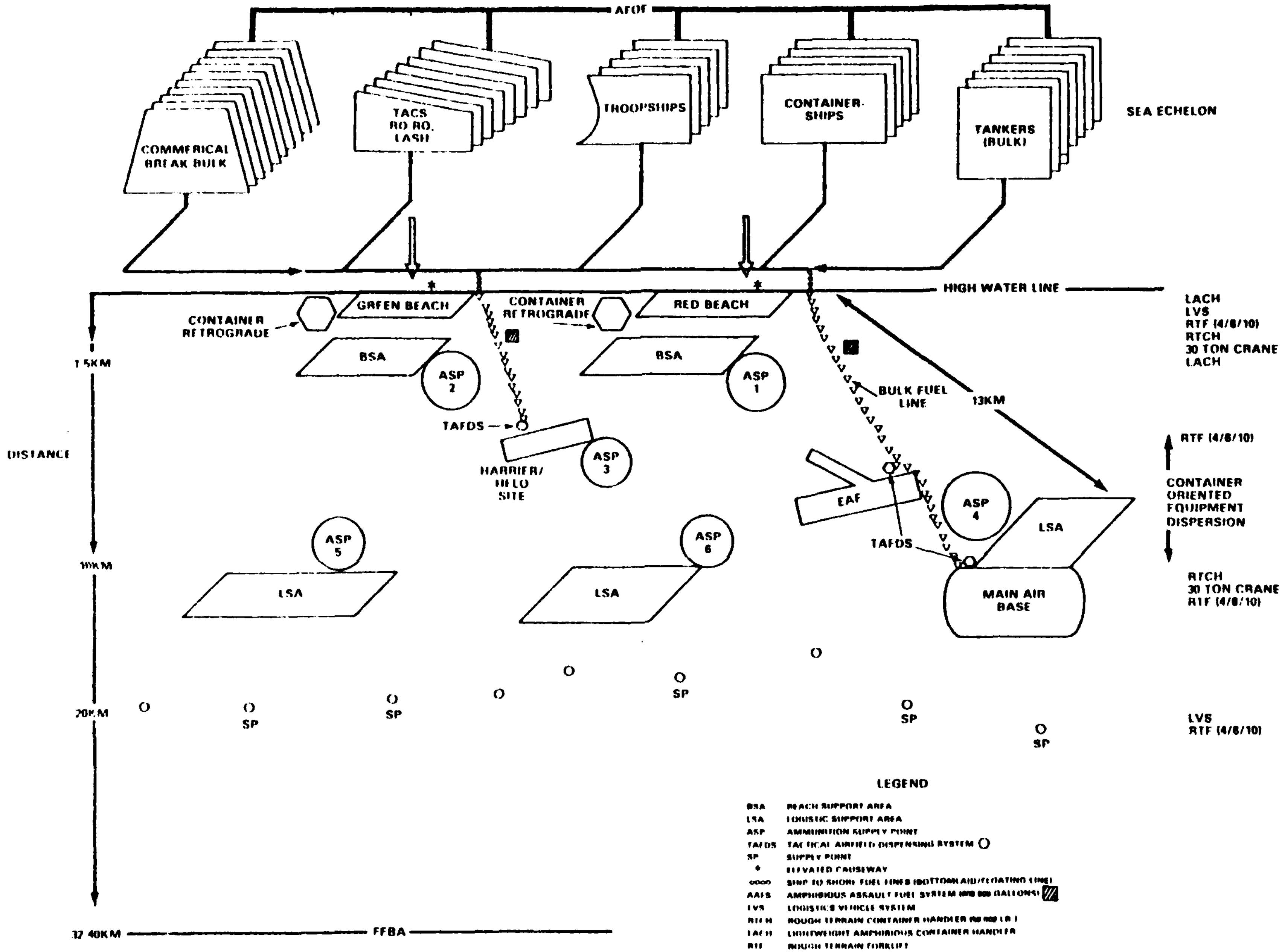
FIGURE III-4. J-LOTS II Beach Discharge Systems

Source: Joint Test Directorate, J-LOTS II, Operational Test Report, Throughput Test, 1 March 1985, p. 46.

Container marshalling and/or storage is a function of many variables such as class of supply, numbers of containers involved, earthwork required, dispersion, type of container handling equipment to be utilized, soil conditions/trafficability, stacking restrictions, type of forward distribution desired, etc. There has been a considerable amount of study directed towards selecting the optimum hardware and configuration, but no final decision will be made until the concept of operations for the entire throughput system is defined. Operational testing has been extremely limited due to the non-availability of containers and container handling equipment. J-LOTS II utilized 1,000 containers, but loads, scenario, line haul distances, and available RTCH's prevented the accumulation of any valuable data or marshalling.

Forward distribution, like storage, is primarily a function of the concept of operations for a given exercise. The key issue at this point is not the type of distribution (point/area), but, moreover, how far forward containers should go before they are unstuffed. This basic decision involves both the type and numbers of MHE and motor transport assets. Current thought process would not send containers forward of the CSSA, thus permitting concentration of container-capable MHE assets in the "rear" and only palletized gear forward. Since the productivity gained by containerization is more strategic in nature than tactical, it would appear that the CSSA would be an opportune time and place to substitute tactical efficiency for strategic volume. In any case, it is difficult to imagine that container operations forward of the CSSA or ASP would be in the ground commander's best interests.

As shown in the Throughput Schematic, Figure III-5, the general scenario would call for containerized cargo to enter the AOA via commercial containership (probably non-self-sustaining for AFOE operations), to be offloaded by the T-ACS, and to make the ship-to-shore transit by one of the previously-mentioned lighters to a beach offload facility on one of two colored beaches. Containerized cargo then moves forward through the Beach Support Area (BSA) to the Combat Service Support Area (CSSA), where the majority of containers will be unstuffed allowing available unit motor transport assets to transport palletized cargo forward.



AOA THROUGHPUT SCHEMATIC

Source: Northrop Services, Inc., Field Logistics Systems Equipment Validation, Final Report, April 1984, p. 14.

The success and productivity of each step in the throughput sequence is governed by the system hardware at that location. As ship-to-shore assets have already been discussed at some length, some further comments on appropriate FLS hardware are in order.

The Lightweight Amphibious Container Handler (LACH), as a non-self-propelled straddle carrier has some unique features which must be considered when assigning its duties in the offload, the first of which is its ability to only approach a container from the end for pick up. It requires a separate prime mover, normally a medium-crawler tractor (tracked) which equates to low speed (cycle time) and large turning radius but excellent trafficability in the surf zone (up to 5 feet). It is hydraulically-operated, non-sophisticated, highly maneuverable (except when backing), and still virtually untested with fully-loaded containers over a significant period of time. The twelve LACH's in a MAF are each rated at an optimistic 120 containers per day (cpd) over a 20-hour work day. Since there are two ELCAS per MAF, each rated at 600 cpd, it is more efficient to use the LACH with landing craft than with either ELCAS or ferries. J-LOTS II showed limited productivity with a LCU/LACH offload system and also demonstrated very close tolerances between the LACH and the landing craft - thus slowing the offload process and supporting an engineer design change if there is further procurement.[1]

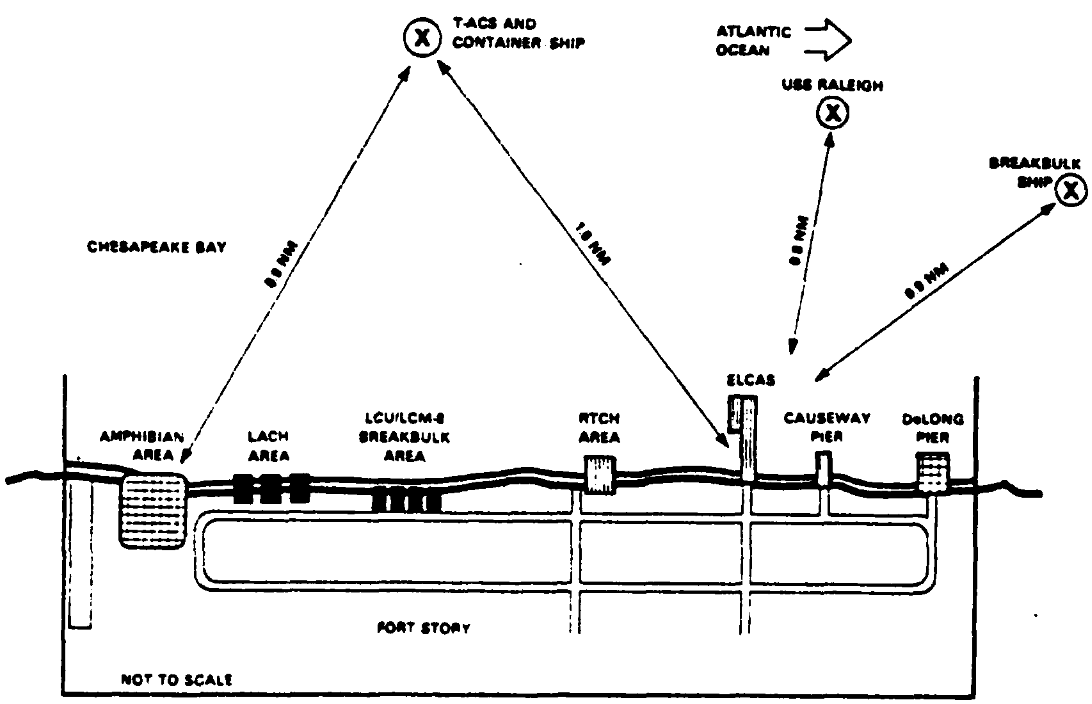
The Rough Terrain Container Handler (RTCH) is a commercial, off-the-shelf version of the Caterpiller 988 tractor, developed and tested by the Army and procured only in small numbers by the Marine Corps, initially for MPS operations. It is an all-wheel drive (4 wheels), rubber-tired, diesel-powered articulated-steer tractor rated at 50,000 pounds for lifting, transporting, and stacking (two high) containers of 20, 35, and 40 foot lengths. In the throughput scheme, it would be the primary container handler in the CSSA, BSA, and marshalling areas, and "available" for use in the surf zone. J-LOTS II showed the RTCH, with transverse loading of containers on causeway ferries and powered causeway sections, to be the single-most productive method of transporting containers across the beach. Some unresolved issues exist, even after the limited, but very successful, operational testing in Little Creek. The ability of the RTCH to safely and continuously operate with fully-loaded containers on unimproved surface (specifically sand and mud) is still at issue. Repeated passes over the same area may reduce trafficability for not only the RTCH, but also any other equipment working in the same area. Also in question are the size, weight, maneuverability, and stability.

The Marine Corps inventory of Rough Terrain Forklifts (RTFL) includes the 4,000, 6,000, and 10,000 pound forks mentioned earlier. The 4,000 pound RTFL is unique in that a recently-completed design change of the mast allows the operator to drive into a container, side-shift his tines from the driver's position, pick up palletized cargo, and back out. The 6,000 pound RTFL is the only forklift with four-wheel (crab) steering, but, other than that, has no specific advantage for working with containerized cargo. The 10,000 pound RTFL has been an extremely versatile and dependable piece of engineer equipment over the years, but, due to its lift limitations, is relatively useless with containerized cargo.

As mentioned earlier, the 30-ton Rough Terrain Crane (RTC) shares this last distinction in its inability to do anything other than lift up to 30 tons at zero boom extension/angle and set that cargo down on a trailer driven under the load. Its best contribution to container throughput, like the 10,000 pound forklift, is with empty or lightly-loaded containers, perhaps in the retrograde operation.

Motor transport assets dedicated to the forward movement of containers to the CSSA have been previously discussed in Chapter II, the numbers and locations of trailers (rear body units) being the critical factor.

Two additional matters should be examined before assessing the problems associated with the system. The first of those is a cursory look at the actual beach layout for the J-LOTS II operational test (Figure III-6), as aversed to the throughput schematic provided earlier. The primary differences, which must be considered when judging the validity of the test, are the rigid definition of beach offload facilities (i.e., RTCH worked only in one location and only with causeway sections), the fact that there was one beach vice the two normally associated with a MAF and only one thousand 20' MILVANS and twenty 40' containers, the weight distribution of containers (only eight at maximum weight), the numbers and types of MHE and motor transport assets (i.e., M127 trailers vice MK14 RBU), and the depth of the operation inland (i.e., short line haul distance to "CSSA").



JLOTS II BEACH LAYOUT

Source: Joint Test Directorate, J-LOTS II, Operational Test Report, Throughput Test, 1 March 1985, p. 13.

The second matter is simply an illustration, Figure III-7, showing the breakdown of forty-five days of containerizable landing force supplies in the AFOE. The figure lists the information presented by supply classification and provides some interesting information on such things as cube, weight, and percentage of supply class by weight and number of containers (note Class V).

LANDING FORCE SUPPLIES, AFOE (CONTAINERIZABLE) -45 DOS

1 CLASS	2 M-TONS	3 FT^3	4 % VOL	5 S-TONS	6 LBS	7 % WT	8 LBS/FT^3	9 NOM FT^3 PER CONT.	10 LBS/CONT.	11 NO. CONT.	12 % CONT.	13 WT. DEN.
I	13,180	628,400	10.3	6461	18,902,000	5.9	20.71	780.33	16,840	782	9.6	2.13
II W	2,862	118,000	2.3	1360	2,718,000	1.5	23.00	824.00	18,862	144	2.0	0.63
III W	3,200	128,380	2.6	2710	5,420,000	2.9	42.22	824.00	34,780	156	2.1	1.10
III A	1,107	44,280	0.9	943	1,886,000	1.0	42.60	824.00	35,102	54	.7	0.38
III MC	390	15,600	0.4	239	478,000	0.3	30.60	824.00	25,132	19	.3	0.12
III TRIOX	144	17,780	0.1	173	348,000	0.2	19.60	824.00	16,083	22	.3	0.02
TOTAL III	5,150	208,000	4.0	4084	8,128,000	4.4		824.00		251	3.4	
IV	183	6,520	0.1	160	320,000	0.2	49.00	824.00	40,376	8	0.1	0.05
VW	24,275	971,000	19.0	28367	56,734,000	30.7	58.43	666.82	38,967	1456	19.9	11.10
V A	67,400	2,696,840	52.9	47571	95,142,000	51.6	35.26	666.82	23,500	4047	55.3	18.66
VI	2,578	103,120	2.0	1231	2,462,000	1.3	23.90	824.00	19,673	125	1.7	0.48
VII NON SQ.	293	11,720	0.2	109	218,000	0.1	18.60	824.00	15,327	16	0.2	0.04
IX W	11,680	467,200	9.2	3959	7,918,000	4.3	16.94	824.00	13,966	567	7.8	1.60
TOTALS	127,717	5,100,000	100.0	92271	184,542,000	100.0				7316	100.0	38.16

Source: Northrop Services, Inc., Field Logistics Systems Equipment Validation, Final Report, April 1984, p. 10.

CHAPTER IV

PROBLEM ASSESSMENT

General. During the past fifteen years, the two factors having the most dramatic impact on strategic readiness to support U.S. military global commitments have been the affordability of the staggering logistical requirements to support modern weapons and communications systems and the associated depletion of adequate amphibious and break-bulk shipping to sustain the "long-war" scenario. In the early 70's, the Department of Defense issued a mandate to all services to promote "dimensional standardization" of equipment and materials so as to be compatible with available commercial shipping. Dictating that military cargo be compatible with commercial containers and non-self-sustaining container ships has, at least in theory, vastly increased the productivity, tonnage, and speed with which the assault follow-on and resupply can reach the AOA from home port. This solution has, however, created additional problems for the logistician charged with getting these large quantities of materials across a beach and forward to deployed troops ashore, especially where established port facilities do not exist. Neither approved doctrine nor a concept of operations have been validated. The "systems" remain virtually untested.

This chapter will examine the impact of containerization on the Landing Force Commander in amphibious warfare and detail the challenges provided by the system as defined.

There are four distinct types of problems associated with containerization which must be resolved by the Navy/Marine Corps team. They may all be defined as "deficiencies" and may be classified further as system-oriented deficiencies, operational deficiencies, training deficiencies, and acquisition deficiencies. Some of these problems are symptomatic of all logistics systems; others are unique to containerization. Some are general in nature; others are very specific. Some are capable of being resolved; others "will take a little longer".

SYSTEM DEFICIENCIES

There are numerous system deficiencies, a significant percentage of which fall into the "uncorrectable" category.

Ship Characteristics. Due to the vast difference in the tonnage and type of commercial containerships, it is virtually impossible to conduct long-range planning for the AFOE offload. Operational procedures and equipment densities would naturally differ depending upon whether the offload included ten 300-container ships or two 1500-container ships. Throughput rates are also affected by such non-quantifiable entities as crew experience and the threat environment.

Container Standards. Containers themselves represent a considerable problem to military strategic planners. In that, other than MILVANS, all containers will be leased from commercial sources, industry, and not the military, determines the standards for construction and the outside dimensions. Commercial containers were at no time a standard 20 feet in length. Now economic considerations have caused industry to turn to 35 and 40-foot containers, which, by their simple size and weight, cannot be handled by some items of material handling equipment and lighterage in the Navy/Marine Corps inventory.

Conflicting Studies. Numerous studies and reports have been undertaken, most provided by civilian firms under government contract, to serve as planning documents and program management tools. Each establishes different (and usually optimistic) assumptions, uses conflicting methodology, and terminates with conflicting conclusions and recommendations. There does not appear to be a "source document" having any more credibility than the next.

Single Commodity Focus. Most of the above efforts are sponsored by a particular government office or individual specializing in a single commodity such as fuel, water, or ammunition. This focus slants the deliverable in the direction of that commodity and at the expense of not only other equally-important commodities, but also the system as a whole.

Conflicting Requirements. Published reports, approved by their military sponsors, offer a wide variation in the definition of hardware and requirements. By changing the criteria in a given study, the word "container" can mean the total number of 8' x 8' x 20' enclosed commercial containers or it can add arrays of intermediate-size containers, shelters, MILVANS, and flatracks. Depending on the criteria used, the number of containers required for a MAF AFOE varies from about 4,500 to 7,500.

Lack of Interoperability. Even with a DOD mandate for joint systems acquisition and direct Congressional impact on the budget, there has been relatively little interoperability. Exceptions have been J-LOTS operational testing and certain joint hardware procurement actions.

Low-Density End Items. The system is replete with low-density items which, if lost through equipment failure, threat action, or environmental conditions, have critical affect on mission success as a whole. Examples are the containerships themselves, powered causeway sections, elevated causeways, LACH's, RTCH's, and container handlers. . . all critical to logistic mobility.

Threat Sensitive. An assumption more than a problem. Simply stated: If there is a threat, meaning there is something less than complete security within the AOA, then there is no system. Containers will not come ashore in a threat environment.

Retrograde. There has been minimal planning and thought process expended on the concept of operations for retrograding commercial containers.

RAM. There is minimal operational information available, other than for commercial, off-the-shelf items of equipment and lighterage which has been in the system for years.

OPERATIONAL DEFICIENCIES

These problems are less numerous, but, in real time, more critical to the landing force. As discussed earlier, the most pressing operational problem (as evidenced by J-LOTS II) is the inability of key system components to operate safely or efficiently in anything beyond sea state 2. Other operational deficiencies which have surfaced include an inadequate means of monitoring/tracking containers, loss of command and control in the ship-to-shore phase, inadequate quantities of certain equipments (once again), unexpected delays (such as ten days to erect the ELCAS vice the scheduled 72 hours), no access to containers afloat, administrative vs. combat loading, and no means of sustaining or controlling throughput (queuing). Even operational tests such as J-LOTS fail to address every issue, such as weight distribution of containers, line haul distances, and flexibility at beach offload facilities.

TRAINING DEFICIENCIES.

With the exception of two J-LOTS exercizes in 1977 and 1984, containerization has remained a non-fleet, non-FMF function. As a result, operational commands have had little training or experience and minimal affiliation with the planning process. The transition from breakbulk shipping and palletization to containerization is so complex and of such magnitude that only time will permit the formulation of doctrine and the eventual publication of policy and field manuals . . . none of which currently exist.

ACQUISITION DEFICIENCIES

The acquisition deficiencies resident in the containerization program are similar to those in any other multi-product program. Regardless of the position within the systems acquisition organization, whether a relatively obscure project officer in R & D or a member of the Systems Acquisition Review Committee, no where is there a concensus on the hardware requirements. Since there is, at best, only partial agreement on the requirements, there is little chance of procurement - at least in the quantity and quality necessary to resolve the training and operational issues addressed earlier. Disagreement at the sponsor level equates to loss of funds. The dollar is an issue on the manpower agenda as well. New technology means requirements for new skills and more people which in turn implies more training. Since training and people cost money which might be spent elsewhere, commensurate reductions are demanded and new item procurement suffers the penalty.

CHAPTER V

CONCLUSIONS

The preceding chapters have presented the major elements of a system designed to offload the containerized portion of the assault follow-on echelon for a MAF; in general terms, about 70 percent of all AFOE cargo or roughly 5,100 containers. The remainder of the dry cargo (30 percent) will be in breakbulk configuration to be off-loaded at about 1,000 ST/day.[1] The driving force for development of this system has been previously described as a combination of (1) an ever-growing battle to satisfy the logistics requirements of modern weapons and communications systems, and (2) the continued depletion of both Navy amphibious and non-combatant support ships and commercial breakbulk shipping assets in favor of Navy combatants and commercial non-self-sustaining containerships. There is little reason to believe, despite a great deal of rhetoric and "out-year planning" on the Navy's part, that either of these trends will change; nor is it even logical to conclude that they would. To lend some continuity to this paper, the conclusions and recommendations will, after some comments of a general nature, follow an "operational" sequence, starting with the T-ACS/containership interface and proceding toward the receiving field command. First, however, some general conclusions which fall into no specific operational category but are germain to the system as a whole.

General. Probably the singular most critical problem currently associated with containerization as a system seeking acceptance and credibility is the lack of any Navy/Marine Corps-wide doctrine or even policy guidance to govern its operation. Containerization remains a sub-system of the Field Logistics System, where the concentration still focuses on new technology and hardware development. One element of the containerization offload process which continues to generate loss of credibility is the high risk environment surrounding its employment. Simply put, the concepts, theory, new technology, and newly-developed hardware all cease to function when, (1) combat forces have not successfully established complete security in the force beachhead area and in the skies over it, and (2) the landing force is not blessed with environmental conditions, primarily sea state 2 or better, favorable to such a time-sensitive operation. Without complete security from the threat, without prioritized combat loading vice administrative, without military preparedness to effectively use off-the-shelf commercial hardware (such as, perhaps, the 40-foot container should industry adopt exclusive use), and without a firm understanding of the role played by sea conditions, the offload of AFOE containers across an undeveloped beach is not possible. For all of these reasons and more, an approved doctrine, even a force level SOP is needed now.

T-ACS/Containership. The following conclusions are made concerning operations at that point where offload of the AFOE from the containership begins:

* The trend towards increased average tonnage of commercial ships will continue equating to larger numbers of containers/ship, larger containers, fewer ships, need for improved anchorage systems, and deeper drafts.

* Given the above, the need for prioritized combat loading, automated monitoring and container access, and improved throughput rates (offload) becomes more critical.

* There is an absolute requirement for the most efficient/best trained crane operators in the world to be on the T-ACS cranes. Throughput rates for the entire operation are determined by the rates sustained by the T-ACS.

* The Temporary Container Discharge Facility (TCDF) used by the Army at J-LOTS II failed to sustain required offload rates and was overly susceptible to weather and sea state conditions. The T-ACS (SS Keystone State), conversely, was relatively successful at sea state 2 and below.[2]

* J-LOTS II verified a 200-225 container per day (cpd) sustained rate for T-ACS and a 300 cpd rate at sea state Ø.

* Automatic spreader bars were too heavy and too slow.

Ship-to-Shore (Lighterage)

* The proper mix of ships and lighterage is essential to maximum throughput (as aversed to more of each).

* J-LOTS II causeway ferries (constructed from the MAF assets of 62 non-powered sections, 42 powered sections, 22 side-loadable warping tugs, and various other lighterage) demonstrated a very high payload and throughput with minimal manpower and cost .

* The powered causeway sections used during J-LOTS II, although production models experiencing some mechanical problems, were extremely successful and productive.

* The LCU (1466/1610) is less productive but very reliable and versatile in transporting either containers or breakbulk cargo. The LCM was used for breakbulk only.

* The amphibians (LARC/LACV-30) were fast and productive but equipment and manpower intensive. Weight distribution of the container in LACV-30 is a safety problem due to 30-ton maximum payload.

Beach Offload Facilities

* J-LOTS II demonstrated the danger of optimistic/unreasonable planning data and assumptions such as sea state Ø. These factors and rates cannot be sustained due to both RAM considerations and weather. This being the case, it is doubtful that the FLS, as currently structured, can offload the AFOE as scheduled (D+30).

* The ELCAS required 10 days to become operational vice the 72-hour planning factor. The J-LOTS final report has recommended a 7-day planning factor as a compromise. If adopted, this will obviously not permit use of ELCAS to commence offload of AFOE by D+5. Additional refinements are required: 2 pinheads and cranes (extra 3 sections).

* The Army's DeLong Pier, while taking less time to install than ELCAS (4 days), is far more time sensitive to deployment.

* The RTCH proved surprisingly effective in J-LOTS II and was the most productive facility in conjunction with the causeway ferries. RTCH was very fast and was neither manpower nor equipment intensive.

* The LACH, as the only means of removing a container (strategically centered) from an LCU, possesses a unique capability. Its operational characteristics (tractor prime mover, turning radius, speed, backing, etc.) make it well suited for surf operations but not productive in ASP/CSSA/Marshalling.

Cargo Documentation/Command and Control

* There is a definite requirement for an automated monitoring/tracking system for containers, to include external visability and hand-held terminal capability.

* The above control measures must be transferable to some platform for ship-to-shore control. J-LOTS II used an Amphibious Squadron and Primary Control Ship to effect command and control - and was effective. A lighter control center can be effectively employed on the T-ACS.

* Commercial, non-tactical radios were very effective.

* Service schools should commence formal instruction in lessons learned from J-LOTS.

Operations Ashore/Tactical Mobility

* Certain varieties of flat-racks are more efficient than enclosed containers in both the strategic sense (transport) and for operations ashore; this is specifically true with respect to certain types of artillery rounds.

* Both the LACH and RTCH perform assigned missions as expected (surf zone and CSSA), but both are limited in their capabilities by engineering factors which are possible to eliminate with state-of-the-art technology.

* The 6,000 pound and 10,000 pound RTFL's have no real mission in containerization. An inventory change is needed. The 4,000 pound RTFL needs considerable help in moving, stuffing, and unstuffing containers.

* The 30-ton mobile crane is also limited in its ability to work in the containerized environment; a heavier lift capacity is required.

* The use of ship-sheet technology, especially for Class V supplies loaded at the depot level and manufacturer, is feasible and could be used with existing FLS equipment.

* The use of tandem trailers on MSR's could increase throughput rates.

* New technology permits the use of lightweight, efficient, expendable packaging materials for ammunition and other dry cargo; vice current dunnage systems or use of PALCON/QUADCON.

* A tremendous amount of critical engineer construction support requirements exist for MSR's, CSSA's and ASP's prior to D+5. MSR's must be sufficient to limit cross country travel (and the 12 and 1/2 ton gross load restrictions) to the absolute minimum. Such off-road travel restricts cargo weight to 21,000 pounds, eliminates productivity, and results in 30 percent more containers to be moved ashore. Engineer effort in ASP's and CSSA's must preclude loss of trafficability by MAF (especially RTCH).

* Based upon the productivity observed in J-LOTS II, it is conconded that the allotted 6 RTCH's per MAF is insufficient and that increased numbers will greatly improve throughput rates.

* Planning documentation seems to be supported by J-LOTS operational testing that containers should, for the most part, be left in-tact until arrival at the CSSA or marshalling yard, where they should be unstuffed and palletized cargo moved forward as required. Containers need not go forward of the CSSA/ASP; thus, neither is there a necessity for container handling capability.

CHAPTER VI

RECOMMENDATIONS

This last chapter will provide recommended solutions to those problems discussed earlier that have not already been resolved or the solutions to which made obvious by the conclusions listed in the previous chapter. The recommendations will generally follow the same operational sequence as the conclusions.

<u>General</u>

* Each and every member of the systems acquisition community, whether in research, development, or procurement, must concentrate on those actions necessary to reduce the logistics support burden to its lowest possible state. This includes discarding systems (weapons, communications, or otherwise) which require an unsupportable amount of logistics "tail".

* The military must adapt to the off-the-shelf mentality, and, where industry holds the cards - as in the dimensions of containers - develop the equipment and doctrine commensurate with what is available at the least cost and time; e.g., the Marine Corps must develop and/or procure the means to handle the 40-foot container.

* FMFM 4-3 should undergo immediate rewrite to include containerization. A force level SOP should be published for operational

commands for immediate incorporation into training programs. An approved "source document" must be identified. Adopt common technology; i.e., CSSA vs. LSA.

* Embarkation SOP's and plans should be written to provide prioritized combat loading procedures for commercial non-self-sustaining containerships of each class.

<u>T-ACS/Containership</u>

* The Army should eliminate any further development and production of the TCDF and join the Navy in joint refinement of the T-ACS concept.

* Substitute lightweight, manually-operated spreader bars for automatic.

* Develop and use stern anchor system when feasible.

* Place maximum emphasis on formal schooling and operational experience for T-ACS crane operators.

<u>Lighterage</u>

* Based on operational experience gained at J-LOTS, determine and standardize the proper mix of ships and lighterage for optimum throughput.

* Continue and expand (for stockpile) procurement of powered and non-powered causeway sections. Convince Army to go with joint procurement action.

* Plan to test logistic/AFOE missions of LCAC during next opportunity - retaining its assault mission.

* Use (CSP+3) configuration for maximum throughput

Beach Offload Facilities

* Rethink the assumptions, planning factors, and sustainability rates associated with prolonged offload operations of the AFOE.

* Make scenario/schedule changes based on above; i.e., ELCAS operational in 7 days vice 72 hours would mean no ELCAS from D+5 to D+7 and a commensurate slow-down in throughput for those days unless additional ferries are operated.

* Add three (3) additional sections to provide two (2) pierheads and two (2) crane sites per ELCAS. The increased productivity warrants the use of additional sections.

* No further procurement of DeLong by the Army. Join the Navy in development and procurement of ELCAS.

* Increased procurement of RTCH for near-term operations; double the six (6) currently available to MAF. Primary container handler at beach (given trafficability) and in CSSA/ASP. LACA reduced to support role and when only LCU's are in use.

Cargo Documentation/Command and Control

* Document and use J-LOTS lessons learned on control procedures and platforms; revise later with increased operational experience.

* Implement formal school training.

* Maximum authorization and use of commercial, hand-held radios for command and control during entire spectrum of operation.

Operations Ashore/Tactical Mobility

* Investigate use of leased commercial flat racks vice enclosed containers for applicable purposes. Incorporate increased productivity in planning factors.

* Continue development of a marginal terrain straddle carrier (i.e., "Wishbone Transporter") to replace LACH and RTCH in mid-term for beach and inland operations.

* Retain and increase inventory of 4,000 pound RTFL with side-shifting mast.

* Delete 6,000 pound RTFL from inventory. Retain 72-31 Terex in current inventory.

* Develop and procure 15,000 pound RTFL with shooting/extending boom (20 foot) for stuffing/unstuffing containers and overhead work. A 15,000 pound lift capability will provide prime means for relocating tactical shelters and vans vice 30-ton crane.

* Investigate and test use of ship sheets with all forms of dry cargo.

* Investigate further use of tandem rear body units for MK48.

* Redefine Engineer Support Battalion and Naval Construction Force (NCF) mission requirements in AOA between D-Day and D+5.

Establish priority of effort and delivery of construction materials and equipment for critical work on ELCAS, MSR, and CSSA/ASP.

* Make the NCF a functional element of the MAF - for training and operations.

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