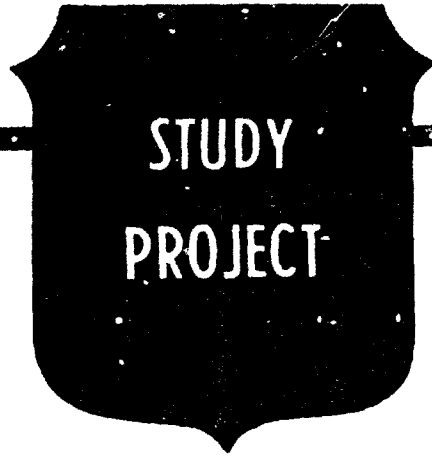


AD-A263 595

2



The views expressed in this paper are those of the author and do not necessarily reflect the views of the Department of Defense or any of its agencies. This document may not be released for open publication until it has been cleared by the appropriate military service or government agency.

**SUPPLYING A DEPLOYED CORPS--  
A SUPPORTING BATTALION  
COMMANDER'S PERSPECTIVE**

BY

**LIEUTENANT COLONEL PATRICK E. GARREN**  
United States Army

**DTIC  
ELECTE  
MAY 05 1993  
S E D**

**DISTRIBUTION STATEMENT A:**  
Approved for public release.  
Distribution is unlimited.

USAWC CLASS OF 1993



U.S. ARMY WAR COLLEGE, CARLISLE BARRACKS, PA 17013-5050

93-09585



93 5 04 12 6

## REPORT DOCUMENTATION PAGE

Form Approved  
OMB No. 0704-0188

1a. REPORT SECURITY CLASSIFICATION <b>UNCLASSIFIED</b>		1b. RESTRICTIVE MARKINGS	
2a. SECURITY CLASSIFICATION AUTHORITY		3. DISTRIBUTION/AVAILABILITY OF REPORT <i>Approved for public release</i>	
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE		Distribution is unlimited	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) _		5. MONITORING ORGANIZATION REPORT NUMBER(S)	
6a. NAME OF PERFORMING ORGANIZATION <b>U.S. ARMY WAR COLLEGE</b>	6b. OFFICE SYMBOL (If applicable)	7a. NAME OF MONITORING ORGANIZATION	
6c. ADDRESS (City, State, and ZIP Code) <b>ROOT HALL, BUILDING 122 CARLISLE, PA 17013-5050</b>		7b. ADDRESS (City, State, and ZIP Code)	
8a. NAME OF FUNDING / SPONSORING ORGANIZATION	8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER	
8c. ADDRESS (City, State, and ZIP Code)		10. SOURCE OF FUNDING NUMBERS	
		PROGRAM ELEMENT NO.	PROJECT NO.
		TASK NO.	WORK UNIT ACCESSION NO.
11. TITLE (Include Security Classification) <b>SUPPLYING A DEPLOYED CORPS - A SUPPORTING BATTALION COMMANDER'S PERSPECTIVE</b>			
12. PERSONAL AUTHOR(S) <b>Garren, Patrick E, LTC</b>			
13a. TYPE OF REPORT <b>INDIVIDUAL</b>	13b. TIME COVERED FROM _____ TO _____	14. DATE OF REPORT (Year, Month, Day) <b>93 APRIL 1993</b>	15. PAGE COUNT <b>44</b>
16. SUPPLEMENTARY NOTATION			
17. COSATI CODES		18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)	
FIELD	GROUP	SUB-GROUP	
19. ABSTRACT (Continue on reverse if necessary and identify by block number) <b>Lack of an asset visibility system, poor material distribution, and shortfalls in the combat service support force structure results of a logistics system with these deficiencies was clearly illustrated at the Logbases of Desert Shield/Desert Storm. This study examines the operations of the 13th Supply and Service Battalion, which supported VII Corps from Logbase Alpha and Logbase Echo during Desert Shield &amp; Desert Storm. The Battalion received, stored, and issued all classes of supply with the exception of bulk petroleum, bulk water, medical, and ammunition. The author was the commander of the Battalion and uses his personal experience to explain the logistics operations. The operation of this battalion clearly highlights future modifications needed to sustain the logistical support to a Corps.</b>			
20. DISTRIBUTION/AVAILABILITY OF ABSTRACT <input checked="" type="checkbox"/> UNCLASSIFIED/UNLIMITED <input type="checkbox"/> SAME AS RPT. <input type="checkbox"/> DTIC USERS		21. ABSTRACT SECURITY CLASSIFICATION	
22a. NAME OF RESPONSIBLE INDIVIDUAL <b>COLONEL JOHN BROWN</b>		22b. TELEPHONE (Include Area Code) <b>717-245-3440</b>	22c. OFFICE SYMBOL <b>DMSPO</b>

**USAWC MILITARY STUDIES PROGRAM PAPER**

The views expressed in this paper are those of the author and do not necessarily reflect the views of the Department of Defense or any of its agencies. This document may not be released for open publication until it has been cleared by the appropriate military service or government agency.

**SUPPLYING A DEPLOYED CORPS - A SUPPORTING BATTALION  
COMMANDER'S PERSPECTIVE**

**A PERSONAL MONOGRAPH**

by

**Lieutenant Colonel Patrick E. Garren  
United States Army**

**Colonel John Brown  
Project Adviser**

**DISTRIBUTION STATEMENT A: Approved for public  
release; distribution is unlimited.**

**U.S. Army War College  
Carlisle Barracks, Pennsylvania 17013**

ABSTRACT

AUTHOR: Patrick E. Garren, LTC, USA

TITLE: Supplying a Deployed Corps - a Supporting Battalion Commander's Perspective

FORMAT: A Personal Monograph

Date: 15 April 1993 PAGES: 44 CLASSIFICATION: Unclassified

Lack of an asset visibility system, poor material distribution, and shortfalls in the combat service support force structure create massive problems in supplying a deployed Corps in war. The results of a logistics system with these deficiencies was clearly illustrated at the Logbases of Desert Shield/Desert Storm. This study examines the operations of the 13th Supply and Service Battalion, which supported VII Corps from Logbase Alpha and Logbase Echo during Desert Shield/Desert Storm. The Battalion received, stored, and issued all classes of supply with the exception of bulk petroleum, bulk water, medical, and ammunition. The author was the commander of the Battalion and uses his personal experience to explain the logistics operations. The operation of this battalion clearly highlights future modifications needed to sustain the logistical support to a Corps.

DTIC QUALITY INSPECTED 3

Accession For	
NTIS CRA&I	<input checked="" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification .....	
By .....	
Distribution /	
Availability Codes	
Dist	Avail and/or Special
A-1	

## INTRODUCTION

The United States Army must develop a robust logistical capability to support contingency operations of the future. This capability must be able to support forces deployed anywhere in the world, with their widening variety of missions. Logistical procedures, techniques, and force structure must not be neglected as the Army enters a period of great change, reorganization, and downsizing. Logisticians are tasked to search for ways to enhance support capabilities with less combat service support (CSS) force structure, a weaker industrial base, and fewer logistical supplies preposition overseas.

Deficiencies and shortfalls in the logistics system's ability to support Operation Desert Shield/Desert Storm clearly highlight future modifications needed to sustain logistical preparedness. Logistical capabilities at the strategic level, in far too many cases, never reached the tactical level and the combat soldier. In, "Victory, The Logistics," the Army's Deputy Chief of Staff for Logistics, Lt. Gen. Jimmy Ross, lauded the great success of logistics in the Persian Gulf War. He mentions the Defense Logistics Agency's (DLA) procurement of the desert battle dress uniform, development of heat resistant candy, the use of the tactical petroleum pipeline, the development of the flameless ration heater, and many other advances.<sup>1</sup> Unquestionably, the wholesale supply system did an extraordinary job of obtaining the right parts, developing effective equipment, and procuring large quantities of supplies.

Unfortunately, many of these items of equipment never were delivered to the soldier in the desert. For example, in VII Corps many soldiers did not receive the desert uniform until after the ground war was over. The strategic level of logistics may have produced the right supplies, equipment, and repair parts, but the logistics system failed to get them to the tactical user in a timely manner.

The current Army logistics system continually sacrifices efficiency and support capabilities because it systematically lacks; asset visibility, a sound distribution system, and an efficient force structure with material handling equipment and automation. These three areas must be improved to enhance the Army's ability to support troops in the field. Many experiences and cases in Desert Shield/Desert Storm clearly demonstrate the hardship caused when they are not available.

The purpose of this paper is to examine the operations of the 13th Supply and Service Battalion, as experienced by the author. With this examination, the author will illustrate the impact of inadequate asset management, and poorly equipped and manned combat service support (CSS) units. Such an examination will clearly show improvements need in the logistics system for the future.

The 13th S and S Battalion provided general supply support to all units assigned to the VII Corps during Operation Desert Shield/Desert Storm. All classes of supply, with the exception of bulk petroleum, bulk water, medical supplies, and ammunition

were supplied by the battalion. The battalion formed the initial stockage and distribution point for VII Corps. The 2nd Armored Cavalry Regiment, 1st Armored Division, 3rd Armored Division, 1st Cavalry Division, 1st Infantry Division (Mechanized), and the 2nd Armored Division (Forward) were assigned to the Corps and their supplies flowed through the battalions' distribution point. In addition, supply support was provided the Corps' artillery, signal, engineer, military police, and combat service support units.

Supply support to the Corps was conducted at logistics bases (Logbase) established through-out the theater. Perhaps, no better place illustrates the disconnects and inefficiencies of the logistics system than in these Logbase operations. Before examining the Logbase, its functions as they relate to the rest of the logistics system must be explained.

#### DOCTRINE - LEVELS, PLAYERS, FUNCTIONS

**STRATEGIC LEVEL.** The strategic level is the primary source of support for the contingency force. Another source of support may be the host nation, depending largely on its own economic development. Host nation support may provide some logistical support, but the larger the force structure to be supported and the longer the operation last, the greater the dependency on the strategic level of logistics. The strategic level is located in the United States and/or in another theater.

Chapter 9 of FM 100-5 (Draft) designates the players at the strategic level as the "National political and military strategic leadership, as well as civilian and military suppliers and contractors, [who] combine efforts to effectively provision the force."<sup>2</sup> This manual specifies that the functions of logistics at the strategic level as mobilization, acquisition, projecting forces, and strategic mobility. The bottom line is that strategic support "links a nation's economic base (people, resources, and industry) to its military operation in a theater."<sup>3</sup>

At this level, the supply managers have visibility of material in the procurement pipeline, material prepositioned in and outside the U.S., and quantities of material stocked. That is, they know what they have, where it is, and how much is available. The managers then know what material has been shipped to support the contingency force; they can obtain information about it and the status of its arrival into the theater.

The Military Traffic Management Command (MTMC), Military Airlift Command (MAC), and the Military Sealift Command (MSC), program the transportation requirements and manifest the cargo for each shipment. These strategic agencies know exactly where and when an item of supply arrives in theater. As with DLA, in Army Material Command (AMC) and other strategic activities, arrival at the theater is the real breaking point: again both asset visibility and distribution management is lost. At the airfields and ports of the theater, control moves to the operational level agencies.



Unfortunately, as demonstrated during Desert Shield/Desert Storm, the capability to track supplies starts failing at this point. At this step in the flow of material, no automated system was in place to capture the contents of containers or pallets. The transportation agencies would know what was unloaded at the port but once moved into the theater of operations, all visibility was lost.

Thus at the strategic level, "the operational commander - the theater commander-in chief - is constrained by the strategic aspects of logistics. How much air-and sealfift is available and how much time is available? Logistics at the strategic level involves determining how the force gets to the theater, what materiel it will bring, and how fast it gets into the theater; this is essentially a strategic movement problem."<sup>4</sup> The real supply problems for Desert Shield/Desert Storm began after the strategic movement problems were solved.

**OPERATIONAL LEVEL.** Operational logistics encompasses those support activities required to sustain campaigns and major operations. Operational logistics focuses on force reception, distribution and management of material, movements, terrain, personnel, and health services.<sup>5</sup> These functions are develop at the operational level and focus on the tactical operational plan. Logistics determines how, when and where the force arrives in a theater, and governs where and when combat power can be massed. Logistics underwrites the concept of operations and the scheme of

maneuver; it is the fulcrum upon which tactical leverage can be created.<sup>6</sup>

At the operational level of logistics, the operators consist of echelons above corps (EAC) units. These units are a mix of active and reserve units; they are deployed into the theater based on the anticipated logistical requirements. Material management centers and movement control activities/centers arrive in the theater to manage the logistical assets and their distribution.

Asset visibility, distribution control, and material management are essential at the operational level. With the Army's current systems and force structure, these functions are difficult, if not almost impossible, to accomplish.

If the logistics support from the strategic level exceeds the capabilities of the operational level - whether at the theater Logbases (including the ports and airfields), or at the forward Logbases (in the interior of the operations) - the performance at the operational level will deteriorate. Establishing the operational level takes time and resources. This structure can rapidly be overwhelmed if the in-bound flow of logistics exceeds its processing capability. The logbases in Desert Shield/Desert Storm were overwhelmed. Thus asset visibility was never obtained, distribution was extremely difficult, and material management was accomplished only for limited critical items.

**TACTICAL LEVEL.** Tactical logistics sustains the tactical commander's ability to fight battles and engagements. The logistical focus at the tactical level is on manning and arming tactical units; fixing and fueling equipment; moving soldiers, equipment and supplies; and sustaining the soldier with personnel service support and health services.<sup>7</sup>

At this level, the contingency force is normally well organized, staffed, and trained in logistics planning and execution. The force will normally have its own organic combat service support (CSS) forces linked permanently with the combat force. This structure at Battalion, Brigade, and Division typically operates as a team, in both peace and in war. The primary operators at the tactical level are the Division Support Command (DISCOM), Main Support Battalions (MSB), and Forward Support Battalions (FSB).

At the Corps level, the logistical functions are performed by Corps Support Groups (CSG) of the Corp Support Command (COSCOM). The rear CSG normally provides general support to the Corps and direct support to Corps rear units, and the forward CSGs are normally assigned in support of a specific Division. These units are a mix of active and reserve forces and, like the operational level force structure, they are assigned based on anticipated logistical requirements. The Corps has a Material Management Center (MMC) and a Movement Control Center (MCC) to manage supplies and transportation assets.

Deployed Divisions and Brigades normally have supporting material managers and movement control teams or centers to orchestrate the flow of logistics to the user. These managers focus on logistical support for the battle. They normally have asset visibility for critical items and limited transportation assets under centralized management.

### CONCEPTS FOR ENHANCING SUPPORT

**ASSET VISIBILITY.** "Asset Visibility" means that users and providers know where specific parts, equipment, or supply are located and know the current status of all requisitions or routinely delivered items. In-transit visibility is also part of asset visibility; it is essential for linking the strategic level with the operational level. The individual item manager at the strategic organization must know how many items he has, where they are located, and their status when in transit. Just as important, the customer must know for certain where the item is and must have a realistic expected time of arrival.

Failure to maintain this total visibility from the manufacture to the foxhole has an adverse impact on the entire system. This lack of visibility impacted every Logbase operating in support of Desert Shield/Desert Storm. It was impossible for the managers at any level to know for certain that their logistical requirements would be met. The first step is knowing an asset's location. The next step is the moving the item from its current

location to the user, or diverting an in-transit item to the user. Such real-time visibility requires a robust distribution system.

**DISTRIBUTION SYSTEM.** The distribution system is defined as "that complex of facilities, installations, methods, and procedures designed to receive, store, maintain, distribute, and control the flow of military materiel between the point of receipt into the military system and point of issue to using activities and units."<sup>8</sup> Under this definition, the Logbase of Desert Shield/Desert Storm clearly became a critical part of the distribution system.

It was at the Logbase that distribution of material sometimes was delayed or even stopped, so many items did not reach the user at the tactical level. The lack of automated identification of the item, a reference to customer location, and scheduling transportation, all contributed to the delay or loss. Large numbers of items were considered "frustrated cargo" because their destination could not be determined.

For example, AMC received 1,290,516 request by customers in support of Desert Shield/ Desert Storm. AMC shipped 1,141,567 parts that were received by the customers. AMC has also stated that over 88% of all requisitions (all classes of supply) were supplied to the customer.<sup>9</sup> Clearly the requisitions may have been shipped and arrived in theater. However, there remains much debate about how many made it to the user.

According to the After Action Review conducted by the Theater Support Commander, LT. Gen. Pagonis, on 20 March 1991, the logistical commanders of the COSCOMs and the DISCOMS all agreed that repair parts failed to make it to the customer.<sup>10</sup> At the termination of the conflict at least 200 standard 40-foot containers of repair parts remained in VII Corps unissued to the user. Where was the disconnect? AMC managers knew items were shipped. But they lost visibility and simply assumed arrival in theater meant issue to the customer. The operational level's distribution system failed to get the parts to the customers. Thus much needed material became "frustrated cargo" at the Logbases.

**FORCE STRUCTURE.** The third element logisticians need to examine to enhance support is the force structure. Force structure consists of units with trained people and the necessary equipment. The structure must also include the automation hardware and software to manage logistics. Modern volumes of transactions make manual operations almost totally ineffective.

The execution of all logistics depends on the assignment of a logistics mission to a unit and an assignment of the management function with appropriate automation to direct and control the operation to a management center. Logistics missions are assigned to CSS supply and maintenance units, and the management mission is normally assigned to material management centers. Transportation assets are found in the transportation units,

where the control of their missions are assigned to the movement control activities and centers.

At the strategic level, the mission assignment and the corresponding force structure is well established; normally it consists of a predominately civilian or a contractor work force. At the operational level, force structure is built from the integration of reserve and active CSS units. Then at the tactical level, the force structure is usually built from organic CSS units, consisting primarily of active duty forces.

#### DESERT SHIELD/DESERT STORM LOGBASES

INTRODUCTION. The logbases in Desert Shield/Desert Storm were built to serve two purposes. First, they served as backup to the warehouses and staging areas at Ad Dammam and AL Jubayl, which quickly overfilled as material surged into Saudi Arabia.<sup>11</sup> Secondly, the operational concept of a wide flanking movement necessitated prepositioning supplies forward to support the forward movement of combat forces. Logbases became "stable forward locations"<sup>12</sup> from which the logistics could flow to the tactical level. At these forward locations, the strategic level functions of logistics stopped and the operational level kicked in.

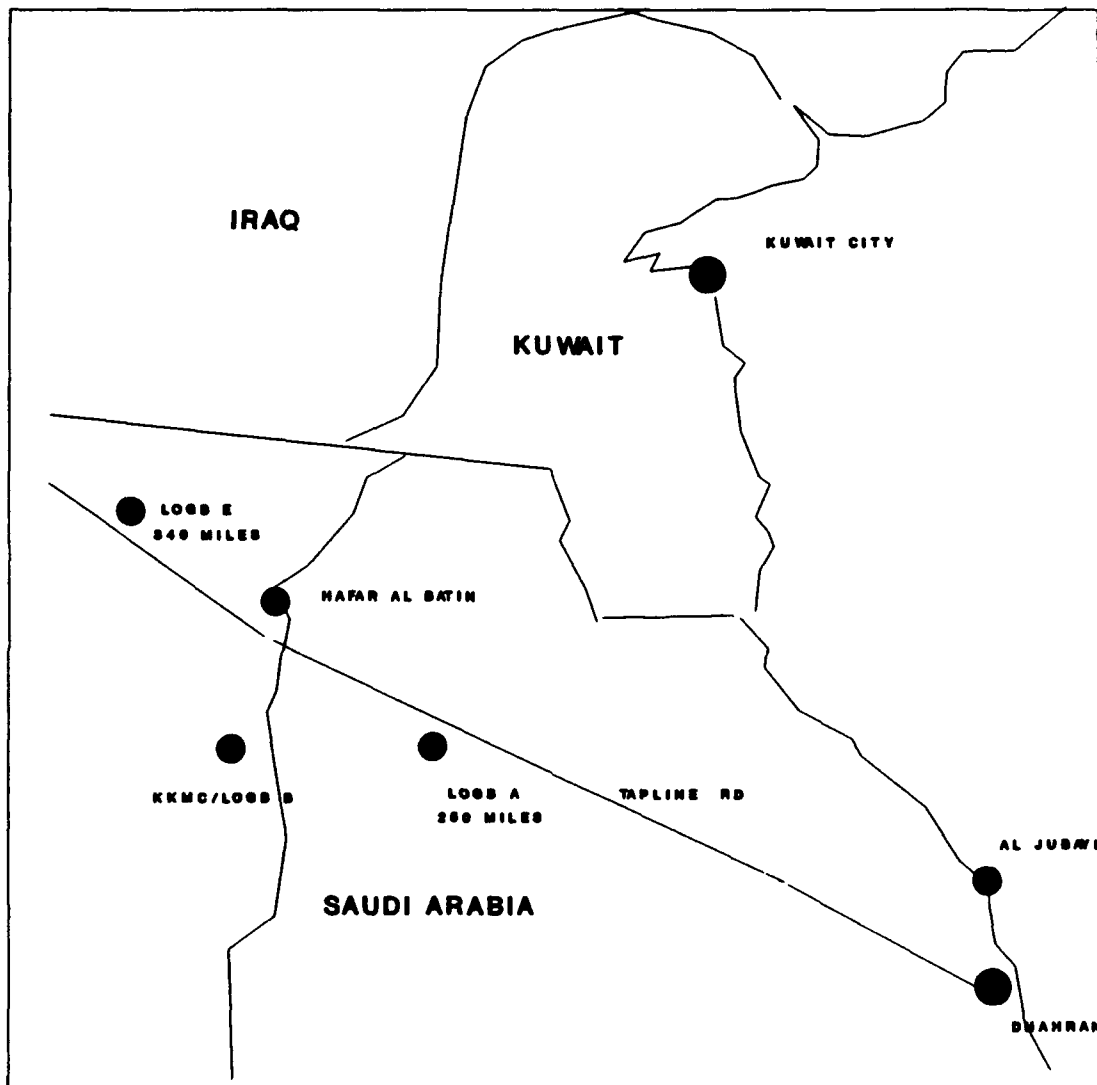
The logbases consisted of a large variety of CSS units, active and reserve, from all unit organizational levels: Theater, Corps, and Divisions. As previously stated, this study

will focus on only one of these many units -- the 13th Supply and Service Battalion (S&S) arriving from Germany in December, 1990. The battalion received supplies and equipment from the other Logbases or directly from the port, received disposition instructions, and issued supplies and equipment to units of the Corps. All supplies, with the exception of bulk water, bulk petroleum, bulk ammunition, and medical supplies flowed through the 13 S&S Bn.'s Logbase.

The battalion initially became operational at Logbase Alpha, 250 miles west of the port of Ad Damman (see figure 1). Logbase Alpha had been established by the theater support units in November. In late December, the 13th arrived and began assuming the mission of receiving VII Corps' supplies.

As both the XVIII and VII Corps swung to the West, additional Logbases were created to sustain the rapid movement. In just six short weeks, the 13th had accumulated an enormous stockage. On 2 February, the unit began a 10 day movement from Logbase Alpha to Logbase Echo, 340 miles westward from the port. The transportation required to move the stocks indicates the enormous size of the logistics base. This movement required 390 stake and platform (S&P) trailers, 79 heavy equipment transporters (HET), 68 five-ton cargo trucks, and 14 two-and-one-half ton cargo trucks. This was for the transport of stockage only; it did not include transportation of unit equipment.<sup>13</sup>





**Figure 1: LOCATION OF LOGBASES**

At both Logbase Alpha and Logbase Echo, the Battalion was functioning between the tactical level of logistics (the Divisions) and the ports and airfields. The problems faced at the Logbases operated by the 13 S & S Bn. clearly indicate where improvements needed to be made to the logistics systems. Also many of the lessons learned have application to the other classes of supply stocked at similar Logbases, such as ammunition, medical supplies, and bulk petroleum.

OPERATION OF A GENERAL SUPPLY SUPPORT BASE (GSSB). Prior to Operation Desert Shield/Desert Storm, the mission to operate a general supply support base by a Corps Support Command or a Theater Area Army Command had been substantially reduced. Army doctrine called for the shipment of supplies from the strategic level straight to a supply support activities (SSA) of a direct support unit (DSU), normally found at the tactical level. This eliminated, in theory, the need for a large stockage of supplies at the theater or corps level. The policy stated that "the Army distribution system maintains its wholesale stockage in CONUS (Continental United States) and uses a modern distribution and transportation system to resupply the SSA's directly from the CONUS wholesale base. Distribution is accomplished by the DSS (Direct Support System) via surface and air transportation."<sup>14</sup>

These changes in the Army's concept for support reduced the requirement for stockage. Stockage was reduced to less than 3000 critical lines that must be air transportable. Therefore, operational requirements for repair parts companies and general

supply companies, both active and reserve, were drastically reduced.

Unfortunately, the theory and doctrine never became reality in Saudi Arabia, with the results being mountains of supplies arrived at the Logbases, and became more or less stranded there. Virtually no supplies of any type were shipped from the strategic level straight to the tactical level. The principle of throughput set forth by the policy simply failed to materialize. Immense personal effort and ingenuity was required to overcome the resulting shortfall in force structure and automation. The soldiers in the CSS units of all levels and types, from the truck driver to the stock control clerk, forced logistics to work. This flaw (the breakdown between doctrine and reality) spelled near disaster for a system lacking asset visibility; and impacted on the availability of all classes of supply. Each class of supply had unique characteristics and problems, and will be addressed separately.

SUBSISTENCE (CLASS I), BOTTLED WATER, AND SUNDRY PACKS. The task of providing rations, bottled water, and personal hygiene items to between 120,000 to 160,000 soldiers was initially assigned to a single general supply company - the 75th General Supply (GS) Company deployed from Germany. According to doctrine, the ratio for allocation of general supply companies calls for four companies assigned to a corps with four divisions (VII Corps had four U.S. divisions). General supply companies had the mission to maintain and issue Corps/Theater Reserve Stocks of

general supplies, to include Class I (subsistence).<sup>15</sup> Normally, this type unit is designed to support only one division's MSB and one to three DSUs in the Corps. The 75th began operations receiving, storing, and issuing to 3 MSBs and 7 DSUs. A mission two and one half times larger than the designers had planned for.

The vast majority of rations arrived in 40-foot and 20-foot Sea-Land containers. In many cases, these containers were loaded onto trailers directly from the ships. They were marked only as "Class I", if marked at all. All marking identifications fell far short of needed requirements and gave little or no information as to exact contents. The only accurate method for precisely determining types and quantities of rations was to break the seal on the container and conduct a time-consuming physical inventory. This problem was recognized as a major theater-wide problem during the 22 Support Command's After Action Review.<sup>16</sup>

To complicate the processing of Class I, all requisitions, issues, and inventories had to be accomplished manually by elements of the Corps Material Management Centers and the operational CSS unit. The total lack of automated asset visibility and inventory control created a manpower intensive operation. Also, this required more manpower and material handling equipment (MHE) than was available, contributing to immense backlogs and inaccuracies.

Our problem with sundry packs (personal items such as toiletries) dramatizes the inefficiency resulting from the lack of asset visibility. The handling of mass numbers of containers

with little or no marking resulted in the 13th S & S Bn. uncovering over 50 containers of sundry packs, enough to supply the Corps for 90 days or more. Transportation was critical. When the Logbase had to be moved forward, these supplies had to be left behind in custody of a theater unit. Asset visibility would have prevented the delivery of such a large volume of non-critical supplies forward to the Logbase and saved critical transportation assets.

But while the male sundry packs were abundant, no female sundry packs could be found. This lack was ascertained after a massive search of hundreds of containers.

As with the female sundry pack, hospital rations, to include baby food, had been shipped by containers again only marked "Class I". These rations were needed primarily for hospital support to injured civilians. A container yard of approximately 500 containers "suspected of having the items" had to be inventoried, but only one container of limited hospital rations was found. There was never a guarantee that the right container made it to the right logbase. And if it did, there was no system to inventory the contents automatically. Manual stock records, or in some cases self-developed desk top computer procedures and large inventory teams, became the norm for operations at the Logbases.

The lack of force structure and a flexible distribution system to deliver supplies as far forward as possible quickly overwhelmed the supply base. The volume of incoming rations

exceeded the capabilities to process and handle them. Convoys of between 30 to 100 or more Sea-Land containers were delivered daily directly from the port to the Logbase, a 240 mile trip. The divisions and other customer units had to wait, in many cases, over 12 hours to be loaded with their rations and bottled water. Lack of an automated system and asset visibility of the container's contents resulted in units receiving rations according to what was "thought" to be on hand. This explained why, in many cases, units failed to receive any variety in type of meals. For example, the Battalion issuing the rations for the entire Corps ate Lasagna for a supper meal seven days in a row. How bad can lack of visibility be!

The lack of material handling equipment at the final destination was another reason the "through-put" of rations and bottled water was rarely accomplished. Only four 50-ton rough terrain container handlers (RTCH) were available for the arrival of VII Corps in the vicinity of Logbase Alpha. The number of 40-foot and 20-foot containers arriving with both sustainment supplies and unit equipment from the port numbered in the thousands. This incoming volume forced very careful management of this critical piece of MHE. Containers could not be pushed to units which did not have the capability to unload them.

If the customer unit did not have a RTCH, the contents of the containers had to be unloaded before they were transferred to the customer. This double handling cost valuable time. To overcome the backlogs, units started accepting what containers they

could. They employed a wide variety of unloading techniques: cranes, wreckers, dual forklifts, and ramps were used to unload containers with mixed results. The bottom line, the lack of a force structure authorizing MHE, contributed to the creation of large stockpiles at the bases where the general supply units suddenly became direct support units issuing straight to customers. These same units also received the mission of unloading individual unit equipment containers. This mission of handling hundreds of containers daily was never planned for by force designers.

The great distance involved was not a primary reason for failure to "through put" rations. The Corps' units were initially nestled around the Logbases - in some cases closer to the port of origin than to the supporting Logbase. The problem was instead the control of trucks and trailers. This may seem a minor problem to the uninitiated, but truck and trailer management became a critical issue throughout the theater.

Lack of communication among units, the movement control centers/agencies, movement control teams, and the tactical units made transportation management extremely difficult. According to the 2nd COSCOM After Action Report:

Movement control teams lacked organic communications and mobility to effectively perform their assigned missions. With virtually no radios or vehicles, movement control teams relied almost entirely on the TASS phone system which reached only about 20% of the units, work sites, and critical transportation nodes. Failure to resource movement control teams resulted in an unsatisfactory level of effectiveness in tracking transportation assets and critical movements.

Tracking the current locations of CSS units was also difficult at best. But insuring that a convoy traveling 250 or more miles from the port would ultimately find the right unit was risky. Changing convoy destinations while the convoy was enroute was impossible. Lack of basic communication equipment prohibited throughput or redirection of convoys. It quickly contributed to the massive build-up of supplies at the known destinations - the Logbases. Even with minor location changes, drivers would spend hours and on a few occasions days looking for moved units. The practical solution was to run convoys to the familiar Logbases and establish fixed routes with return loops.

A third reason for creation of large stockage of subsistence was the lack of subsistence personnel. With the implementation of the combat field feeding system, personnel authorizations were eliminated or reduced throughout the CSS force structure. The theory that tray packs (T rations) would be easier to handle and preparation requirements would be reduced justified this reduction in force structure. But in fact the soldiers in the desert ate a much larger variety of rations, based on availability and the commanders' desires. Commanders rightly insisted on hot meals if at all possible. Meals ready-to-eat (MRE), meals operational ready to eat (MORE), B rations, T rations, commercial meal items, fruits, vegetables, and ice - all of these require intensive handling and sorting. Even a repair parts platoon from the battalion was sent to the theater Logbase to help sort out commercial lots and containers into individual meals. The



process of simply identifying what had arrived from the port to feed 120,000 soldiers was overwhelming.

A second general supply company, the 452nd from Minnesota Reserve, was later assigned to help with the Class I mission. This added resource, coupled with 24-hour operations and soldiers averaging of only 4 hours sleep, overcame the structural shortfall. The platoons that handled both rations and bottled water averaged a total strength of 70 soldiers, and the platoons had no organic computers. In addition to receiving and issuing rations, the Class I site maintained over five days of supply on hand, or 1.8 million meals. When the Class I mission had finally ended in April, the Battalion had issued 14,482,271 meals and over 20,000,000 bottles of water.<sup>18</sup>

To summarize the Class I problem, the lack of force structure and MHE to handle the mission, lack of throughput forward, and lack of automation to determine asset visibility greatly hampered operations. Only because we had a large volume of back-up supplies available and because they were pushed forward was the Class I mission successful.

CLOTHING, INDIVIDUAL EQUIPMENT, AND GENERAL SUPPLIES (CLASS II). Many of the problems in Class II Logbase operations are closely related to the shortcomings found in Class I operations. The lack of force structure, inability to manage transportation, shortage of MHE, and the lack of asset visibility plagued Class II operations in support of Desert Shield/Desert Storm.

The major difference between Class I and Class II is the wider variety of items. Class II items were requisitioned by units. Virtually all Class I supplies were pushed to the Corps from theater, based on the receiving units' personnel end strength. Some Class II items were likewise pushed to the Logbase, primarily chemical protective clothing and desert camouflage uniforms. Overall, the sheer volumes of Class II had the same overwhelming impact on the 13 S & S Battalion as did the massive quantities of Class I.

At the start of Logbase Alpha, an unexpected large volume of Class II items arrived. Examination of this initial Class II (approximately 30 lanes of palletized cargo, 50 yards long) indicated approximately 40% would be considered non-critical supplies. The large number of water cans was expected, but the large numbers of bayonets, cases, carrying bags, paper for copy machines, office supplies, canvas products, and nice-to-have items simply overwhelmed the system.

Most of these supplies were ordered on high priority and wasted valuable air transportation. Ironically, units may have had good intentions in ordering the item, but they finally had to be forced to take them. They resisted acceptance because of their lack of organic transportation to carry such non-critical items around the battlefield. Asset visibility and appropriate management would have prevented most Class II items from ever being shipped on high priority by air. Additionally, units' lack of confidence in being able to get supplies resulted in units

using high priority requisitions for everything. This inflated prioritization wasted valuable strategic transportation.

The volumes of supplies simply clogged the system almost to a stop. ALOC (Air Lines of Communication) pallets had to be manually broken down. Then their contents had to be sorted not only by DODAAC (Department of Defense Activity Address Code) but by class of supply. Multiple classes of supply would arrive on the same ALOC pallet or in the same container. Until locations and support activities could be identified to a specific DODAAC, the supplies sat on the ground in the desert. Even a large number of class VIII medical supplies were received. Asset visibility at the initial build up of VII Corps was zero. Why? We were unable to establish sufficient automation to deal with the extremely large volumes.<sup>19</sup>

Some additional problems with Class II highlight deficiencies in the current concepts for supporting contingency forces. Chemical clothing and equipment become high priority items, and thus require special management. Chemical Protective Overgarment (CPOG) distribution at Logbase Echo was critical to insure all Corps soldiers had the required 2 sets of CPOGs prior to combat; a number of divisional units had already begun movement across the line of departure without them. In a 24-hour period, over 70,000 CPOGs were issued using manual stock record accounting procedures.<sup>20</sup> Additional CPOGs and chemical equipment was packaged and prepositioned next to the two helipads built, solely for emergencies.

Clothing items were issued using manual computations accomplished on site by the material management center's (MMC) personnel. Issues were made directly to units - not from a general supply unit only to supporting direct supply units, according to doctrine. Time and lack of automation resulted in "best guessing" size requirements for the units. Not having an automated system to compute sizes, quantities, and manage other documentation made operations inefficient.

Maintaining accountability and trying to cross-level was extremely difficult. In December, 60,000 sets of DCUs were enroute by air to the VII Corps. They arrived in Ad Damman but could not be traced after arrival. Needless to say, they never made it to the Corps. Further, DCU's became a critical item for VII Corps, and the theater issued 17,000 in one shipment. Unfortunately, with their actual arrival and physical inventory, it was discovered that almost all of the uniforms were extra small or small.

One platoon from the 75th operated the Class II storage site. Its mission was supported by elements of the 496th Repair Parts (RP) company deployed from Germany. The 496th did the initial identification and sorting of supplies as the containers or pallets arrived. The force structure for Class II, as with the other classes of supply, assumed "through-put" - from port to Division. This did not happen. So when the Class II operation was at its peak in February, it had stocked over 2000 lines, amounting to approximately 1000 tons of supplies. In the 5

months of operation 1,200,000 uniform pieces and 650,000 CPOG items were issued.<sup>21</sup> All was done with little automation support.

PACKAGED PETROLEUM PRODUCTS (CLASS III P). As with the previous two classes of supply (I, II), packaged petroleum products presented the same major systemic problems - lack of asset visibility, lack of automation, shortage of dedicated MHE, and lack of force structure to support the unexpected volumes.

Two additional and related characteristics of Class III (P) created special problems. Unlike rations and general supplies, packaged petroleum products are much more critical to a contingency force. An offensive operation will stop without it. Not only was Class III (P) critical, in Desert Shield/Desert Storm it was initially short supply. Shortage of a critical commodity in war brings out the best and worst of logisticians.

Management of this class of supply was manual and streamlined. Products were flowing in from the states, loaded straight on S & P trailers, and then rapidly moved to the forward Log-bases. Here the MMC managers would normally be on site. They simply divided the inbound quantity by an equitable amount and issued it to the units without waiting for their requisitions. Where available Class III (P) products were locally purchased in Saudi Arabia, critical shortfalls were thus met in more rapid manner than if they had they been supplied from the strategic level. Estimates were made for Class III (P) requirements, the products were purchased or ordered, and then they were pushed

forward to the logbases. Just prior to the offensive ground operation, all shortages were met. As with the other cases discussed, the extraordinary efforts of many made a broken system work.

In extremely short supply was lubrication oil (turbo shaft) for the main battle tank (M1). As stated before, the shortage of critical items created very stressful situations: one support commander threaten to bring in his "tanks" to get his turbo shaft oil. Fortunately his threat was resolved by the issue of the "just arrived" lubricant. His anger illustrated the frustrations of all logisticians found at the operational and tactical level, where lack of confidence in the system was the norm.

The Class III (P) mission for support to VII Corps was assigned to the 452nd GS company, a reserve unit. It performed a splendid job. This unit had dedicated managers whose performance exceeded that of active duty sister units. Yet dedication could not overcome the lack of MHE and their lack of training in dealing with such high volumes. The stockage averaged around 1,200 lines, with most issues for a few large-volume items. The 452nd issued 200,178 gallons of oil in containers of 55 gallons or smaller. The unit also issued 26,175 gallons of engine coolant/antifreeze and 7,060 gallons of battery water. As with all classes of supply, none had anticipated these volumes. Additionally, the unit had no automation support and endured poor management of distribution.

CONSTRUCTION MATERIAL (CLASS IV). Class IV supply operations at the operational level was very similar to Class II. This class of supply has both push items (common barrier material) and specific items ordered by customer units. Plywood, sandbags, and concertina wire were the critical items. Because of the demands created by a quick offensive operation, the projected requirements exceeded the actual demand. The base operation maintained only 50 lines of stock but had approximately 600 short tons of supplies on hand.

Early on, the lack of lumber and plywood had another critical impact. Units short of construction material started using the aluminum ALOC pallets for roofs of bunkers and fighting positions. Not only was this hazardous, it as well caused a shortage of Air Force ALOC pallets. So management of their return to the Air Force became critical.

Even with the small stockage requirements, compared to other classes, the volumes and sheer bulk placed a high demand on the MHE and the operations of a platoon from the 11th Heavy Material Supply (HMS) Company, from Germany. This unit processed over one hundred 40-foot containers of supplies for stockage, and processed another approximately 200 containers of Class IV for return to Germany at the end of operations. As with the other previously mentioned classes, the containers' contents were not known until inventoried.

If the operations in Desert Shield/Desert Storm had continued, usage and volume of Class IV would have unquestionably

increased. Most of the Class IV stocks arrived late in the operation, shortly before the war started. Relatively little stockage was available through host nation support. Had the Army remained in fixed positions for a longer period of time, just lumber for bunker preparation would have overwhelmed this operation. The CSS force structure is not trained or equipped to deal with the such volumes.

MAJOR END ITEMS (CLASS VII). If any class of supply was understated in terms of processing requirements and the corresponding required support force structure, it was Class VII. Over 3000 end items were issued from the Logbases in support of VII Corps. The 11th HMS had the mission to process vehicles and large pieces of equipment, and the 75th GS had the mission to handle the smaller end items including small arms.

The 11th HMS had to split operations to manage vehicle processing and issue. Part of a processing platoon remained at the port of Ad Damman to process arriving equipment for inbound units, and another team processed equipment at the Logbase. The 11th HMS processed and issued 800 High Mobility Multipurpose Wheeled Vehicles (HMMWV) in three weeks. During this time, the unit had to relocate from Logbase Alpha to Logbase Echo, while processing turn-ins of the old M880 series vehicles. The unit gained notoreity for its defensive berm, a fence created out of vehicles placed tightly bumper to bumper. Not only did this aid in controlling traffic, it prevented theft because only the first or last vehicle in a line of 100 or more could be moved.



In addition to the HMMWV, the 75th processed 120 Main Battle Tanks, 100 howitzers, 30 Bradleys, and 200 critically needed fuel-carrying Heavy Expanded Mobility Tactical Trucks (HEMTT). This unit never trained to handle such volumes, and it sustained all accountability using non-standard desk top software on non-tactical computer hardware.

In coordination with the Corps MMC, the 13th sent a team of soldiers and the Battalion executive officer to the port to expedite the processing of vehicles just prior to the launching of the ground attack. When a HEMTT truck arrived at the port, it was immediately processed, loaded with ammunition or fuel and then sent forward through the Logbase for last minute coordination. Then it was delivered immediately forward of the line of departure to divisional units in contact with the enemy.<sup>22</sup>

The units of the 30th Corps Support Group and the 13 S & S Bn created a pool of 40 drivers from assigned cooks, mechanics, and other volunteers. They were trained in 8 hours and drove the fuel hauling vehicles forward when they arrived from the port.

While the processing of vehicles was manpower intensive, the sometimes forgotten part of Class VII operations is the processing of hundreds of smaller items. Besides small arms, the 75th GS stocked on the average ten 40-foot containers of sensitive items, such as the NAVSTAR Global Positioning Systems (GPS), communications equipment, computers, chemical agent monitors, and night vision devices. All of these items were critical and had to be secured and guarded. These items, many serial numbered,

had to be accounted for manually. It was impossible for the item managers back in the U.S. to have any knowledge of their location, other than that they were in "theater".

**REPAIR PARTS (CLASS IX).** The management of Class IX repair parts became the real logistics "nightmare" at the ports, airfields, and Logbases. This serious lack of repair parts on the battlefield was highlighted by both Coscoms and the Discoms during the 22 SUPCOM's After Action Review.<sup>23</sup>

For example, the 1st Infantry Division passed 58,488 requisitions to higher sources of supply and received only 16,782 receipts (28.6 percent).<sup>24</sup> Also, in a conversation with a company commander, MG Murray was told that none of his requisitions had been filled. General Murray's subsequent investigation revealed that 96 percent had been filled at the source, but none had gotten to the unit.<sup>25</sup> Where did the system break down?

Repair parts arriving in the theater came from a variety of sources. Hundreds of containers of repair parts flowed into the theater at the ports. These containers were filled with parts from three sources: containers shipped from Germany and other locations with war reserve; containers shipped from CSS units' home stations with their authorized stockage list, (ASL) shop stock, bench stock or prescribed load list (PLL) items; and containers shipped from the wholesale supply system with parts to fill requisitions. All three had one thing in common: lack of outside markings or documentation of the contents. Shipments

arrived at the ports of debarkation (POD) with the destination classified or marked as only "Operation Desert Shield."<sup>26</sup>

Whether arriving in a container at the port or on a ALOC pallet at the airfield, supplies lacked visibility. Elements of the Theater and Corps MMC's had to sort out repair parts to forward them to the right units and the right logbases. "Even if adequately documented, frequently pallets that contained material for several units were broken down on arrival in theater and reconsolidated into shipment by destination unit."<sup>27</sup>

All of the sorting had to be done manually by cross referencing DODAACs, units, Corps, Divisions, and appropriate logbases or destinations. The ports and airfields did not have the CSS force structure, automation, or communication to make sound decisions on the breakdown of incoming supplies. If addressed as to a specific Corp or logbase, ALOC pallets would be marked in many cases with spray paint "XVII" or "VII" in the hope that they would make it to at least the right Corps.

In a short war, maintenance companies and supply companies must deploy with an initial authorized stockage level. This stockage enables the support unit to rapidly establish an operation with critical supplies. Then supporting automation should indicate the correct quantities and locations. This failed to happen. Of the nine maintenance companies deployed in support of VII Corps, only six had an ASL established at its home station, and only one deployed to Southwest Asia with its repair parts. Four of the nine units did bring shop stock and bench stock. The

active duty maintenance units deploying from Europe had a 30 to 70 percent zero balance.<sup>28</sup> Attempts to mass requisition ASL shortages added to the already unmanageable quantities of supplies flowing into the theater.

The theater's shortage of repair parts to support a force of 12,400 tracked vehicles, 114,000 wheeled vehicles and more than 1,800 helicopters created to need for "extraordinary logistic pipeline support."<sup>29</sup> A special daily airlift, "the Desert Express," moved critical parts from the United States to the theater. The parts were marked as critical and coded for ease of recognition. This became a highly successful system. The Desert Express' volume increased from 2.17 tons of supplies in October 1990 to 274.58 tons for the month of February 1991.<sup>30</sup> But this tremendous growth trend through several more months of operation would have resulted in the same frustration as with the old system.

The repair parts flowed into Logbase Echo from the air POD at King Khalid Military City (KKMC), the air POD at Ad Damman, and the ports of Ad Damman and Al Jubayl. The 13th received all of the Class IX parts flowing into the theater identified for VII Corps. This included the containers of Class IX from Germany, ALOC pallets of supplies requisitioned by units, and Desert Express. One entire repair parts company, the 496th RPC from Germany, had to break down all incoming supplies, including the Class II, III (P), and IV that would arrive mixed with the Class IX. This company did not have a stockage function, and the

unit's entire workforce was required to establish and operate a Corps level receiving point. The company assumed a far greater responsibility and different mission from the doctrinal mission of receiving, storing, and issuing repair parts. Large volumes, lack of automated receipt process, and the manual cross-checking of DODAACs to supporting units forced the dedicated use of this unit for the mission.

In the five months, this unit processed over 3,700 ALOC pallets and provided management of over 2,500 containers. Two helipads were built, and the company processed 160 airloads of approximately 11,000 items. These items were loaded internally onto the helicopter or, as in the case of major assemblies, sling loaded. Most of the air operations took place in 10 day around the start of the ground war. The 496th also was responsible for processing Desert Express items; between 24 February and 17 March, 1,173 critical pieces were processed. These items were flown straight from the Logbase to the units.<sup>31</sup>

The fact that this repair parts company processed an estimated 500 tons of supplies is remarkable, especially since it was an 100% manual operation. Solders with clipboards, working in dust storms, looking through a list of 3000 DODAACS became the only means whereby the parts would find their way to the requisitioner.

Even the DODAAC listing was only partially accurate. Supported customer units continually changed supply support activities due to unit movement and re-task organization. Units

changed support structure so much that they requested parts through as many as three different SSAs without receiving parts or status.<sup>32</sup> Manually trying to keep an updated list of units and DODAAC's was nearly impossible, especially when the CSS units lacked the ability to communicate changes back to the Logbases.

Stockage arriving from Germany and other frustrated cargo was received and placed in stock by the 766th RPC (Reserve unit from New York). This operation, like the receiving operation, was a manpower intensive operation. A data base built on the battalions' desk top computers offered some automated assistance, but no standard supply system was available. With the technical assistance of MMC personnel, the unit relied on the old manual system of locator cards and penciled-in quantities. This stockage continued to grow. Finally, just a few days prior to the ground offensive, warrant officers of the MMC started manually issuing items to units without request to expedite shipment. Critical items such as major assemblies had to be somewhat arbitrarily pushed forward to the divisions, where they proved essential for sustaining the offensive momentum. From 15 February to 8 March, over 9,668 critical parts were identified and issued, all manually. In addition to the identified critical parts, 1,603 major assemblies were issued and 540 unservicables processed for retrograde.

The accountable and automated system for the Corps was the Standard Army Intermediate Logistics System (SAILS) located at the 800th MMC. The center was located two hours away by vehicle

from the Logbase. The large volume of receipts collected daily rendered manual entry into a computer impracticable. The 766th did not have a computer system (DAS 3 Van) and the SAILS system was overwhelmed with requisitions. In the final analysis, the system became largely ineffective in tracking arriving supplies and in checking issues against specific requisitions.

A module of the Maneuver Control System (MCS) was set up at Logbase Echo to try and send data from the Logbase to the material management center. According to the 2nd COSCOM After Action Report, "although the technology showed great promise, the unreliability of telephonic communications rendered the system ineffective at several critical points."<sup>33</sup>

Manually issuing parts directly to users effectively turned a general supply unit into a direct support unit and bypassed other direct support units. Although significant payoff was achieved in terms of assisting units with last minute issues needed for combat operations, the resulting lack of accountability and visibility of assets created sustainment problems. This stop-gap method further precluded non-divisional supply support activities from performing their doctrinal missions.<sup>34</sup> There is no question that a sound automated system to process receipts and cut material release orders would have been the preferred method; it could have issued at least four times as many parts. Unfortunately the automation was ineffective. When time came to close out the Logbase, over 200 40-foot containers of repair parts still remained unissued.

**Material Handling Equipment:** The Corps had only 20 RTCHs on hand, with an average of 15 available.<sup>35</sup> At least 6 were required at all times to sustain the Logbase operation. The remainder were tasked out for unit support missions (handling containers). This piece of equipment became the logistician's most valuable asset. In addition to the RTCH, the battalion had 53 additional forklifts of various types. It could have used more.

**Completing the Distribution Loop:** One method of improving the distribution system was not developed until months had passed. Truck drivers were told to deliver, but they rarely received instructions on the back haul. In the operation of the Logbase, trucks delivering supplies should never return without a load of unservicables, ALOC pallets, or empty containers.

## CONCLUSION

**ASSET VISIBILITY.** The lack of automation and communications to link the strategic level with the tactical level resulted in waste of valuable and needed resources. In-transit visibility was virtually nonexistent for some munitions, chemical warfare defense equipment, repair parts, and food shipments once they arrived in South West Asia.<sup>36</sup> Such inefficiencies may not be affordable in the next war.

**DISTRIBUTION SYSTEM.** In the final report to congress, The Conduct of the Persian Gulf War, the dilemma facing the distribu-



tion system was clearly described: "The distribution system was confronted with units spread across great distances, constantly changing unit locations, often marginal communications, and early saturation of the ground transportation system."<sup>37</sup> The problems of the 13th S & S Bn. clearly illustrated the negative impact of such a distribution system. Logistical operations in support of contingency forces must have a distribution system that is "responsible to requirements and fits well into regional crises' infrastructure; provides visibility of high-demand, crucial supply items; and allows for the expeditious movement to satisfy these needs."<sup>38</sup> Such a system does not currently exist.

**FORCE STRUCTURE.** The impact of MHE shortages throughout the force structure cannot be understated. This shortage "led to large materiel accumulation at the port, adding to the visibility problem and delaying delivery to already anxious users."<sup>39</sup> Delays were encountered at every stop from the port to the user because of this shortage.

As with the shortage of MHE, the CSS units were hampered with the basic lack of communications capabilities. "The effectiveness of Army logistics automation during Operations Desert Shield and Desert Storm was substantially degraded by the lack of tactical communication support below corps level. Due to the limited availability of tactical communications support, CSS units have become dependent on commercial telecommunications to augment C2 tactical communications."<sup>40</sup>

CSS units must possess and deploy with compatible computer hardware and software capable of interfacing with all levels of the supply system. The automation network must be seamless.

**SUMMARY.** This examination of Logbase operations conducted by the 13th Supply and Service Battalion during Desert Shield/Desert Storm clearly illustrates enhancements required for the future:

- Provide the right force structure. Trained units must deploy with all required MHE, automation, and communication equipment. They also must deploy with the authorized stockage for the force they are assigned to support. The manpower required for CSS units needs to be realistically determined, especially for skills such as forklift operators and mechanics.

- Logistical units must train and organize to handle extremely large volumes. At company level, reserve and active units must be exercised with the real products and with anticipated volumes.

- Standard marking systems are needed for containers. Micro-chip technology must be developed to rapidly track and inventory the contents.

- Supplies must be pushed as far forward as possible. Techniques for controlling through-put of supplies must be practiced.

- Within the automation framework, the Army must have the ability to "plug in" and "plug out" unit support relationships,

locations, and DODAACS. Then the system must be able to communicate those changes to all levels of logistics.

- Transportation units and movement control elements must have sufficient communications.

- Logistics managers at strategic, operational, and tactical levels must be tied together by automation and assured communications into one "seamless logistics operating system."<sup>41</sup>

When we provide support to the next deployed contingency Corps, we may not be able to accomplish the mission with the inefficiencies that characterized logistical operations during the Gulf War.

## ENDNOTES

1. Jimmy D. Ross, "Victory: The Logistics," Army (October 1991): 136.
2. Department of the Army, Operations, Field Manual 100-5 (Draft), (Washington: U.S. Department of the Army, 10 December 1992), 9-3.
3. Ibid., 9-3.
4. William G. Pagonis and Michael D. Krause, "Operational Logistics and the Gulf War," The Land Warfare Papers, no. 13 (October 1992): 5-6.
5. D.A. FM 100-5, 9-3.
6. Pagonis, 4.
7. D.A. FM 100-5, 9-16.
8. Department of Defense, Doctrine For Logistic Support of Joint Operations, Joint Publication 4-0 (Test), (Washington: Department of Defense, June 1990), I-4.
9. Department of the Army, "Operation Desert Storm Sustainment" (Washington: U.S. Department of the Army, Office of the Deputy Chief of Staff, Logistics, undated), 11-12.
10. 22nd Support Command, 22nd SUPCOM, VII Corps, and XVIII Corps Logistics After Action Review, 180 min. (Saudi Arabia: 20 March 1991), videocassette.
11. William G. Pagonis, Moving Mountains (Boston, Mass: Harvard Business School Press, 1992), 124.
12. Ibid., 125.
13. Data was obtained from "Transportation Assets Briefing Chart," After Action Review, 13th S & S Bn. (Saudi Arabia: May 1991).
14. Department of the Army, Supply Policy Below the Wholesale Level, Army Regulation 710-2 (Washington, U.S. Department of the Army, 31 January 1992), 92.
15. Department of the Army, Staff Officers' Field Manual: Organizational, Technical and Logistic Data, Extracts of Nondivisional Tables of Organization and Equipment, Field Manual 101-10-2 (Washington, U.S. Department of the Army, October 1987), 11.
16. 22nd SUPCOM, Videocassette

16. 22nd SUPCOM, Videocassette
17. Robert P. McFarlin, "2d COSCOM, Operation Desert Storm After Action Review," (Saudi Arabia, Headquarters 2d Corps Support Command, undated), 4.
18. Data was obtained from "Class I Briefing Chart", After Action Review, 13th S & S Bn. (Saudi Arabia: May 1991)
19. William G. Pagonis and Harold E. Raugh Jr., "Good Logistics is Combat Power," Military Review (September 1991): 38.
20. McFarlin, 1.
21. Data obtained from "Class II Briefing Charts" After Action Review, 13 S & S Bn. (Saudi Arabia: May 1991)
22. McFarlin, 1.
23. 22nd SUPCOM, videocassette.
26. 1st Division, Division Support Command, 1ID(M) DISCOM Desert Shield/Storm Support Operations (Fort Riley, Kansas, 15 January 1992), Q-I.
25. William J. Webster and Stephen D. Hensley, "MG Charles M. Murray Speaks Out," Ordnance (February 1992): 59.
26. Department of Defense, Conduct of the Persian Gulf War, Pursuant to Title V of the Persian Gulf Conflict Supplemental Authorization and Personnel Benefits Act of 1991 (Washington: Department of Defense, April 1992), 428.
27. Ibid., 428.
28. Charlotte E. Kimbal, "Maintenance during Gulf War, A Piece of the Story," Ordnance (February 1992): 18.
29. Department of Defense, 415.
30. Ibid., 417.
31. Data obtained from "Class IX Briefing Charts," After Action Review, 13 S & S Bn. (Saudi Arabia, May 1991)
32. McFarlin, 6.
33. Ibid., 3.
34. Ibid., 7.
35. Ibid., 7.

36. Department of Defense, 428.
37. Ibid., 428.
38. Ibid., 429.
39. Ibid., 428.
40. Ibid., 449.
41. U.S. Army Combined Arms Support Command, "Vision of Combined Arms Support," (Ft. Lee Va., U.S. CASCOM, 30 October 1992), 19.

## BIBLIOGRAPHY

- Cusick, John J. "Quartermaster Corps, A Vision of the Future." Ft. Lee., Va.: U.S. Army Quartermaster Center and School, 30 June 1992.
- Garren, Patrick E. "13th Supply and Service Battalion After Action Review." Saudi Arabia: March 1991.
- Hellrich, Paul H. "169th Corps Support Battalion DS/S After Action Observations." Saudi Arabia: undated.
- Kimball, Charlotte E. "Maintenance during Gulf War, A Piece of the Story." Ordnance (February 1992): 18-20.
- Kennedy, Gordon T. "503rd Forward Support Battalion DS/S After Action Observation." Saudi Arabia: undated.
- McFarlin, Robert P. "2d COSCOM, Operation Desert Storm After Action Review." Memorandum for Commander, VII Corps, ATTN: G-3 Plans. Saudi Arabia: undated (March 1991).
- Mott, J.R., Jr. "Logistics Distribution in a Theater of Operations." Monograph prepared for the School of Advanced Military Studies. Fort Leavenworth, KS.: 21 May 1991.
- Pagonis, William G. Moving Mountains. Boston Mass: Harvard Business School Press, 1992.
- Pagonis, William G., and Harold E. Raugh Jr. "Good Logistics is Combat Power." Military Review (September 1991): 29-39.
- Pagonis, William G., and Michael D. Krause. "Operational Logistics and the Gulf War." The Land Warfare Papers 13 (October 1992): 1-16.
- Ross, Jimmy D. "Victory: The Logistics." Army (October 1991): 128-138.
- Salomon, Leon E. "Reshaping Logistics for a Supportable Force into the 21st Century." Presentation to the U.S. Army War College on 5 November 1992.
- U.S. Army Combined Arms Support Command. "Vision of Combined Arms Support." Ft. Lee, Va: U.S. CASCOM, October 30, 1992.
- U.S. Department of the Army. Combat Service Support. Field Manual 100-10. Washington: U.S. Department of the Army, 18 February 1988.

- U.S. Department of the Army. Inventory Management. Army Regulation 710-2. Washington: U.S. Department of the Army, 31 January 1992.
- U.S. Department of the Army, Office of the Deputy Chief of Staff, Logistics. "Operation Desert Storm Sustainment." Washington: U.S. ODCSLOG, undated.
- U.S. Department of the Army. Mobilization, Deployment, Redeployment, Demobilization. Field Manual 100-17. Washington: U.S. Department of the Army, 28 October 1992.
- U.S. Department of the Army. Operations. Field Manual 100-5 (Final Draft). Washington: U.S. Department of the Army, 10 December 1992.
- U.S. Department of the Army. Support Operations: Echelons Above Corps. Field Manual 100-16. Washington: U.S. Department of the Army, April 1985.
- U.S. Department of the Army. Staff Officers' Field Manual - Organizational, Technical, and Logistical Data (Non-Divisional). Field Manual 101-10-2. Washington: U.S. Department of the Army, October 1987.
- U.S. Department of Defense. Conduct of the Persian Gulf War. Pursuant to Title V of the Persian Gulf Conflict Supplemental Authorization and Personnel Benefits Act of 1991. Washington: U.S. Department of Defense, April 1992.
- U.S. Department of Defense. Doctrine for Logistic Support of Joint Operations. Joint Publication 4-0 (Test). Washington: U.S. Department of Defense, June 1990.
- Webster, William J., and Stephen D. Hensley. "MG Charles M. Murray Speaks Out." Ordnance (February 1992): 58-59.
- 1st Infantry Division, Division Support Command. "1ID(M) DISCOM Desert Shield/Storm Support Operation." Fort Riley, Kansas: 1st ID(M) Discom, 15 January 1992.
- 22nd Support Command, producer. 22nd Supcom After Action Review. 180 min. 3 tapes. Saudi Arabia: 20 March 1991. Videocassette.