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**Lessons in Combat Service Support Tactical
Mobility: The Afghanistan Conflict, Falklands War
and Operation Desert Shield/Desert Storm**

**A Monograph
by**

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Transportation**



**School of Advanced Military Studies
United States Army Command and General Staff College
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ABSTRACT

Lessons in Combat Service Support Tactical Mobility: The Afghanistan Conflict, the Falklands War, and Operation Desert Shield/Desert Storm by Major Carol D. Clair, USA, 75 pages.

This monograph examines lessons in combat service support (CSS) tactical mobility during the Afghanistan Conflict, the Falklands War, and Operation Desert Shield/Desert Storm. The unique environments of these operations have significant differences in terrain, weather, and transportation infrastructure which have a marked influence on CSS tactical mobility. In addition each of these campaigns involved force projection forces which is the foundation of the new U.S. military strategy.

The monograph proves that tactical mobility is more than the physical mobility to negotiate terrain. Force projection forces require multi-dimensional CSS tactical mobility. Multi-dimensional reflects the complex interrelationships that produce mobile CSS forces and their ability to support the maneuver of combat forces. Physical mobility, the ability to rapidly displace, evacuation, recovery, movements management, and the doctrine and organization of the CSS system all mutually interact to affect CSS tactical mobility. In addition, combat and combat support forces take actions to protect, enhance, and improve CSS mobility. For each campaign these dimensions of tactical mobility are explored under the broad categories of doctrine, organization, movement, maintenance, fuel, medical, and the protection, enhancement, and improvement to CSS tactical mobility.

The monograph concludes that improvisation is a critical doctrinal principle necessary to the success of CSS tactical mobility. In the area of organization, tactical mobility is greatly enhanced through multi-functional CSS units. Additionally, division level units must be 100 percent mobile which requires transportation assets at the brigade/regiment level as well as at the division. Tactical relocation was critical by heavy equipment transport and helicopter. Materially, corps level units must be provided more mobile transport assets such as the heavy expanded mobility tactical truck (HEMTT) and palletized load system (PLS) HEMTT.

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I. INTRODUCTION

Force projection is the foundation of our new national military strategy. The characteristics of a force projection Army are versatility, deployability, and capability for decisive victory with minimum loss of life. To accomplish this, the Army has to operate in several environments, organize tailorable force packages, and rapidly fight, sustain, and win. To rapidly fight, sustain, and win, the Army must be capable of generating overwhelming combat power. Generating combat power requires the effective application of maneuver, firepower, protection, and leadership.¹

Service support planners and operators are particularly concerned with combat service support (CSS) tactical mobility and its impact on the maneuver of combat forces.

Recent experience in Desert Shield/Desert Storm provided insights on CSS tactical mobility and how critical it is to the maneuver of combat forces. However, a force projection Army must be able to operate in a multitude of environments. Modern war experiences of the former Soviet Union in the Afghanistan Conflict and the British in the Falklands War can provide lessons in the unique environments in which they operated. Like Desert Storm/Desert Shield, they involve a force projection Army. The unique environments of these three operations have significant differences in terrain, weather, and transportation infrastructure that have a marked influence on CSS tactical mobility.

The thesis of this paper is to prove that force projection operations require multi-dimensional CSS tactical mobility.

Multi-dimensional is a term which reflects the complex interrelationships that produce tactically mobile CSS forces and their ability to support the maneuver of combat forces. Physical mobility, the ability to rapidly displace, evacuation, recovery, movements management, and the doctrine and organization of the CSS system mutually interact to affect CSS mobility. In addition, combat and combat support forces take actions which protect, enhance, or improve CSS mobility.

The methodology is to discuss and analyze lessons learned from the Afghanistan Conflict, the Falklands War, and Operation Desert Shield/Desert Storm. For each operation a brief summary of the tactical scenario is provided. Following each scenario, are unique weather, terrain, and transportation infrastructure for each theater of operations. These brief discussions will be followed by a summary of each force's CSS doctrine, and the organization and structure of combat service support in the theater. Special emphasis is placed on organizational and structural adjustments made to improve or enhance tactical mobility. The last section of each of the respective operations will discuss CSS tactical mobility using the concepts discussed in paragraph four above. These concepts are covered within the areas of movement, maintenance, supply, fuel, medical, and the protection, enhancement and improvement to CSS tactical mobility where applicable to that operation.

The paper concludes with the significant lessons and considerations concerning CSS tactical mobility. Possible solutions or recommendations concerning doctrine, organization or materiel are postulated. The paper contends that actions taken in each of the operations and the lessons provided by each of these experiences are useful to CSS planners and operators.

II. AFGHANISTAN CONFLICT

The Soviet Union invaded Afghanistan in December 1979 with an initial assault force of four motorized rifle and one and a half air assault divisions.¹ By January 1980, the number of Soviet soldiers in Afghanistan had reached 35,000. The invasion was controlled by the Southern Theater of Military Operations (STVD). When the Soviets announced their withdrawal in April 1988, there were approximately 115,000 Soviet troops in Afghanistan.¹

Kabul International Airport was the first Soviet target as Airborne Troops landed to secure the area for follow on air landed troops. Airborne/assault forces also secured Bagram Air Base and other key Afghan communications facilities, airfields and population centers.⁴ Following the assault landings, a forward detachment was sent out to secure the Salang Tunnel, a 2,700 meter long tunnel, representing a significant choke point along one of the Soviet invasion routes. This was followed by a two pronged attack by four motorized rifle divisions along two axis from Termez and Kushka in the USSR (see appendix A for a map of the area).

The attack was carried out according to Soviet operational doctrine. However, the remainder of their nine years occupation would be spent adjusting to unconventional warfare in mountainous terrain.

Terrain, Weather and Transportation Infrastructure

Afghanistan has a land mass of approximately 260,000 square miles, slightly less than the state of Texas. The topography of Afghanistan is extremely mountainous. Over sixty percent of the land is mountainous with the remainder being treeless flatland and desert. The Hindu Kush region of the Central Highlands has mountains which reach heights of over 21,000 feet.¹ The Himalayas also push into central Afghanistan. Much of the mountainous areas are inhospitable, consisting of defiles and steep passes. The rugged terrain canalizes transportation networks and lines of communication. Much of the region lies above 14,000 feet where the terrain is devoid of any vegetation--bare rock.¹ Little territory exists that has significant vegetation that can conceal troop movements. See appendix B.

The climate of Afghanistan is one of extreme variation. It has cold winters and hot dry summers. Winter is characterized by severe blizzards, whirlwinds of up to 177 kilometers per hour, and average temperatures of -4 F degrees. Snow can be as deep as two meters and the valleys become snow traps. Permanent snow covers the highest mountains. Summer is accompanied by heat, drought, and sandstorms. Surprise rainstorms can transform rivers and streams to torrents and cause flooding. Temperatures rise to 96 F degrees.¹

The transportation infrastructure in Afghanistan is austere. The only rail links are short (nine to fifteen kilometers), providing little military value. The Amu Darya is the only major

waterway with a length of 1,200 kilometers, however it too provides little value since it is situated along the northern border.' There are an estimated 21,000 kilometers of roads, however only about 2,800 kilometers are hard surface. The majority are unimproved earth and tracks.' There are five major airfields."

Soviet Logistics Doctrine

Soviet logistics doctrine focuses on reducing the cost of provisioning by reducing the tactical logistics structure in the Soviet division.¹¹ The divisions' logistic support is below NATO standards because they are not as concerned with the endurance of the individual division. Once a Soviet division is combat ineffective, a new division replaces it. Soviets concentrate most of their logistical structure at Front and Army level. This ensures resources are not wasted through idleness at division. Soviet divisions are supported based on need according to Front planners' calculations. Priority is given to main axis attack forces with less emphasis on the supporting axis or defensive operations. Retaining major logistic reserves at high levels gives greater flexibility to the operational commander and allows him to exploit success by quickly switching resources to support the most successful formation. Appendix C displays the Soviet's logistic principles.¹² Key to their support philosophy is the priority given to supplying ammunition and fuel. Soldiers are provided with other supply and support as necessary.

The Soviets have a unitary logistics philosophy; a "whole"

concept that means logistics belongs to the total force. Even though divisions are authorized logistics organizations, they can be taken away to support another tactical formation. This philosophy is predicated on forces configured for mass and shock.

Organization and CSS Structure

Supporting widely dispersed forces over the mountainous terrain necessitated significant force structure changes. Heavy forces were augmented with light forces and light armored forces to improve mobility. Likewise the Soviet logistical structure and forces changed. Initially forces were organized along functional lines. The motorized rifle and tank divisions and regiments were organized as depicted in appendix D with separate field bakery, transport, food, POL, repair parts, clothing and other units. By 1987 a new support concept emerged that combined functional logistics units into multi-functional units called material support." See Table II. Appendix E and F depict combat units with their respective support units.

Soviet Materiel Support Structure

Front	Variable Number of Materiel Support Brigades
Tank or Combined Arms Army	Materiel Support Brigade
Tank or Motorized Rifle Division	Materiel Support Battalion
Motorized Rifle Regiment	Materiel Support Company

The reorganization is commensurate with what Soviet military

theorists term "the dynamism and maneuverability of contemporary combined arms battle" and the "constant reduction in time required to prepare and deliver supplies".¹⁴ The Soviets came to recognize the complexity of supporting tactical forces. They recognized the problems of conducting, controlling, and coordinating logistical operations in a high-tempo non-linear environment with increased demands for ammunition, fuel, and other supplies that characterize the battlefield. They also learned that maintaining soldier morale in harsh conditions required changes to their philosophy of logistics support to improve the quality of life. These changes increased demands on logistics assets.

Areas the Soviets considered key in the implementation of the new support structure were the ability to support task-organized forces that are isolated from the main body and the need for a more mobile logistics tail.¹⁵ Soviet's logistics units supported units from numerous bases scattered throughout Afghanistan. The terrain and tactical mobility did not easily permit shifting logistical support from one area to another. Appendix G depicts the distribution of forces and bases throughout Afghanistan. CSS forces in Afghanistan took independent action to support forces in their area of responsibility.

The reorganization coupled with the introduction of new trucks represented a 30 percent increase in lift thereby increasing mobility and support.¹⁶ Increasing the lift capability ensured that Soviet logistical units had 100 percent

organic mobility. It also ensured that logistical units could displace in accordance with doctrinal standards. Soviet planners envision advances of more than 40km per day on a linear battlefield. The materiel support battalion of the division is required to displace itself one to two times each 24 hour period.¹⁷ Frequent relocations are expected to ensure continuous support to combat forces. The battalion is expected to move to its new location in march column behind the main forces. The increased mobility acts as a capability multiplier on the non-linear battlefield, increasing their ability to support isolated units.

Movement

The vulnerability of troops and logistics over the limited and frequently interdicted roads in Afghanistan became what the Soviets referred to as the "highway war" (dorozhaia voina).¹⁸

The Afghans had the advantage of knowledge of the terrain. They knew where mountain areas were that dominated valleys and roads throughout the country.¹⁹ They also knew where crevices and rocks were that could conceal their movements. The Afghans frequently launched attacks on Soviets traversing valleys. Most guerilla operations were concentrated in the mountains near areas where large cities and towns existed. Because Afghanistan has the some of the roughest mountain terrain in the world, alternate lines of communication were not available nor could routes be dedicated solely to the logistics effort. Military units, civilian traffic and supply all used the same routes.

To counteract part of the interdiction of road movements, the Soviets mixed in helicopters to make Mujahideen targeting of either movement asset less predictable. Initially, helicopters were also more difficult for them to target. Nevertheless, as the conflict progressed they became more adept at acquiring both air and road targets. However, helicopters were vital for rapid movement of combat forces reinforcing threatened cities or defending lines of communication throughout the course of the conflict.

The limited lines of communication, weather conditions, terrain, and frequent interdiction of movement assets created friction in the Soviet's movement management program. All these problems combined to make it difficult for the Soviets to achieve an optimum mix of air and road movement."

For both security and control purposes, Soviet convoys kept getting larger. Eventually convoys routinely comprised about 100-300 vehicles." Seventy percent of the vehicles contained logistics assets; half POL carriers and half cargo carriers. The principle Soviet transport truck was the KamAZ. The KamAZ transport truck withstood the rugged Afghanistan conditions and had the power to negotiate the steep gradients and maintain speed.

Poor training also complicated the transportation system. Driver and unit inexperience created problems and confusion reducing the productivity of critical tactical mobility assets. Terrain, weather, and inexperience produced many scenarios such as the one described below:

The road winds there in steep and narrow hair pin turns, with a perpendicular cliff on one side and an abyss on the other. The ice covered route is terrible, and the thousands of trucks which cross the pass every day polish it to a mirror like shine...you crawl along at a snail's pace all the time. The heat and dust of summer, periodic freezing and thawing, flash floods, and other climatic problems create maintenance, visibility, and trafficability problems that in many areas constrain road movement."

Appendix H depicts the key lines of communication used during the Afghan conflict. Refer to map at appendix A.

Maintenance

One of the key concepts of service support units maintaining the tactical mobility of combat forces is the principle of fixing forward. A key personnel issue affected the Soviet's maintenance performance. The Soviet's lack career NCOs to provide technical maintenance and leadership skills. Soldiers lacked the necessary technical skills to fix the equipment on site, therefore much of the equipment was returned to the rear. Upon being attacked or ambushed, if equipment was not quickly fixed or recovered, units left it behind. The inability to fix forward caused much Soviet equipment to be abandoned. One way the Soviets attempted to counterattack this problem was to tailor special repair trailers for each type of equipment. The trailers contained specialized tools, parts, and assemblies. Only minor repairs were performed, the remaining equipment was exchanged rather than fixed on site."

Sustaining mobile forces and maintenance mobility became a major problem for the Soviets. First, they discovered they needed to deploy mobile repair shops and spare parts to support a mobile

force. The regimental maintenance company was wholly inadequate to keep up with repair much less recovery. These units had only two armored recovery vehicles to support a mobile and often dispersed force." Typically in an armored formation recovery entails evacuating equipment to a repair point in the rear. This system proved too slow in Afghanistan except in a few major armor operations. Unconventional, nonlinear warfare in mountainous terrain required more maintenance forward and more assets in the force structure. Supporting dispersed forces did not allow units to reinforce or quickly shift resources among combat units or formations. The longer it took to make repairs or evacuate, the more vulnerable the logistics forces became to guerrilla attack. Mobile repair workshops that were called forward on an on-call basis became increasingly important especially during large scale offensives.

Supply

A combination of air and road lines of communication was critical to Soviet supply efforts since both were vulnerable to interdiction and attack. Initially, helicopters were used extensively to move supplies within the country. The Soviets soon realized that the extensive use of helicopter resources was not only difficult to maintain but that it was also wasteful. The mountainous terrain reduced the payload of helicopters by 25 percent." Eventually, the Soviet logisticians realized that the majority of resupply must take place by road and that total resupply efforts would require a mix of air and road. However,

helicopters remained essential for emergency resupply of units that were encircled or cut off by rebel forces.

Fuel

One of the key mobility lessons the Soviets learned concerning fuel was the difference in consumption planning factors from a European scenario from the mountainous terrain of Afghanistan. Vehicles transiting the extreme mountainous terrain (both combat and logistical) consumed 30-40 percent more fuel than a European scenario.¹⁴ In an effort to reduce the amount of road traffic devoted to POL and also to reduce transport vulnerability, the Soviets built two pipelines along the Termez-Salang-Kabul road. However, protection of the pipelines took considerable assets. Pipeline protection required a special brigade of troops to keep them open.¹⁵

Protecting, Enhancing, and Improving CSS Tactical Mobility

The Soviets found that protection would be the key to maintaining the mobility of combat service support assets-- particularly protecting the vital lines of communication.

Initially, the Soviets did not think that protecting their LOCs would require significant effort. This assumption proved erroneous. The Soviets also viewed their involvement in Afghanistan as temporary and did not initially build or create permanent log bases. The terrain, climate, and limited lines of communication presented the Soviets with a significant obstacle to the successful prosecution and completion to the war. Beginning in 1980, the Soviets began to recognize the need to upgrade

facilities, road system networks, and build up a series of major bases to increase mobility and sustainability." The log bases and improved infrastructure reduced the number of convoys and decreased Soviet movement vulnerability.

The war in many respects became a conflict focused on control of lines of communications. Protection of Soviet lines of communication became the highest priority. Protecting the LOCs required establishing a series of fixed fortifications, strong points and firebases, the use of large protected convoys, and using helicopter escort along critical routes. In addition, they established roving patrols and traffic control units. When the Soviets launched operations they often included service support units throughout the attack march. In many engagements this method was determined to be safer than having logistics units trail behind the combat forces because of the guerrilla threat.

Thirty percent of most convoys was devoted to protection vehicles." Military escorts were positioned in front, behind and within the convoy. Additionally, transport KamAZ trucks were mounted with special anti-aircraft guns to provide fire support. Eventually, through training replacement personnel, special support teams were established to quickly tow, repair, or destroy vehicles while en route.

Significant engineer and construction efforts to improve road systems decreased the movement times and thus the vulnerability of the transportation system. To prevent disruption, mine removal was a continuous effort using mine

detectors, mine probes, and mine rollers. The engineer effort was so critical that helicopters provided special fire support on call to engineer forces. Engineer efforts were vital. No action or operation was undertaken without their support.

Local militia was used to protect supply routes. The indigenous forces guarded routes, helped keep routes free of mines, obstacles and booby traps. They also helped keep the Mujahideen from setting up ambushes or establishing points to fire upon convoys."

So many units were involved in logistics or were siphoned off to protect or support logistics operations that only one third of total troop strength was engaged in tactical operations at any one time."

Summary

The Soviets experience in Afghanistan was adapting to providing support to forces engaged in unconventional warfare. The mountainous terrain, harsh weather conditions, and limited lines of communication presented challenges to Soviet logisticians. Throughout the nine year's occupation they eventually developed logistics methods to support widely dispersed forces on a non-linear battlefield. In the next section, British logisticians are also faced with unique support challenges.

III. FALKLANDS WAR

The fight for the Falklands Islands was primarily a contest between the British naval task forces and land based Argentinean air forces." The actual fighting lasted only seventy-four days, from 2 April to 14 June 1982. The conflict began with the Argentineans invading the Falklands Islands. This was followed by a naval battle between the two belligerents. The British then launched an amphibious landing operation, followed by an Argentinean counterinvasion. The war concluded with the British recapture of Port Stanley. Appendix I contains maps of the Falkland Islands.

Like the Soviet experience in Afghanistan, the Falklands Conflict was a limited war involving unique terrain, weather, and logistical challenges. However, a significant difference was in planning and executing strategic deployment and supporting naval and amphibious operations rather than maintaining critical ground lines of communication. Similarities exist in the tactical mobility issues of supporting land forces in extremely restrictive terrain conditions, as well as, poor weather conditions.

Terrain, Weather, and Transportation Infrastructure

Terrain was a major factor in the logistical planning for the support of the war. The ground consists of peat bog. In many places there are large areas of hummocky tussock grass--mounds, knolls and clumps of grass. Stones are scattered throughout the islands ranging in size from a man's head to the size of a car.

Areas of stones can be from a hundred yards wide to several miles long." Mountains on the islands are around 2,000 feet high with the highest mountain, Mount Usborn, at 2,300 feet. Most of the mountains are topped with jagged rocks. The numerous indentations in the rock, deep fissures and sudden drops presented obstacles to any vehicle movement.

No Gulf Stream to warm the water coupled with the proximity to the frozen continent of Antarctica both combine to make winter weather in the Falklands harsh. Icebergs frequently come within 200 miles of the islands." Icebergs that ground on the Burdwood Bank in the South can alter the weather pattern of the Falklands. Weather is extremely changeable, rapidly changing from snow, rain, fog and sunshine all year round. Winds blow at a constant 15 mph.

Few roads exist in the islands. There are roads surrounding the Port Stanley area and there is one surfaced track that leads from Port Stanley to Fitzroy. A few minor dirt tracks exist. One airfield exists at Port Stanley able to take up to a C-130 type aircraft. Unfortunately, some of the strongest Argentinean defenses were at Port Stanley so use of the field for logistical or tactical operations was not possible.

British Logistics Doctrine

The British recognize five principles which govern their logistics. They are: foresight, economy, flexibility, simplicity, and cooperation.

- o Foresight - requires logisticians to plan forward and develop plans for transition to various phases.

- o Economy - is a systematic approach to the problem of allocating limited economic resources when procuring equipment, to

decisions on stock levels and logistics priorities.

o Flexibility - is the ability to get the proper quantity at the right place and time to enable the unit or formation to carry out the mission. To achieve this in a fast moving battle, or when axis are being switched, or there are heavy materiel losses through enemy interdiction, the system must be supple and easily adaptable to meet new circumstances.

o Simplicity - means the need to have simple plans, and simplicity in the design of supply systems, maintenance, and operations.

o Cooperation - means to supply forward. It also means the need for units up to Army Groups to cooperate logistically and avoid duplication of effort and waste, to maximize logistic resources such as transport, and to resupply across unit and formation boundaries."

When conducting an amphibious operation with a Commando Brigade (Royal Marine) size force, the British initially establish a lodgement ashore. Once the lodgment is established, the logisticians begin setting up the Beach Support Area (BSA). As operations expand, the logisticians can establish a support area further inland or at an alternate location called a Brigade Maintenance Area (BMA). Both the BSA and BMA include supply, transport, maintenance, and other logistical activities. If the tactical situation permits, a forward BMA may be established to shorten lines of communication. The forward BMA will contain support which the tactical situation dictates. Units could draw logistics support from any of three support areas discussed or a distribution point (DP) can be established for units to draw critical supplies. The DP is similar in concept to the US logistics resupply point (LRP). An Army infantry brigade can establish a BMA, a forward BMA, or DP depending on the situation.

Organization and CSS Structure

Initially land forces were comprised of the 3rd Commando

Brigade of the Royal Marines reinforced with additional helicopters, light artillery, engineers, reconnaissance, and medics, totalling around 5500 soldiers (see appendix J and K for organization). Major forces were five commando battalions, twenty-four 105mm guns, fifteen light helicopters and eight reconnaissance vehicles. The commando brigade was supported by the Commando Logistics Regiment." Additional service support was provided by Army units consisting of an Air Maintenance Group, three mexefloat (pontoons) detachments, five landing ship logistics detachments, and three surgical support teams."

The Commando Brigade (Royal Marines) is specifically organized and trained to conduct what the British term "out of area" operations. Out of area operations are those which are not specifically in NATO areas where significant prepositioned stocks, host nation support, and other pre-planned support are not available. The Commando Brigade normally trained for operations in Norway. To support out of area operations, the Logistics Regiment has greater service support capabilities than typically found in an Army infantry brigade. The Logistics Regiment has medical, ordnance, transport, and petrol troops. The Infantry Brigade has one ordnance (all classes of supply and maintenance) and an ambulance company.

In addition to the 3rd Commando Brigade, the British deployed the 5th Infantry Brigade (Army). On 1 June elements of the 5th Infantry Brigade began arriving at the Bluff Cove area. The 5th Brigade was composed of three Army battalions, two

artillery regiments, half an armored squadron, several hundred special forces, and an engineer regiment." The brigade was supported by a field ambulance and soldiers of two ordnance companies (see appendix L)." The infantry brigade relies heavily on higher logistic formations for providing support forward.

With the introduction of 5th Infantry Brigade, total ground forces numbered 9,500 personnel." To command and control both units, a Landing Force Command was developed (see appendix M).

The structure of logistics focused on shortening lines of communication to improve mobility. The 3rd Commando Brigade expanded logistics operations out from the Beach Support Area (BSA) at Ajax Bay. To reduce transit time for helicopters and effectively employ additional mobility assets, a forward Brigade Maintenance Area was established at Teal Inlet. Logistic ships could deliver supplies directly to the forward BMA. From here boats could deliver supplies up river at Estancia where units could load vehicles and return to their units. Additionally, supplies could be lifted by helicopter directly to the unit DP at Estancia (see appendix I).

The 5th Infantry Brigade (Army) was also able to expand operations. A forward BMA and DP were established at Fitzroy and Bluff Cove respectively.

Movement

Although the terrain at the initial landing site for the Commando Brigade at San Carlos was not ideal, it was the best

choice. Only two other landing areas exist, one at Berkely Sound and the other at Port Stanley. Both areas were considered heavily defended; therefore, the British opted not to attack them directly. This complicated an already tough logistics situation as soldiers, equipment and logistics would have to negotiate extremely difficult terrain.

Like the U.S., the British depend on most of their ground transportation by truck. Mobility across the bogs was difficult. A lightly loaded land rover could barely cover 4k in an hour and had to avoid the numerous knolls and stones." Each vehicle had to be careful not to follow in the tracks of another vehicle to avoid sinking into the earth where the other vehicle had broken through the thin crust of the bog. Once a vehicle had broken through the crust, the earth becomes an impassable muck. Vehicles loaded with ammunition or towing anything could not move at all.

The mainstay of the logistical effort was the BV 202 tracked towing oversnow resupply vehicle. Although the vehicle was designed for use in the snow it is useful in the bogs because it only had a ground pressure rating of one and a half pounds per square inch, similar to a man on skis." Seventy-six of them were available in the Commando Brigade.

Helicopters provided excellent mobility during the Falklands War. Initial shortages of helicopters prevented the British from launching a vertical envelopment of any Argentinean defenses. Soldiers establishing a lodgement would have to be transported ashore by a combination of lighterage and helicopters. However,

British helicopters provided both support and combat missions ashore. The British realized that the logistics mission of providing mobility by transporting soldiers, equipment and supplies was more critical than the attack mission. Unfortunately all but one transport helicopter was destroyed when the ship carrying them was sunk. The one Chinook transport helicopter that was not lost at sea proved vital as it logged 109 hours and transported up to eighty combat troops with a total payload of 20,000 lbs. Because of the shortage of these critical transports, other helicopters assumed a transport role. The Navy Sea King was particularly useful in a support role. In all, over 10,381 helicopter sorties and 21,049 flight hours were logged by the Naval Air Command. Eighty percent of the missions were for mobility/transport."

British helicopters moved logistics, men and equipment in the most adverse weather and across some of the most rugged terrain. Repeatedly the British demonstrated the ability to insert soldiers, equipment and logistics into a rugged and isolated environment with few helicopter losses; only one per 742 sorties." Individual training, endurance, and professionalism were critical to accomplishing the mobility mission with such outstanding results. Comments by a company commander during the war underscores the logistical accomplishments:

All comments and lessons from the logistics of the campaign should be leavened with the fact that this must be one of the few campaigns fought by a regular force since the internal combustion engine became generally available, where the widespread use of wheeled transport was not possible. This combined with which it was necessary to put the whole -

act together, and the enemy's efforts to disrupt the act, makes it arguable that we were fortunate to have any logistics at all!"

Supply

Initially the nonavailability of helicopters from aboard ships severely hampered both the logistical effort and movement of soldiers. Ship loaded pallets required all helicopter assets to unload because no cranes or materiel handling equipment was available. Although the commando units could make assaults by foot, they would rely on significant amounts of ammunition, fuel, and food replenishment by air. When the final decision was made to attack, troops had to move by foot. Priority of the main logistical effort was directed at moving unit supplies for units engaged in direct fighting. Available transport priorities were first to establish logistics ashore and second to supply ground forces with ammunition and fuel. Often soldiers had to do without food, sleeping bags, and replacement dry clothing because the shortage of helicopters prevented moving the large rucksacks forward. Units marching but not engaged in combat often did without supply and were extremely vulnerable if attacked. Because there was a shortage of helicopters it was common for soldiers to walk 12-50 miles through extremely rough terrain."

Fuel

The Commando Brigade Logistic Regiment's assessment of the theater terrain was critical to the success of the fueling operation. Mobility was the critical factor in distributing fuel. The Logistic Regiment recognized that truck distribution was next

to impossible. Therefore, they loaded ten trucks equipped with loaded fuel pods and filled hundreds of five gallon jerricans." Sling-loaded fuel in pods, jerricans, and drums was critical to providing fuel forward to units and the forward battalion maintenance area. The mountainous terrain caused high fuel consumption in the BVs oversnow vehicle and helicopters. The Regiment also took an additional nine 4-wheel drive forklifts that became the mainstay for moving logistics in the BSA because of their mobility. Sling load operations also required high forklift usage.

Unfortunately, the situation was different for the 5th Infantry Brigade. The ordnance companies had no additional stocks, and brought no vehicles, craft, or forklifts. Even their jerricans were loaded empty." Wartime planning for this unit had assumed the Brigade was going to operate from a garrison. It was primarily an "Intervention Force" that was to evacuate embassies and other type missions. The ordnance companies had very little equipment. The assets of the 3rd Commando Logistic Regiment, originally organized to support a formation of 3,000 men, not only had to support the 5,500 of the Commando Regiment, but their assets were employed in supporting another 4,000 soldiers of the 5th Infantry Brigade.

The 3rd Commando Brigade also used a Forward Arming and Refueling Point (FARP). A FARP was established at the FMA at Teal Inlet for the Brigade's light helicopters, reducing transit to the BSA by 90-100 miles." The helicopters drew fuel from drums

placed on the ground.

Medical

Medical evacuation was performed by helicopter due to the terrain. Battalions held patients up to six hours in Field Dressing Stations because the operational situation prevented patient evacuation to the Regimental Aid Post or directly to the Main Dressing Station aboard ship.

Protecting, Enhancing and Improving Tactical Mobility

Air superiority was key to successful tactical mobility and to the successful prosecution of the war in general. The task force faced over 300 Argentinean land based aircraft. Harriers were critical to maintaining local superiority so that logistics could move forward prior to the establishment of an air defense umbrella. The importance of air superiority was underscored when the Harriers were grounded aboard ship because of mist at sea and the Argentineans launched a successful attack on the BSA.

Engineer efforts were critical to the maintenance of the only land line of communication (LOC) in the Falklands War from Fitzroy to Port Stanley. The LOC supported offensive operations aimed at capturing Port Stanley. A significant choke point was the bridge over the Murrell River. When this bridge collapsed under the weight of an armored recovery vehicle loaded with ammunition, it temporarily closed the LOC. To reopen the bridge, the engineers built an air-portable bridge at Fitzroy and flew it under a Chinook to reopen the bridge. Without the bridge, BVs could not pick up supplies at the distribution point (DP) located

at Estancia and move it forward to their units.

Summary

The British considered many changes to their doctrine as a result of the experience in the Falklands. Some of these reflect organizational concerns, as well as, other issues affecting tactical mobility. One of the changes that the British are considering is the reorganization of their logistics to provide a flexible system whether they support forces inside or outside NATO. Most of the immediate changes are directed at the composition and organization of the 5th Infantry Brigade. The organization and capabilities of the 3rd Commando Regiment was such a success that many additions were made to ensure that 5th Infantry Brigade has similar capabilities to operate "out of area". Of particular significance is the provision of additional logistic support units and an Army Air Corps squadron. Taken together, the units will provide Britain with mobile airborne, assault, and amphibious capability with equally mobile support forces for out of area operations.

They also considered several new and additional pieces of equipment to improve the mobility of both combat and logistical systems. Probably the most significant change was the purchase of five Chinook helicopters to ensure air mobility of critical items in restricted terrain."

The Falkland's War only involved two brigades of land forces. However, the operation demonstrated how critical CSS tactical mobility was to the support of the combat forces and

ultimately to the success of the war. In the next section, Operation Desert Shield/Desert Storm, significant land forces participated in the war. The enormity of the operation will provide added lessons concerning tactical mobility.

IV. OPERATION DESERT SHIELD/DESERT STORM

On 2 August 1990, Iraq invaded Kuwait. On 7 August 1990, President Bush announced to the American public that the 82nd Airborne Division was being deployed to Saudi Arabia for Operation Desert Shield--the defense of Saudi Arabia. Within 90 days over 180,000 soldiers, sailors, and airmen arrived in theater, including the XVIII Airborne Corps." Beginning in November 1990 the U.S VII Corps began deploying to Saudi Arabia. Deployment of VII Corps continued until late January 1991. Desert Storm began with an air operation 17 January 91 followed by the ground operation 24 February. The ground war lasted 100 hours.

Throughout the course of the campaign 122 million meals were served, 1.3 billion gallons of fueled pumped, 52 million miles driven, 31,800 tons of mail handled, and 500 new traffic signs erected." Tactical mobility was integral to the logistical efforts to support the maneuver of combat forces.

Terrain, Weather and Transportation Infrastructure

The Arabian peninsula is about the size of the US east of the Mississippi. The area of operations was extremely large magnifying the austere transportation infrastructure. Appendix N and O show the size of the area. Most of the land mass is vast desert with scattered nomadic inhabitants. Few highway systems exist that are comparable to the US interstate system. Much of the limited road networks are simple macadam highways barely wide enough for two-way traffic and lacking any shoulders. Virtually

no roads existed in areas where the major offensive operation would occur. Vehicles and tracks would have to traverse through deep sand, rock, wadis, dry lakes and river beds. Little to no man made or natural features exist to guide movement.

Temperatures run upwards to 130 F degrees resulting in asphalt and equipment surface temperatures reaching 165 F degrees. Rainstorms can make a track cut through the desert an untrafficable mire in addition to temporarily flooding wadis and dry lake beds. Fog and sandstorms affect visibility. A Saudi winter can produce shamals; blizzards of dust and sand that produce blinding conditions, blocking out the sun.

US Logistics Doctrine

Five characteristics govern all logistics activities: anticipation, integration, continuity, responsiveness, and improvisation.

o Anticipation - The agility of the force and its ability to seize and retain the initiative and synchronize its activities in depth all depend on how well commanders and logisticians anticipate requirements. It is the ability to foresee future operations and demands as clearly as possible.

o Integration - Tactical and operational plans depend on fully integrated combat service support. The commander must ensure support at every stage of its execution.

o Continuity - Any interruption in the logistics system diminishes the combat power of a force. During operations, committed forces must receive continuous supply and service support to sustain their fighting strength and quality of life for soldiers. Continuity requires logistics efforts never to become hostage to a single source or mode of transportation.

o Responsiveness - In crisis, the logistics system must be versatile and react rapidly. Units must be respond on short notice and surge their support for brief periods to react quickly to increased demands.

o Improvisation - Planners anticipate requirements to provide predictive push of support forward. This predictive push minimizes the necessity for improvisation. However, no matter how well an intended operation is planned, friction causes performance

to be less than the intended goal. Improvisation is the talent to make, invent, arrange or fabricate what is needed out of what is at hand."

The logistics system is designed to push supplies and support forward to lower echelons. For example, supplies and support are pushed forward to corps units from the theater logistics base. Corps units push supplies and support forward to divisional units located in the division and brigade areas. At brigade level, battalions pick up supplies from their support battalion unit with their own organic vehicles. Maintenance and medical support teams deploy forward from the support battalion directly to combat battalions. Because of the push system, the majority of the logistics support structure is at corps and higher levels. This structure also provides commanders with the ability to shift resources and priorities when necessary.

The organization of each of the support units in Table III are contained in appendix P and Q. Of particular interest is the composition of the COSCOM. Doctrinally, the COSCOM is composed of functional units each performing supply, ammunition or other type support. It also contains a variable number of support groups that are comprised of functional battalions. By doctrine, the COSCOM units operate in the Corps Support Area (CSA). During Desert Shield/Desert Storm, support groups and other units of the COSCOM operated from improvised forward logistical bases (logbase) instead of the CSA.

Organization and CSS Structure

The focus for organizational efforts supporting Operation

Table II Support Relationships

Organization or Echelon	Support Organization
Corps	Corps Support Command (COSCOM) - Functional
Division	Division Support Command (DISCOM) - Multi-functional
Brigade	Forward Support Battalion (FSB) - Multi-functional

Desert Shield/Desert Storm was preparing for offensive operations covering vast distances. Tactical mobility of CSS and maintaining the mobility of the combat forces was the primary consideration. Positioning of forward logbases was based on the ability to rapidly expand and keep pace with tactical movement. Vital to the operation was minimizing the distance of lines of communication. It was decided that the forward logbases should not be moved during the offensive. Too many assets might be devoted to moving logbases instead of logistics efforts. Logbases also could not be moved too far behind units' lines of departure because of the anticipated tempo and distance involved. These alternatives resulted in co-locating logbases with defensive positions so that they could move forward on short notice.

During Desert Shield, the first of the forward logbases, Logbase Bastogne, was established 180km northwest of Dhahran directly ahead of the 101st Airborne Division along MSR Dodge (Tapline Road) (see appendix R). This was a controversial move because it was forward of US combat troops. However, the position

of the logbase enabled it to provide support regardless of which direction the XVIII Airborne Corps moved. The second logbase, Alpha, established was west of Bastogne along MSR Dodge to support VII Corps.

Conceptually, the theater logbases were to be positioned no farther than one day's round-trip from Corps Support Commands (COSCOM) supporting the Corps and in turn the COSCOM logbases would be less than one day's round trip from the Division Support Commands (DISCOM). This resulted in establishing a 90-mile rule, the approximate distance vehicles or convoys could cover in one round-trip per day.

With the air operations for Desert Storm commencing on 16 January, logistical preparation for the western flanking maneuver took on increased emphasis. Support Command units established Logbase Bravo where massing of trucks would take place. Once the air operation began, the assets of Alpha would be pushed forward to form two new Logbases--Charlie and Echo for XVIII and VII Corps respectively. Further logistical bases were planned deep inside Iraq--Oscar and Romeo to support the XVIII Airborne Corps and further north, Hotel and November to support the VII Corps. However, the swift conclusion of the war led to their use only as trailer transfer points (TTPs). See Appendix N for a diagram of bases.

The 2nd COSCOM used five corps support groups (CSGs) to support the VII Corps. The two rear CSGs operated Logbases Alpha and Echo with five single function battalions (transportation,

ammunition, water, maintenance and supply). The two rear CSGs provided area support and support forward to the forward CSGs. Forward CSGs would support each of the respective US divisions. Each forward CSG improvised by forming two multi-functional battalion-sized logistic task forces (LTFs) that had mobile stocks tailored to unit needs. Some single function battalions performed multi-function roles. LTFs were provided enough transport assets by the COSCOM to allow supply convoys to travel with combat forces--keeping logistics mobile." All but one division was supported with LTFs. The LTFs normally supporting the 1st Infantry Division were diverted to support units further west. 1st Infantry DISCOM elements would have to go back to a corps logbase south of the breach until a new corps logbase was established--Logbase Nelligan (see appendix S). Appendix S also shows an example of COSCOM tailoring to support mobile forces.

XVIII Airborne Corps' 1st COSCOM initially operated from Logbase Bastogne. The COSCOM used Logbase Charlie during the offensive. 1st COSCOM also provided LTFs to support their divisions. However, supporting the 101st Airborne Division (Air Assault) required a large logistics base to support their rapid move of over 300 Black Hawk helicopters. Corps improvised by establishing Forward Operating Base (FOB) Cobra halfway between the line of departure and the Euphrates. Cobra was vital to refueling and rearming helicopter assets and subsequently to 101st ground elements.

Movement

The detailed planning and organization of logistics to support every phase of corps, division, and brigade operations is vital to maintaining tactical mobility of CSS and the tempo of combat forces. Logistics units echeloned support to ensure continuity through each operational phase. For example, the 24th Infantry Division planned six subsequent division support area (DSA) locations to provide mobile support over more than 300 km the unit was expected to cover. LTFs from corps followed division elements to provide additional mobile stocks of high expenditure supply items. The speed of the movement was so rapid that DSA# 2 was only used for 12 hours and DSA#3 was not used."

Several methods were used to organize for mobility in the FSBs supporting brigades in both corps. One method was to load FSB vehicles with critical class III and V and have them tucked in with the field trains following behind the battalions. The FSB assets and battalion field trains remained mobile except when replenishing unit vehicles or if the formation had halted. This method was similar to having a mobile logistic resupply point (LRP). Once FSB vehicles were emptied, they returned to the FSB and more were sent forward. Another method employed was having elements of the FSB class III and V forward with elements of all the battalion field trains under the Brigade S-4. Supplies would be ready to move forward quickly to replenish battalions with the multitude of assets.

Tactical relocation was one the greatest challenges of

Operation Desert Shield/Storm. Insufficient numbers of heavy equipment transporters (HETs) constantly plagued operations. As XVIII Airborne Corps units were arriving in theater, a total of 112 HETs were available in theater. Over 1,300 additional HETs with drivers were assembled from coalition partners." The use of trucks minimized wear and tear on tracks, shifted maintenance time and cost to truck repair which is cheaper and consumed less fuel. It helped preserve both the limited road network and the mobility of combat forces by ensuring higher operational ready rates of combat systems.

The major drawbacks for wheeled vehicles was the significant tire and rim wear, tire explosions, and truck availability. VII Corps alone had to travel 420km (3 day round trip) to reach their initial tactical assembly areas. It took 2,068 HETs, 1,647 lowboys, and 906 stake and platform trucks (S&Ps) to move the corps. Only 254 HETs and 152 lowboys were available. The Corps missed the Army Central Command (ARCENT) close date of 15 January and did not arrive until 27 January even after receiving an additional 275 contract HETs on 1 January."

Tactical relocation was also essential to supporting the mobility of light forces. Sixty Chinook helicopters deployed an infantry task force with equipment to Landing Zone Sand (50 miles north of FOB Cobra). The battalion was to link-up with lighter forces deployed by Black Hawk helicopters. XVIII Airborne Corps also augmented the 82d Airborne division with a light-medium truck company to increase mobility for their follow and support mission.

More than 2,700 miles of main supply routes were used during Operation Desert Shield/Desert Storm. At a major checkpoint along the route an average of eighteen vehicles passed every minute, twenty-four hours a day, seven days a week, for six weeks." The enormity of the operation made movements control critical to the mobility of both CSS and combat forces.

Foremost among the unit moves orchestrated was the crossing movement of VII and XVIII Corps into attack positions for Operation Desert Storm. XVIII Airborne had to move to the west of VII Corps. XVIII Airborne Corps was initially located in tactical assembly areas northeast of VII Corps. Simultaneously VII Corps would be moving further west (see appendix T). VII Corps had to move 330 miles and XVIII Corps had to move approximately 500 miles.

Not only did the move have to be carefully planned because of the timing of movements across a critical intersection which both units would have to use, but over 4,000 heavy transport vehicles were used to assist in the movement of tracked vehicles to conserve the corps' tactical mobility for the offensive operation." The operation took ten days. Ongoing logistical operations were balanced with the movement plan.

Scheduling and traffic control were critical to the success of the operation from deployment through redeployment. The numbers of forces coupled with the limited availability of routes made movement control an extraordinarily complex, detailed, and difficult operation. An intricate system of traffic control

points (TCPs), trailer transfer points (TTPs), movement control centers (MCCs), movement control teams, final destination release points (FDRPs), and check points kept the movement network flowing.

An innovative method was established throughout the distribution network to help increase the tempo of transportation operations called convoy support centers (CSC). Nine such CSCs provided food, showers, and other facilities to ensure safety and increase performance. While most CSS planning factors assume a 12-hour shift, convoy support centers allowed both military and contracted civilians to operate over 18 hours a day, greatly increasing the total amount of lift available. Another method used to maximize transport efforts and control transportation was the establishment of transportation control center (TCCs). XVIII Airborne Corps effectively established TCC North and TCC South. They required drivers to perform two hours of maintenance and a minimum of six hours of sleep at either end of the run. To get the most efficiency from available transport assets, a central dispatch was conducted at battalion level instead of company."

Several mobility problems were experienced at division level. Among the most significant was the mobility of the FSB. Doctrinally, the FSB is suppose to be 100 percent mobile. However, in reality they are not. Numerous lifts were required to move repair parts vans and shops, and stockages. The Aviation Brigade and slice elements, such as the engineers, were not 100 percent mobile which added more transport requirments.

At corps level, the mobility issue was throughput delivery of fuel and combat configured loads to divisions. The primary corps vehicle, the M915 (14 1/2 ton truck), had difficulty negotiating the terrain. The M915 vehicle was designed for on-road movement.

Maintain

Most problems associated with maintenance mobility were slow evacuation and recovery. The M88 recovery vehicle is slow and had difficulty recovering the M1 tank. The vast distances magnified the problem. To increase the tempo, the HETs of the division main support battalion transportation company provided the primary means, but there are not enough to meet the need. HETs were also needed to provide transport for operational float tracks. Lastly, maintenance support teams (MST) from the FSB could not keep pace with the combat forces tanks and infantry fighting vehicles.

Supply

Insufficient trailers and materials handling equipment (MHE) such as forklifts and cranes greatly impeded the ability to move supplies. Shortages of both caused truck turnaround time to be lengthened increasing total truck requirements. Significant amounts of transportation were required just to keep classes of supply uploaded and moving in support of combat forces. Distances involved seldom left any vehicle of any tactical organization empty or idle. Trucks became mobile rolling stocks.

Fuel

Combat units considered fuel their most critical supply item

throughout Desert Storm. Mobility of the 5,000 gallon tanker was a major concern especially at division and below. Numerous divisional units exchanged 5,000 gallon tankers for 2,500 gallon heavy expanded mobility tactical trucks (HEMTTs)--a proven and reliable truck in the desert terrain. Unfortunately, maintaining the same fuel capacity doubled driver requirements. Additional HEMTTs were also provided to various units down to battalion.

Within the FSB, the number of fuel tankers was generally insufficient to maintain the speed of attack. Some FSBs had refueled tankers up to three times in a 24 hour period which decreased the tempo of support operations.

Medical

The ability of medical facilities to move quickly, set-up, and then displace again was slow. Two causes were the facilities and the transport vehicle. Mobile army surgical hospitals (MASH) and combat support hospitals (CSH) facilities or wards are towed on dollies behind trucks. The dollies were tested for mobility in the desert and the movement was slow and difficult. Once in position, it takes soldiers several hours to set-up the wards. To improve mobility, MASHs were uploaded on S&Ps and contracted HETs.⁴¹ Initial fielding of the medical modular system (DEPMEDS) equipment demonstrated that its prime mover, the M923A2 5-ton and the facility both significantly increased operations.

Forward medics equipped with M113 tracks could not keep up with units equipped with Bradley fighting vehicles and Abrams tanks.

Protecting, Enhancing, and Improving CSS Tactical Mobility

Communications equipment was one of the weakest links to the transportation system. Authorizations documents do not provide the appropriate types of equipment for movement control teams to work in typical contingency environments. Teams were provided with cellular telephones, hand-held radios, and AM/FM radios. In transportation units, only control vehicles at platoon and higher have radios. Movement control teams were essential to track, divert or otherwise change truck movements to support tactical operations. Movement personnel followed directly behind units during the offensive to maintain asset visibility and task backhaul assets.

Guides, maps detailing exact distances, and placards assisted drivers to final destinations. Some units even mounted multi-channel signal nodes on unit heavy expanded mobility tactical trucks (HEMTTs) for added mobility. One of several items quickly fielded to support operations was the global positioning system (GPS) to improve mobility. However, most were provided to combat forces because of limited quantities. Another item which could help mobility, especially at division level, were night vision goggles (NVGs). However, few CSS units are authorized them.

Engineers efforts contributed immeasurably to the tactical mobility effort. To support the major crossing of XVIII and VII Corps, the engineers built berms over a major pipeline and provided 50 crossing sites for vehicles. Engineers were also

critical to the offensive by working on combat trails and marking them for follow-on logistics elements. A multitude of techniques were employed including chemical lights, bicycle reflectors, engineer stakes mounted with warning lights and marked with GPS, and road signs. The recent additions of the armored combat earthmover (ACE) under the engineer reconstruction initiative (ERI) was especially useful in constructing combat roads and trails. Trafficability analysis was also a challenge for the engineers. While topographic analysis was conducted, it often took someone to physically check the terrain to validate whether transport would be able to cross it. Topographic units also produced needed maps of the areas by exploiting imagery and GPS."

Lastly, the factor contributing most to CSS units maintaining their tactical mobility was the freedom of action created by the air operation's achievement of air superiority.

Summary

The US learned many lessons from Operation Desert Shield/Desert Storm. The enormity of the operation made control of transportation assets one of the most important factors for success and the greatest contributor to supporting high tempo operations. The US learned that theater and corps movements personnel must be brought in early in the deployment phase of a contingency where no forward deployed forces exist to manage incoming forces.

Among the other important lessons was the importance of

tactical relocation to preserving the mobility of combat forces,
structuring the CSS system to improve mobility, and phased
operations to maximize available mobility to support the tactical
rate of advance of combat forces.

V. CONCLUSIONS

CSS tactical mobility is critical to a force projection Army. Tactical mobility ensures logistics forces maintain the tempo of combat forces to contribute to decisive victory. A force projection Army can expect to conduct operations and campaigns in areas where weather, terrain, and available transportation infrastructure play an important part in how logistics is tailored.

CSS tactical mobility is more than the physical ability of trucks to negotiate terrain. Doctrine, organization, and C3 of the CSS system influence tactical mobility. The ability of CSS units to quickly displace, relocate tactical units, evacuate and recover all contribute to CSS tactical mobility. Lastly, combat and combat support units protect, enhance, and improve CSS mobility through communications, engineer operations, and survivability methods.

The Afghanistan Conflict, the Falklands War and Operation Desert Shield/Desert Storm provide lessons, insights, and considerations to maintain the tempo of battle through mobility. The significant lessons learned concerning doctrine, organization and materiel are discussed below.

Doctrine

Operation Desert Shield Desert Storm proved once again that improvisation is an important characteristic of US logistics doctrine. When current organizations, materiel, or doctrine did

not meet requirements, logisticians improvised to provide the needed support. British and Soviet doctrine do not recognize this principle, but found that improvisation was often necessary to successfully support operations.

Organization

The first organizational issue is multi-functional support. In each of the operations, multi-functional support was required for effective support operations. In the case of Afghanistan, the ability to support widely dispersed mobile operations required changes to CSS organizations. In the case of the British, the success of their existing multi-functional service support structure of the Commando Brigade gave them reason to reevaluate the austere and single function capabilities of the CSS units in the 5th Infantry Brigade. During Operation Desert Storm, many single function battalions at corps were realigned to provide multi-functional support. Multi-functional battalions were better able to command and control subordinate units and tailor logistical packages to support over the long lines of communication. Providing mobile multi-function support forward to divisions was critical to maintaining the maneuver of combat forces. Multi-functional organizations already exist in the divisional CSS structure.

A second organizational concern is the mobility of divisional CSS units. In 1987, the Soviets recognized that they had miscalculated mobility requirements for Afghanistan and made materiel and organizational changes to increase the lift by 30

percent. In particular, the Soviets recognize the need to have transport assets at the regimental level.

During Operation Desert Shield/Desert Storm, the forward support battalion in the US division proved that it also was not 100 percent mobile. There are several possible resolutions to increase mobility: one is to provide more lift assets directly to units of the forward support battalion; second is to add a truck company to the FSB. Third, do not make changes to the force structure and reduce the size of ASLs and other stockages, thereby reducing lift requirements; lastly, continue to push transport support forward from the division MSB or corps. The best option is to provide a truck company to the FSB. However, it is the most expensive and the transport resources may not always be used.

Widely dispersed operations, potentially long lines of communication, and high tempo operations require CSS units in the division to be 100 percent mobile. They must be capable of displacing in one lift and able to keep pace with combat units.

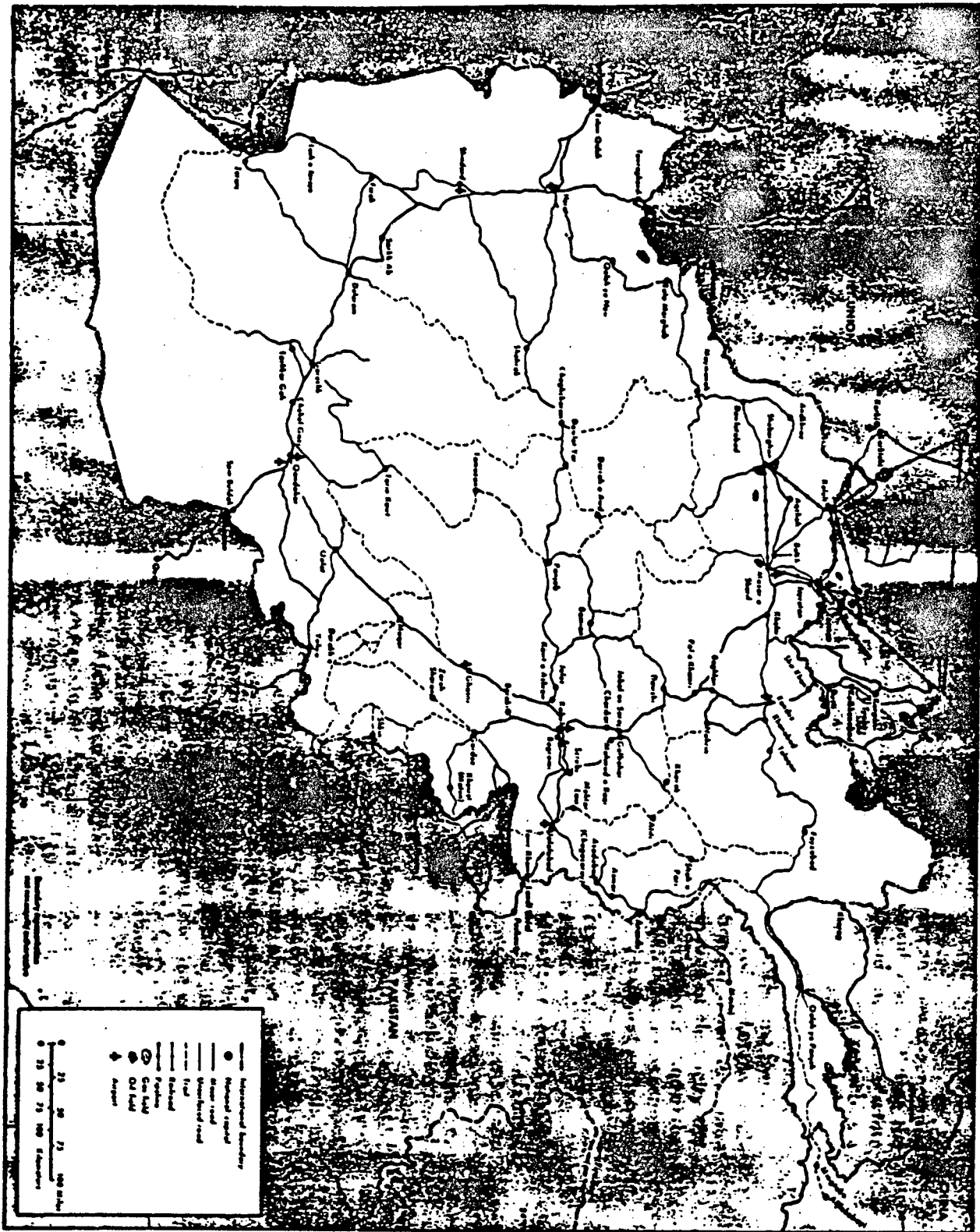
Finally, a major lesson learned concerned tactical relocation. Each operation demonstrated how important tactical relocation is for CSS forces. Tactical relocation increases the tempo of operations and preserves combat mobility. The Falklands War demonstrated how a shortage of air transport can affect tactical mobility. Soldiers negotiated difficult terrain in harsh conditions over extended distances. In Afghanistan, the Soviets effectively showed how air mobility could be used for every facet of their operations, including using assault forces for convoy

defense. Operation Desert Shield/Desert Storm involved tactical relocation of light and heavy forces. It especially demonstrated how tactical relocation of heavy forces is critical when forces must be moved vast distances. The US Army is now forming new HET companies with a goal of adding up to twelve HET companies consisting of 96 HETs each to the force structure.

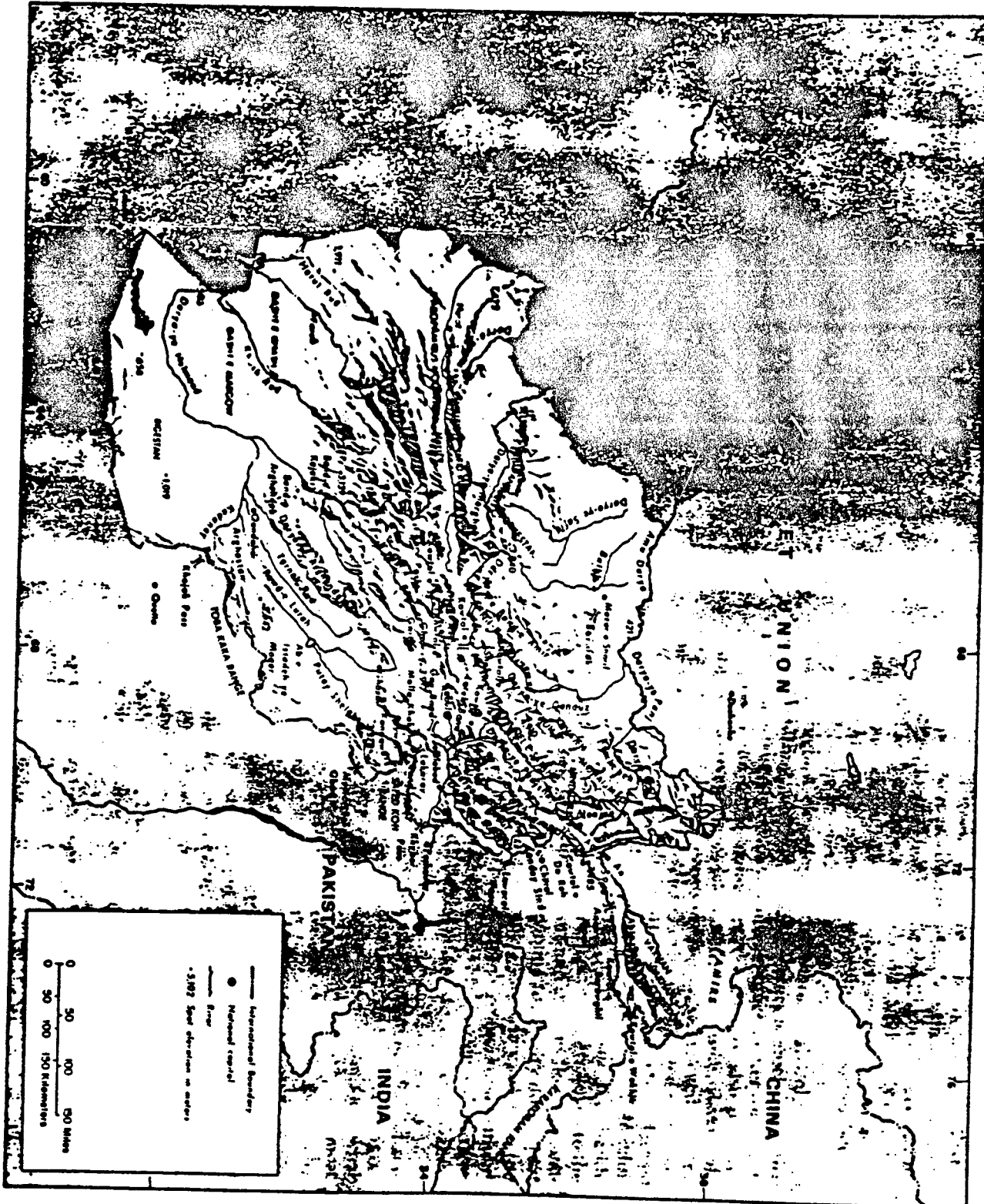
Materiel

A force projection army requires tailored logistics capabilities. In each case study, specific environmental factors determined the type of units and materiel essential for mission accomplishment. Of special note are transportation resources that effectively negotiate terrain. Air transport is essential to operations in mountainous and restrictive terrain. Transportation assets should provide a wide array of support capabilities. Planners have to balance total logistics requirements with mobility requirements. Often they make trade-offs. Improving mobility may mean more assets and increased driver requirements. In the Persian Gulf, the M915 (14 1/2 ton truck with 34 ton trailer) at corps did not perform well pushing support forward to divisions. Various contingencies may require an evaluation of the type truck companies used to support operations. There may be a need to provide transport units with more M923 5 ton series vehicles and add HEMTTs at corps. When the palletized load system (PLS) HEMTT with trailer is fielded it may offset the trade-off requirements for ammunition resupply. Current fielding plans envision providing the PLS HEMTT to corps units.

Appendix A - Map of Afghanistan, Major Cities and LOCs



Appendix B - Topography of Afghanistan



CENTRALIZED CONTROL. The bulk of logistics resources are held at Army and front levels. This in Soviet eyes, contributes to operational and tactical flexibility.

TAILORING. Just as Front and Army combat strengths are tailored to their mission, so are their logistic resources. These are then allocated to subordinate formations according to the importance of their mission and level of fighting anticipated. Commanders are prepared to realign their own resources or take away subordinates resources as required.

MAINTENANCE OF STOCK LEVELS. Supplies are held as far forward as possible and replaced as quickly as possible regardless of the rate of consumption. The aim is to preserve divisional stocks so that in the event of a supply chain break-down, the division can continue to fight with its mobile stocks. An emergency reserve is held at each level and may be used only upon approval of the higher commander.

FORWARD DELIVERY. It is the responsibility of higher commanders to keep their subordinates supplied. Using their transport assets, they deliver supplies to their subordinates. Often, to save time, an echelon may be skipped. For example, Front may deliver to division. Forward delivery means the bulk of transportation assets are at higher formations.

FLXIBILITY IN THE USE OF MOVEMENT RESOURCES. Planning is based on the use of all movement resources available. Thus, rail transport is used as far forward as possible such as Front or Army. Pipelines deliver fuels down to Army if possible. Motor transport is the primary means from Army down. Air resupply is used for emergencies and sensitive/controlled supplies. Delineation of vehicles by function is not followed. For example, a standard fuel carrier hauling fuel forward may evacuate wounded on the return trip.

SUPPLY PRIORITIES. The strict order for resupply is ammunition, POL, and technical supplies. If supplied at all, food, medical supplies and clothing are at the bottom. In the pursuit, ammunition and POL may be reversed.

CAPTURED MATERIAL AND LOCAL RESOURCES. Even though logistical planning is not affected by their use, units are encouraged to exploit local resources and captured material. Special staffs exist to plan for their use. Engineers of the fuel supply service have special pumps to extract fuel from filling stations. Foraging may provide food after the first few days.

FORCE RESTORATION. Units are not kept up to strength with piecemeal replacements except where lightly wounded or damaged equipment can be returned in hours. Once casualties become high enough to render the unit combat ineffective the whole unit is taken out of line and restored out of combat. Timely replacement of units is critical to maintaining momentum. The unit may be reorganized into composite groupings or reconstituted with new personnel and equipment.

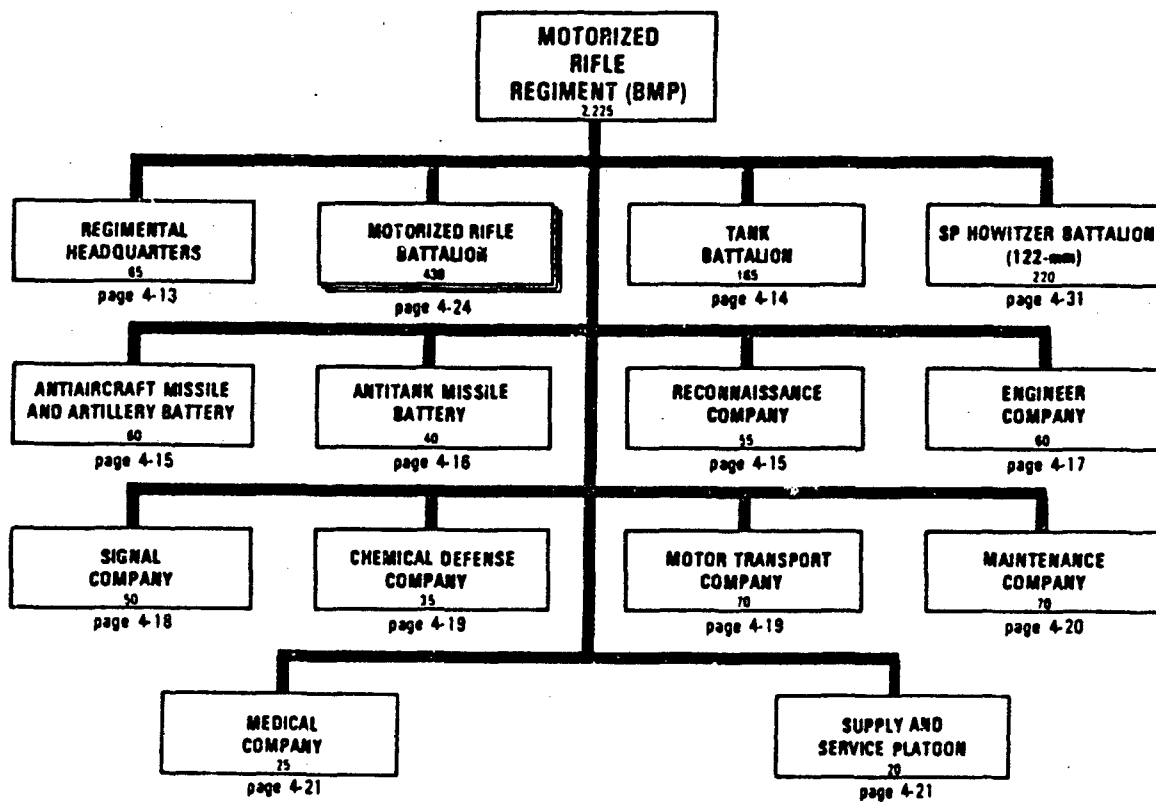
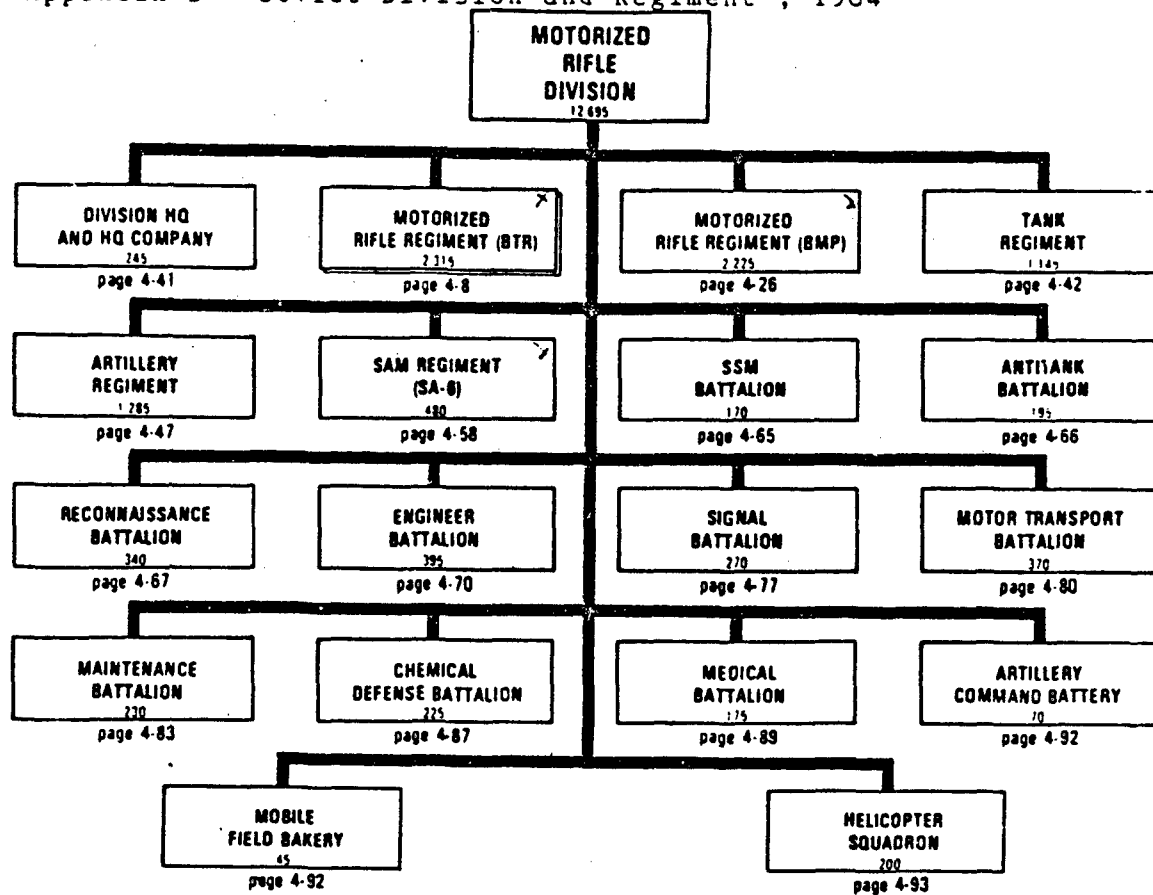
FORWARD POSITIONING OF SUPPORT ELEMENTS. Repair and medical facilities are moved well forward to the areas of greatest need, where battles have been fought, and set to work at the site. The emphasis is on quickly returning personnel who have been lightly wounded and equipment that is quickly repairable. Serious casualties are evacuated and longer repairs are left to higher formations. Divisional teams move on to the next battle area and start over again.

STANDARDIZATION AND CONSERVATION OF EQUIPMENT. The Soviets attempt to achieve a high level of standardization of equipment to make repair and resupply easier by reducing the spare parts needed and making cannibalization easier. Even civilian trucks used during mobilization are the same as those used in the military.

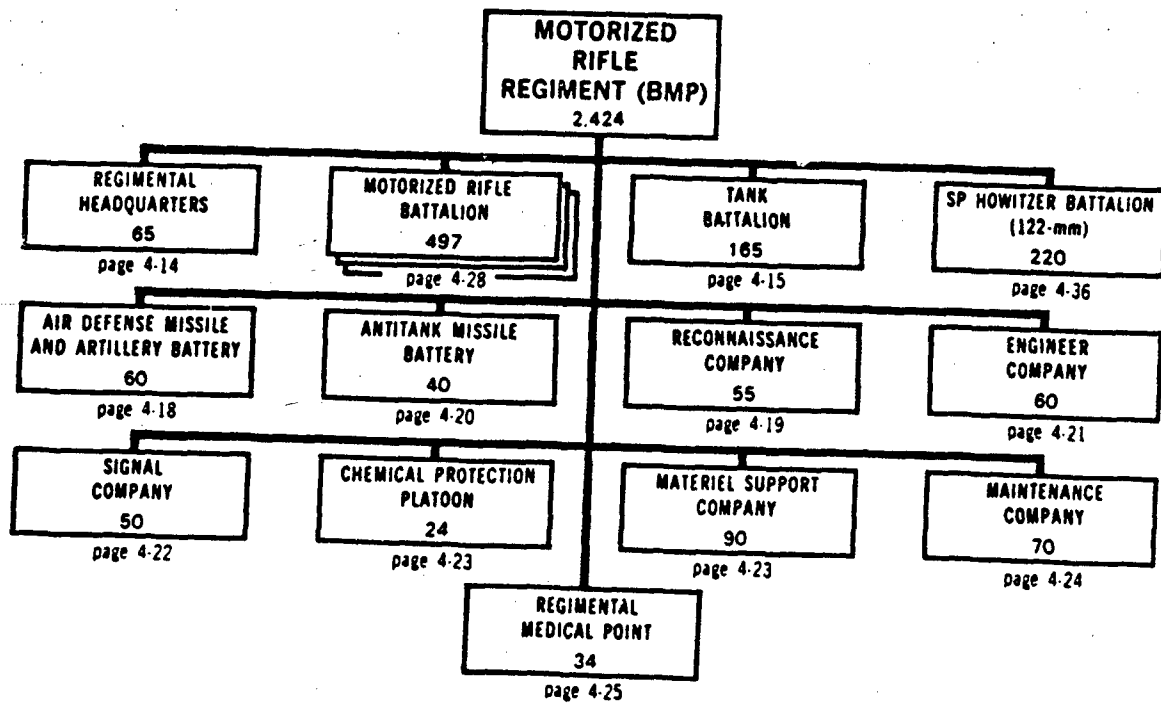
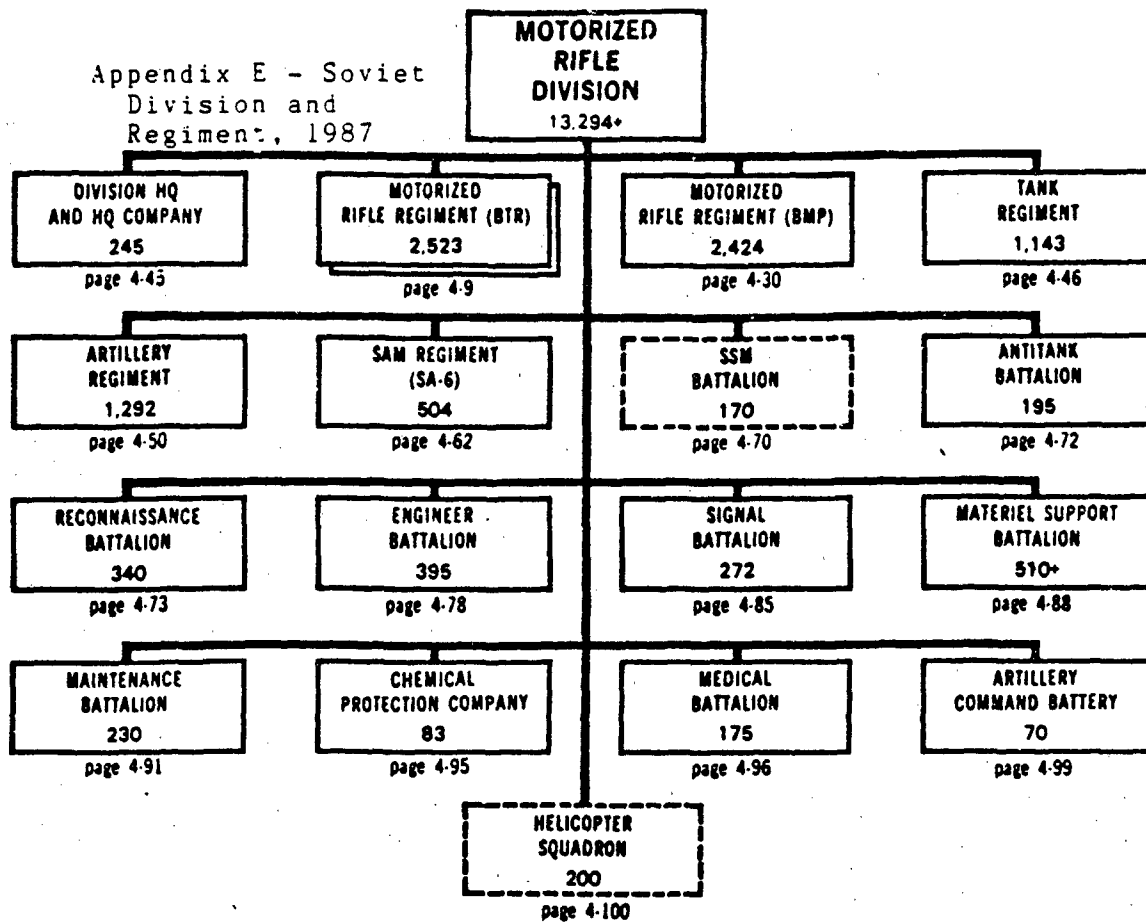
(Adapted from Her Britannic Majesty's Government, The Army Field Manual Volume II: Soviet Operations (London: Ministry of Defence, 1966): 11-1 thru 11-4.)

Soviet Logistic Principles

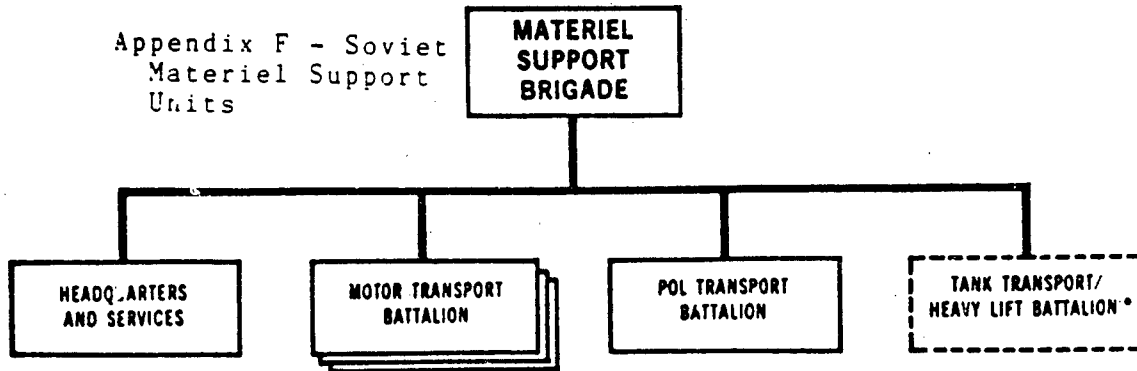
Appendix D - Soviet Division and Regiment , 1984



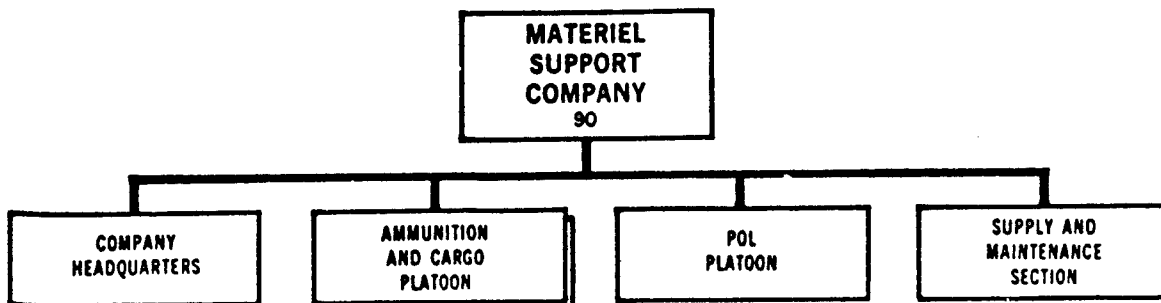
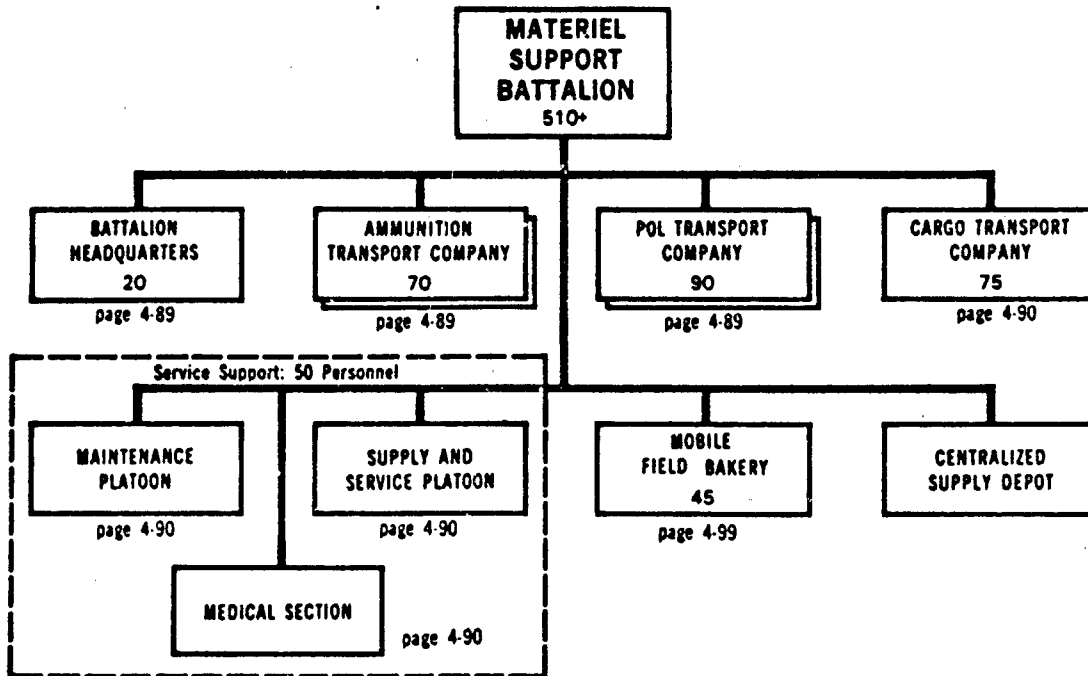
Appendix E - Soviet
Division and
Regiment, 1987



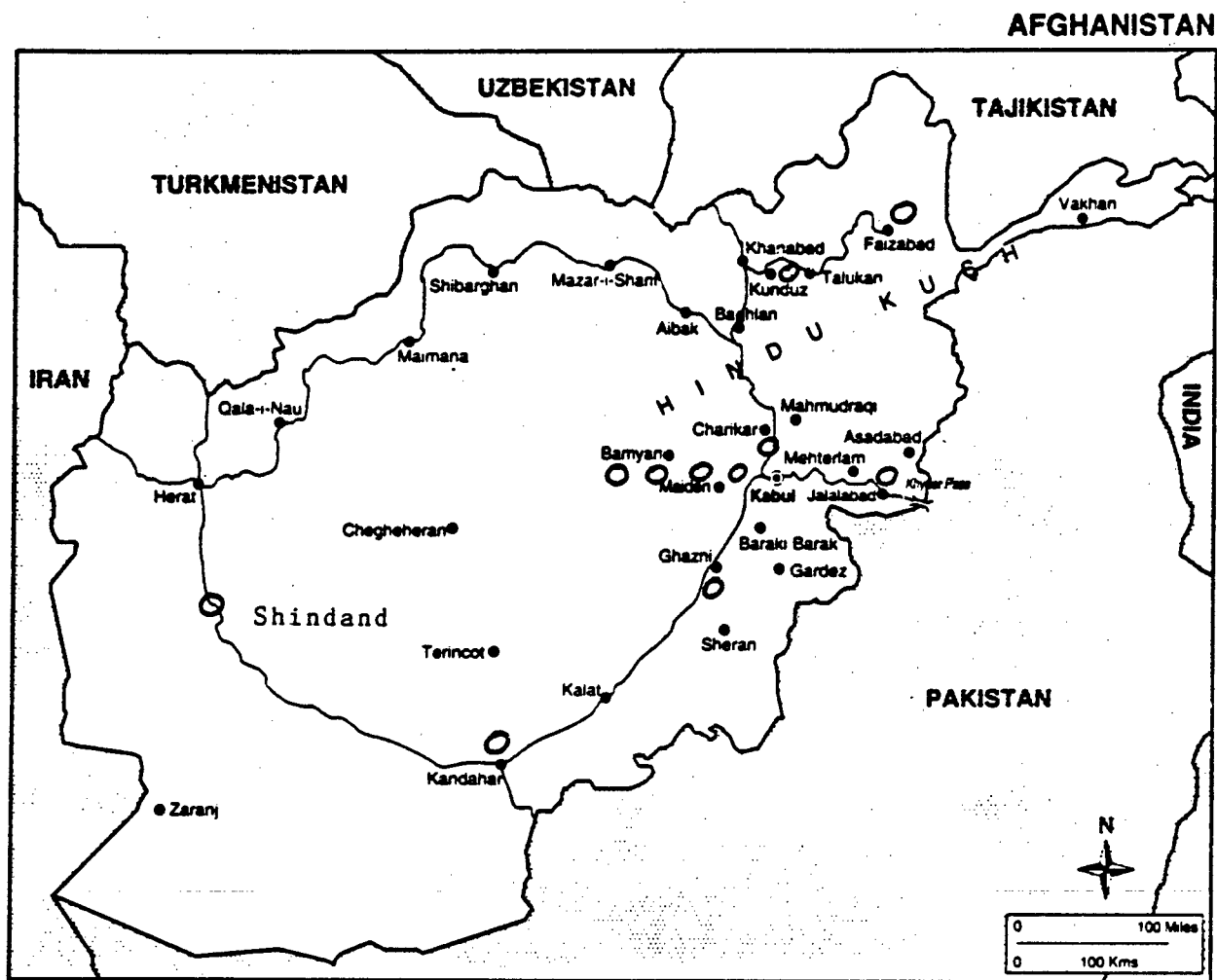
Appendix F - Soviet
 Materiel Support
 Units



*A tank transport/heavy lift battalion, equipped with MAZ-537 heavy tank transporters, may be attached to the brigade when the mission dictates.



Appendix G - Soviet Distribution of Forces



○ - Major Soviet Combat Deployments -
Division and Brigade Size Elements

Termez/Jeyrstan to Naebabad: Route 4

Length: 60km. Bituminous asphalt road connecting Soviet border with Afghan road systems, particularly roads to Pol-e-Khowri depot and beyond.

Nazar-i-Shariff to Pol-e-Khowri: Route 3

Length: 230 km. Bituminous asphalt road with 20 or more bridges. Has extensive valleys, gorges, and mountain curves. Major road from border to key junction at Pol-e-Khowri.

Shir Khan to Kabul: Route 2

Length: 425km. Bituminous asphalt with 40 or more bridges, the Salang Pass (2700m), and many narrow snow passageways. Key route south from the Soviet Union subject to numerous guerrilla attacks. Rugged mountain terrain and adverse conditions in the winter.

Kabul to Tsur Khan/Kuyiar Pass: Route 1

Length: 285km. Concrete road with 15 bridges, eight tunnels, narrow snow passageways, and extensive switchbacks. Minimal passing room at passes and gorges. Landslides common, high mountains and river gorge conditions. Frequently interdicted by guerrillas.

Herat/Macqandak to Kabul: Route 12

Length: 600km. Gravel or unsurfaced road with improvised bridges at streams. Extremely poor road conditions. Only east-west central route. Not passable in many areas during winter due to extreme snow and ice conditions. In spring and autumn subject to flash floods closing route for several days. All wheel drive required at all times. Mountain areas have frequent landslides. Sparsely populated region.

Kashka to Herat: Route 10

Length: 115km. Bituminous concrete road with few bridges. Good road through open plains. Third main route from Soviet Union to city of Herat (center of Afghan/Persian trade).

Key Lines of Communication

Herat to Kandahar: Route 13

Length: 600km. Concrete road with 30 or more bridges including two major bridges over the Harirud and Farah rivers. Mostly open valleys and plains except the hills surrounding Delaram city. Main access to bases established at Shindand (controlling western sector of country) and Kandahar (southern sector). All roads are open two lane without significant hills and grades to restrict movement. Some areas subject to flash floods. The extreme heat of summer and the extreme cold of winter coupled with small earthquakes cause frequent road repairs.

Kandahar to Chaman (Pakistan): Route 14

Length: 120km. Bituminous asphalt with a few small bridges, including one over the Darya-ye Arghandab near Kandahar. Low hills and open plains characterize the route.

Jalalabad to Barq-e-Matal (Asadabad): Route 23

Length: 250km. Consists of a mixture of gravel and concrete with up to 30 small bridges, particularly where it runs parallel with the Darya-ye Kabul river. Extensive guerrilla and Soviet attacks and counterattacks. Extensive road curves through valleys and rugged mountains.

Khanabad-Fayzabad-Eshkashew-Wakhan Corridor: Route 7

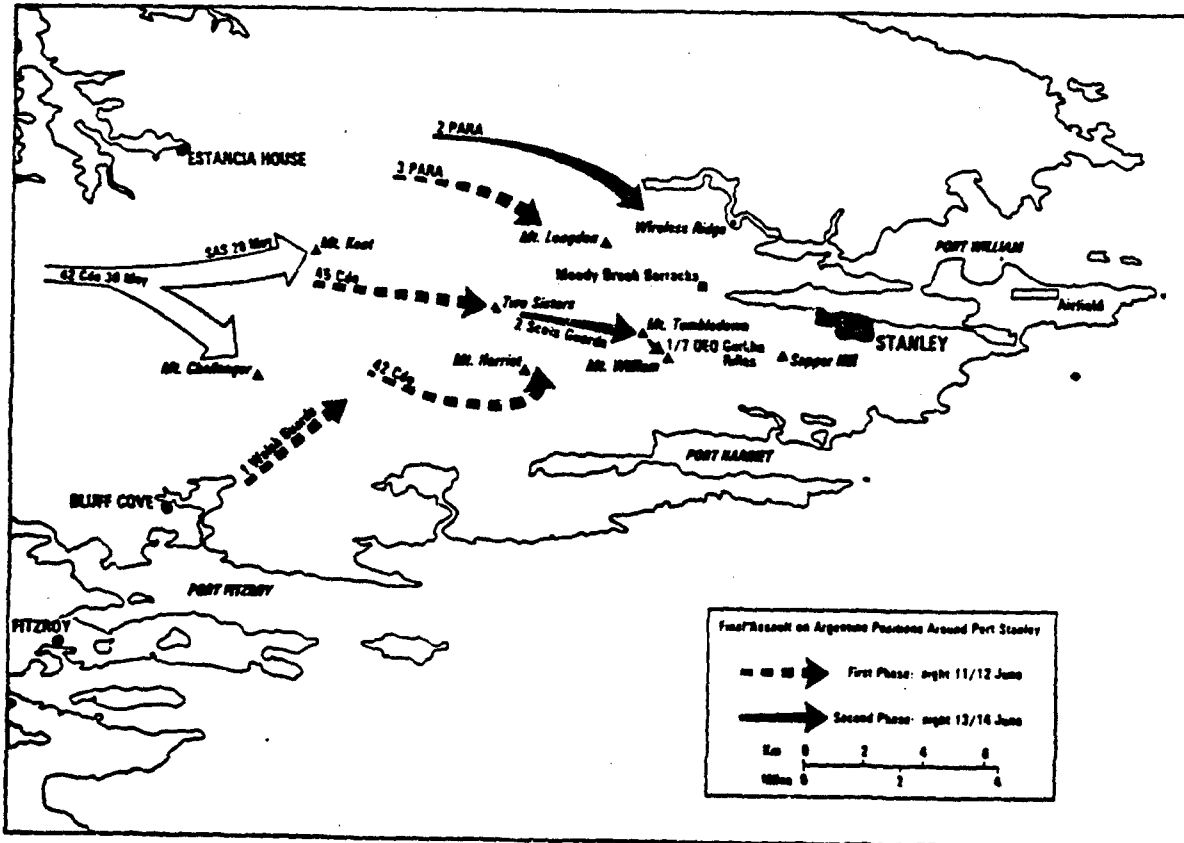
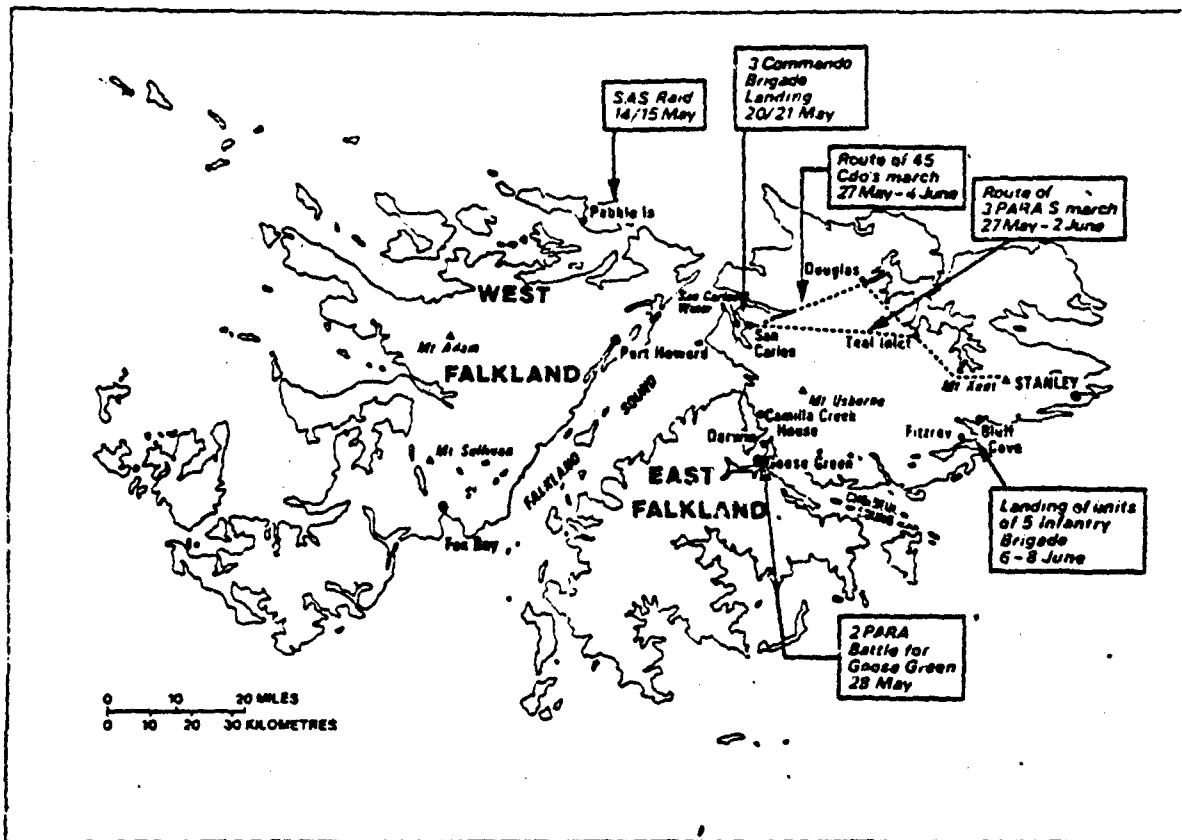
Length: 800km. Mixture of bituminous asphalt, gravel, stone, and unpaved with several small bridges. Extensive curves and rugged mountains particularly through the Hindu Kush region. Very steep with sharp curves and deep ravines. From Eshkashew road is unpaved (360km). From Qaleh-ye Panjeh pack animals can transit in spring and summer. Small 4x4 vehicles can transit in summer only.

(Adapted from A. Cordesman, Lessons of Modern War: Volume III (Boulder and San Francisco: Westview Press, 1990): 106-107.

Key Lines of Communication

Appendix H (cont.)

Appendix I - Maps of Falkland Islands



Appendix J - 3rd Commando Brigade Organization

3rd Commando Brigade (Royal Marines)

Headquarters, 3rd Commando Brigade
29 Commando Regiment Royal Artillery
59 Independent Squadron Royal Engineers
40 Commando Battalion RM
42 Commando Battalion RM
45 Commando Battalion RM
2nd Battalion Parachute Regiment
3rd Battalion Parachute Regiment
Commando Logistics Regiment
3 Commando Brigade HQ and Signals Squadron
3 Commando Brigade Air Squadron
2 X Medium Reconnaissance Troops
T Battery 12 Air Defence Regiment
Air Defence Troop
1 X Raiding Squadron
Mountain and Arctic Warfare Cadre
2, 3, & 6 Sections Special Boat Squadron
D & G Squadrons 22nd SAS Regiment
3 X Tactical Air Control Parties
Air Maintenance Group
Rear Link Detachment 30 Signal Regiment
3 X Mefloat Detachments 17 Port Regiment Royal Corps of
Transport
3 X Surgical Support Teams
5 X Landing Ship Logistics Detachments 17 Port Regt.
Postal Courier Detachment
Detachment RAF Special Forces
Detachment 47 Air Despatch Squadron
Detachment 49 EOD Squad. on 33 Engineer Regiment
Y Troop Detachment (Communications)
Commando Forces Band (stretcher-bearers)

Appendix K - Commando Logistics Regiment Organization

Commando Logistics Regiment

Regimental Headquarters

Headquarters Squadron (110 personnel)

Administration & Supply
Training Team
Signal Troop

Medical Squadron (109 personnel)

Admin Troop
3 X Direct Support Teams
3 X Decon Teams (not deployed)
Collecting Section
Treatment Section
Evacuation Section
Ground Section

Transport Squadron (117 personnel)

Hq Troop
A, B, C, & D Troops
(transport includes fuel pods and forklifts in
addition to truck transport)

Workshop Squadron (179 personnel)

Hq Troop
Vehicle Troop
Ancillaries Troop
Oversnow Troop
Condor Troop
Support Troop to Transport Squadron
Stores Troop

Ordnance Squadron (87 Personnel)

Hq Troop
Technical Troop
Supplies Troop
Petrol Troop (unable to deploy because of reserve
status. 35 pers. not in total)
Stores Troop

Appendix L - 5th Infantry Brigade Organization

5th Infantry Brigade (Army)

2nd Battalion Scotts Guards

1st Battalion Welsh Guards

1st/7th Duke of Edinburgh Own Gurka Rifles

97th Battery Royal Artillery

HQ 4 Field Regiment RA

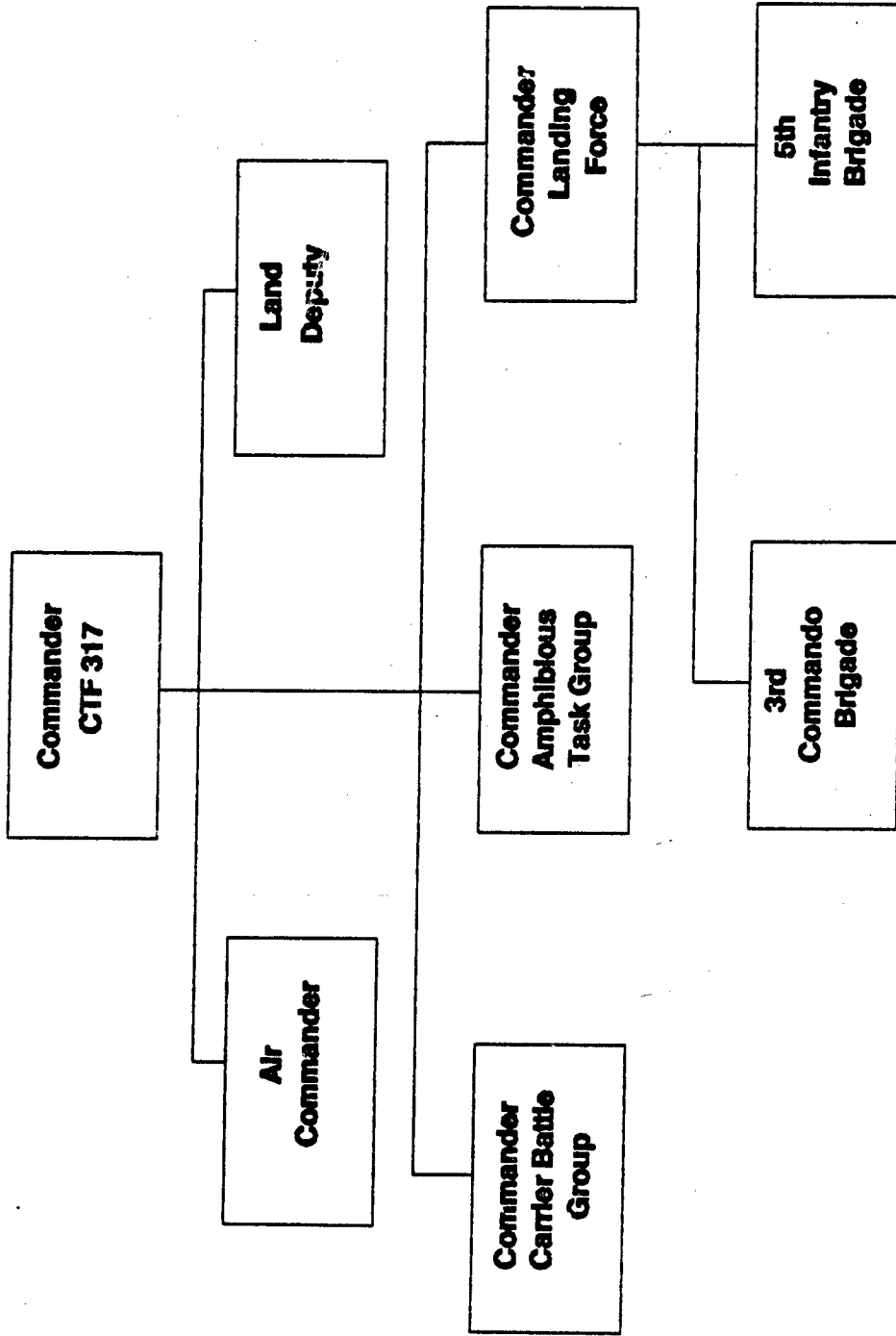
656 Squadron Army Air Corps

16 Field Ambulance

81 Ordnance Company (plus soldiers of another company)

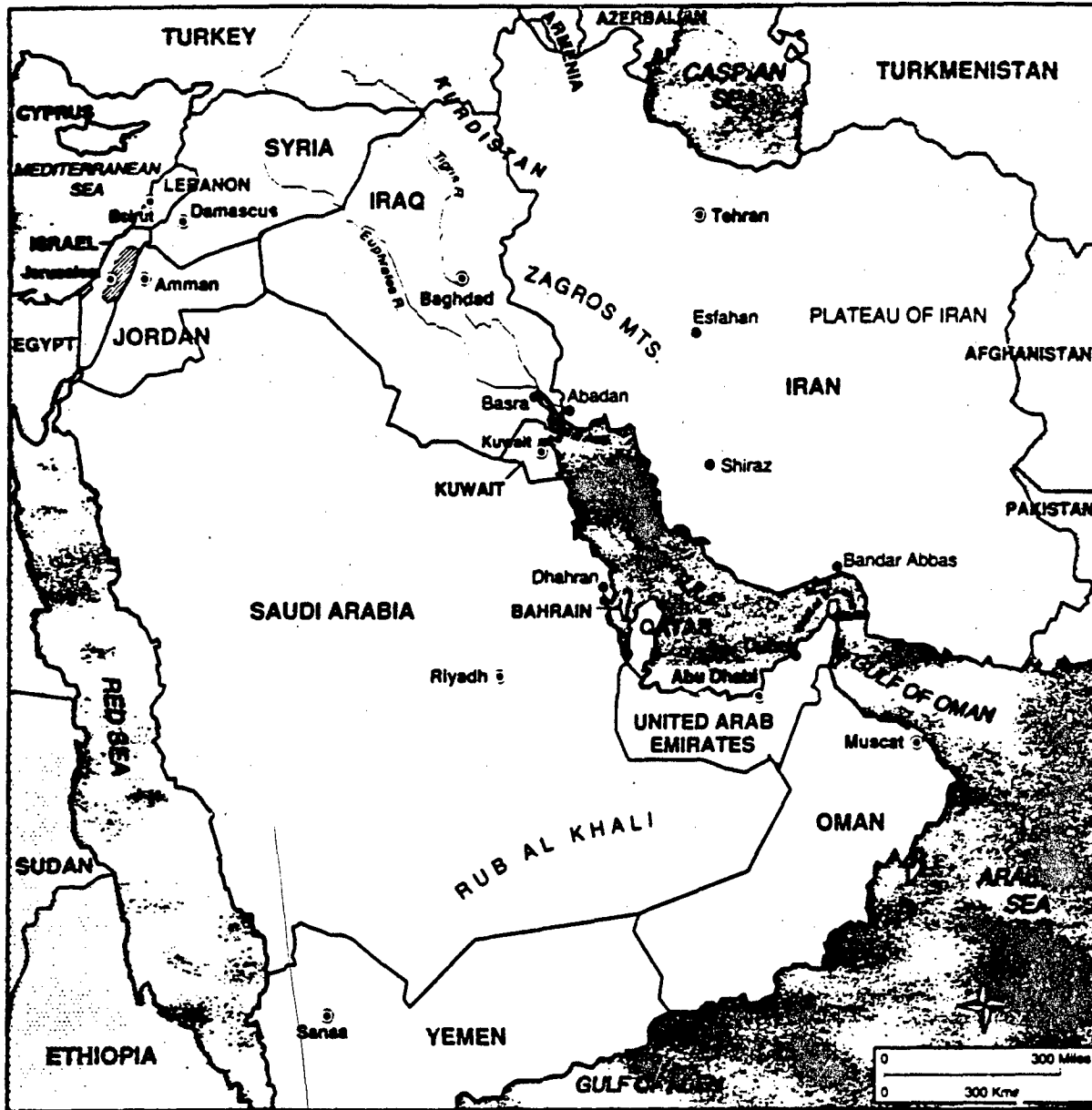
2 X Forward Air Control Party

Command Chain - Falklands War

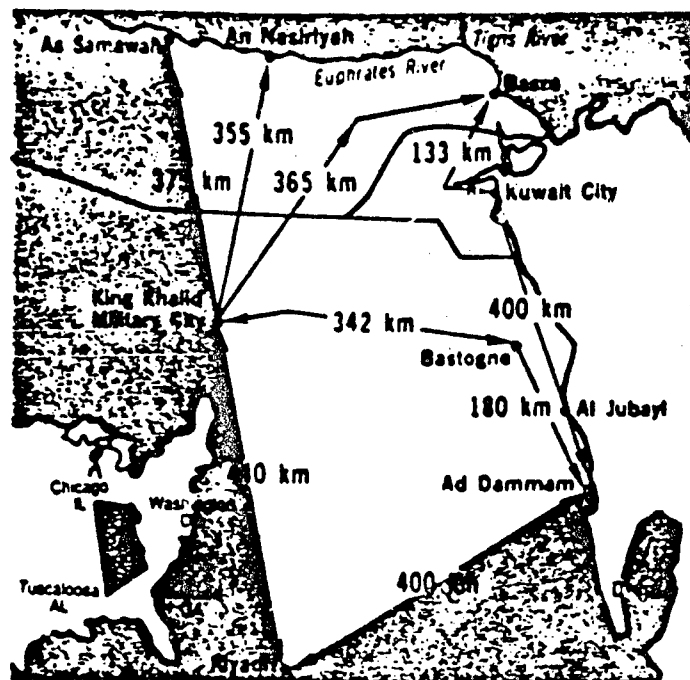


Appendix N

PERSIAN GULF AREA

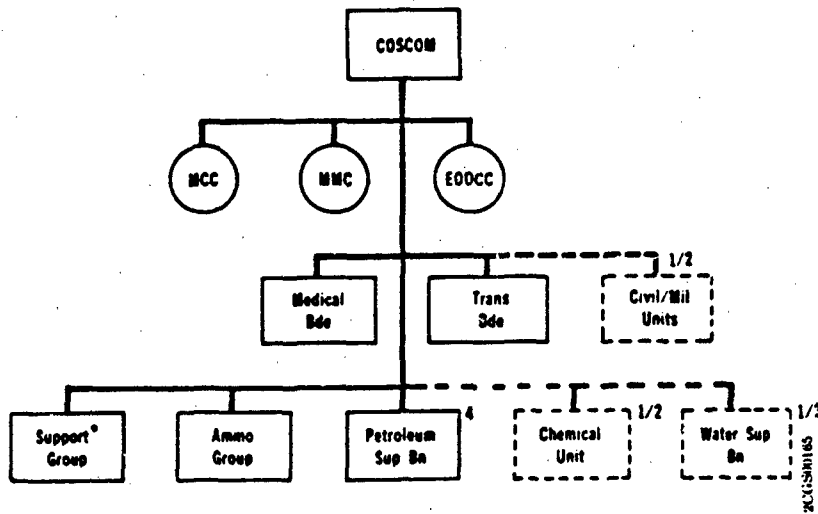


Appendix O - Desert Shield/Desert Storm Area



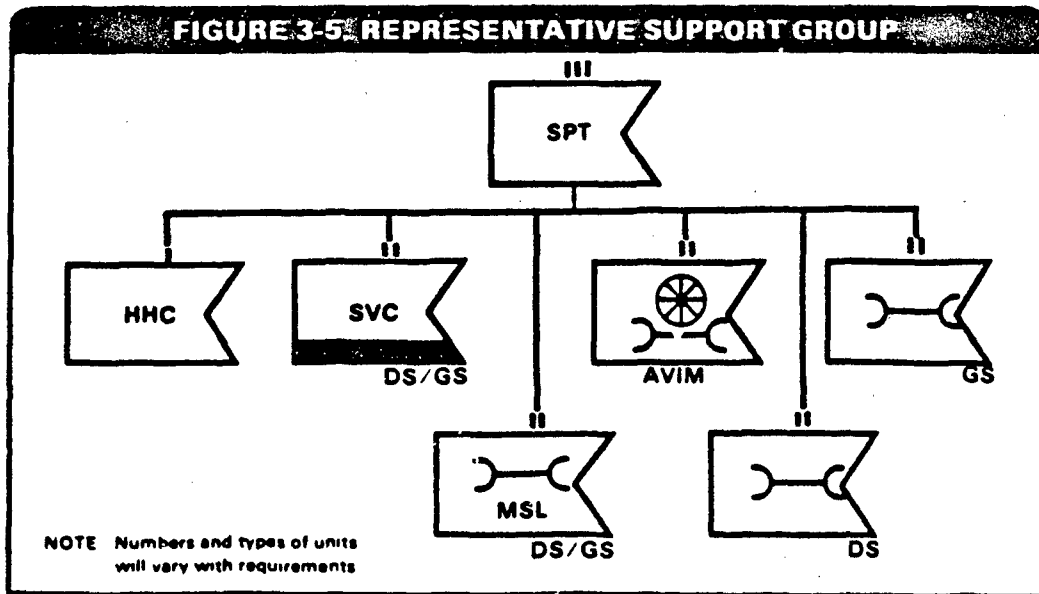
Appendix P - COSCOM and Support Group Organization
 Corps Support Command (COSCOM)

SRC-63431L000



- 1 Size will depend on mission. Assigned/attached as required
- 2 May be assigned to corps or COSCOM
- 3 And environment augmentation
- 4 May be assigned/attached to support group
- Variable number

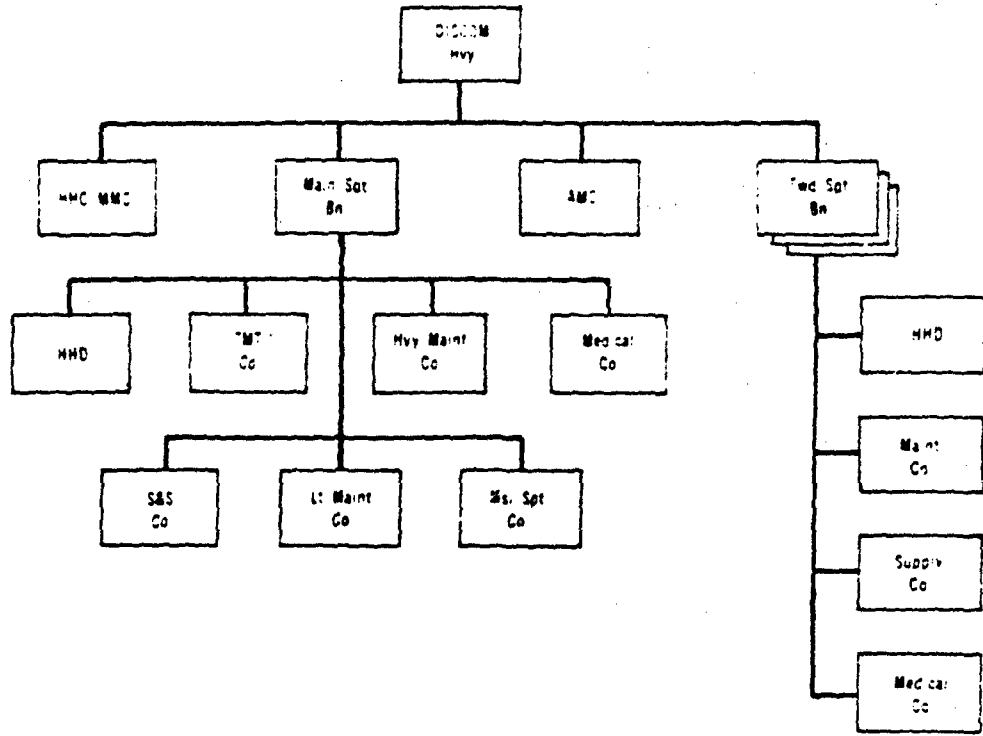
FIGURE 3-5 REPRESENTATIVE SUPPORT GROUP



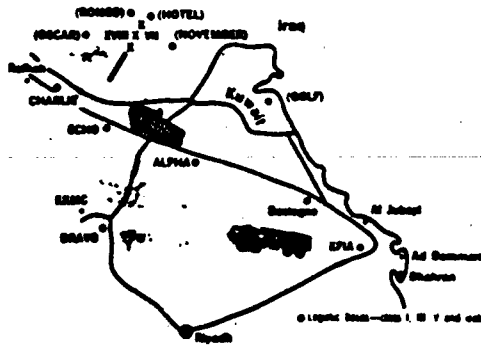
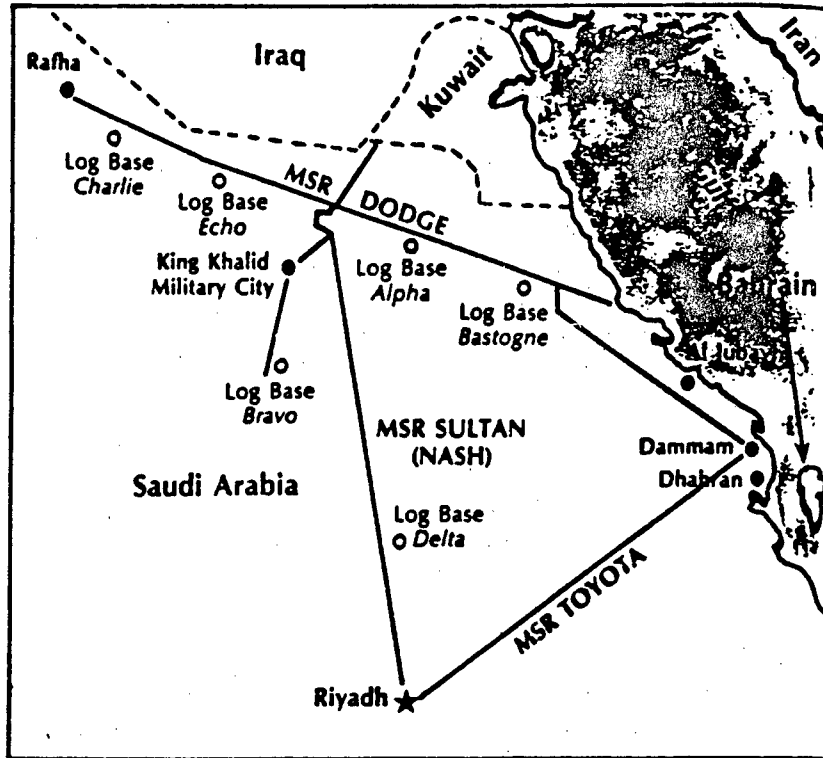
NOTE Numbers and types of units will vary with requirements

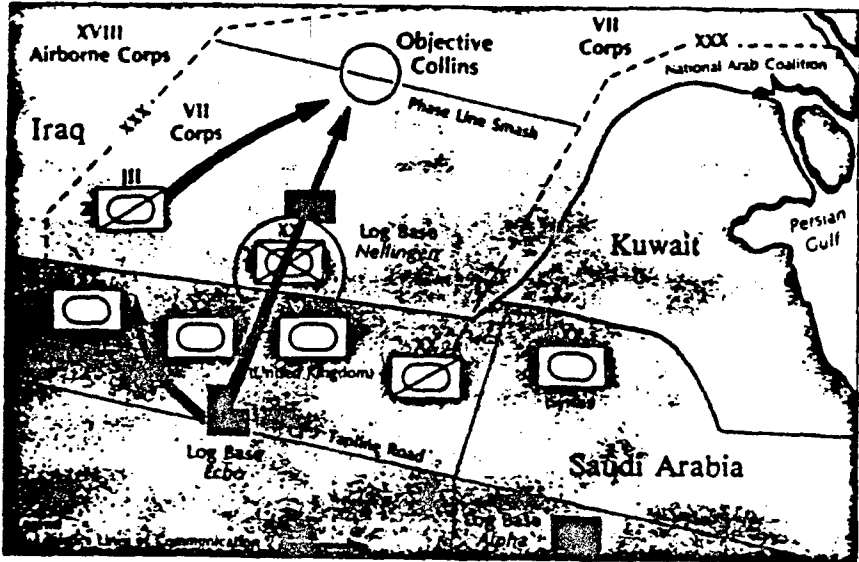
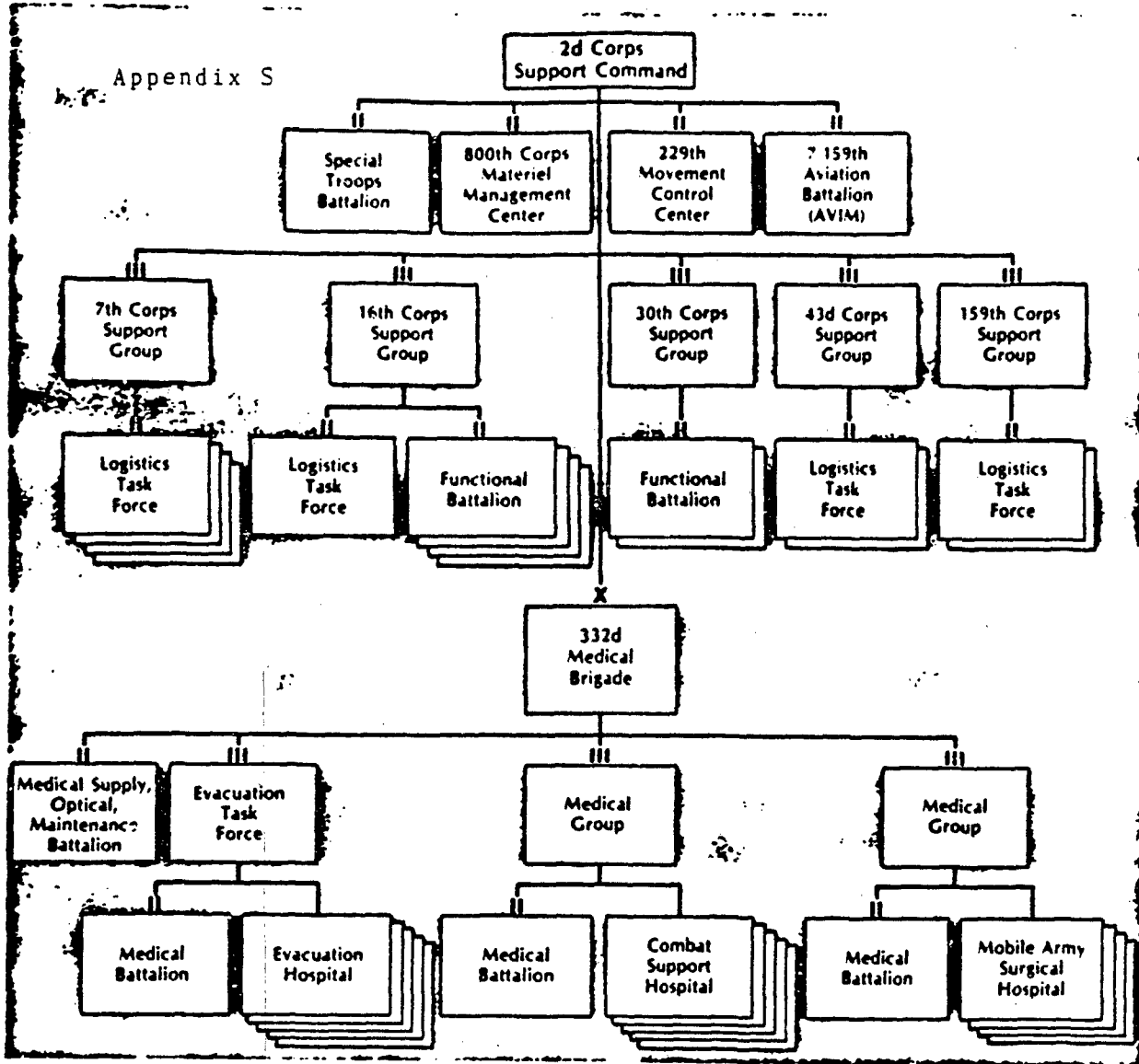
Appendix Q - DISCOM Organization

Division Support Command (DISCOM) (Heavy)
SRC-63001L410

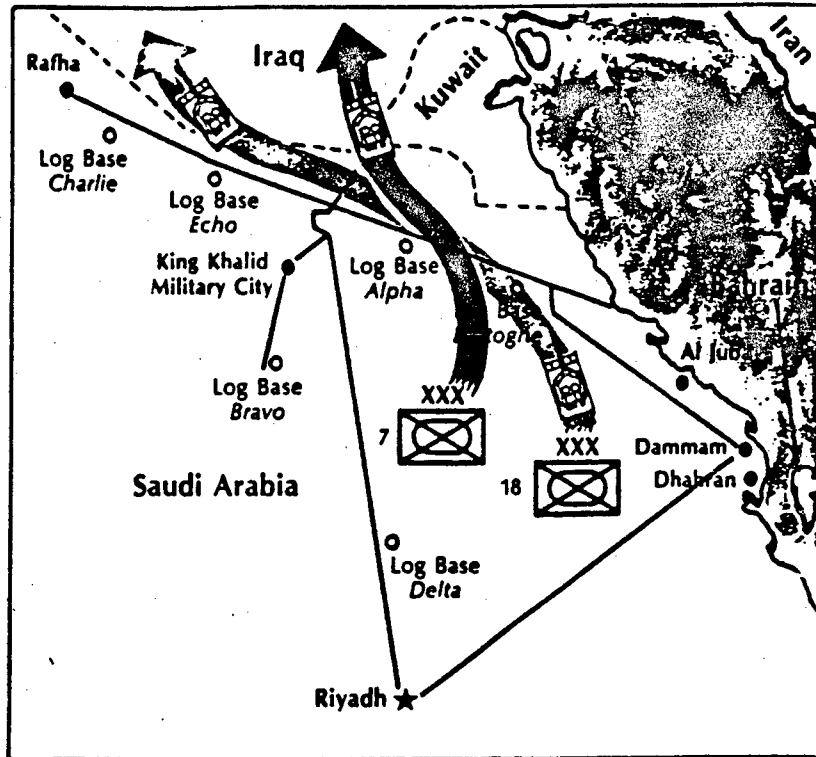


Appendix R - Desert Shield/Desert Storm Logistical Bases





Appendix - Tactical Relocation of VII and XVIII Corps
T



NOTES

1. FM 100-5 (Draft), Operations (Washington DC: Department of the Army, 1992): 2-11.
2. S. De Banzie, "Afghanistan: Coming Home to Roost?," RUSI & Brassey's Defence Yearbook (1989): 99.
3. S. De Banzie: 110-111.
4. Dr. Graham H. Turbiville, Jr., Ambush: The Road War in Afghanistan. (Fort Leavenworth: Soviet Army Studies Office, U.S. Army Combined Arms Center): 3. Hereafter referred to as Ambush.
5. USCENTCOM, Soviet Surface Transportation in Afghanistan (U), (MacDill Air Force Base: United States Central Command, 3 May 1988): 9.
6. Anthony C. Cordesman, Lessons of Modern War Volume III: The Afghan and Falklands Conflicts (Boulder and San Francisco: Westview Press, 1990): 101.
7. Richard F. Nyrop and Donald M. Seekans, editors, Afghanistan: A Country Study (Washington DC: Headquarters Department of the Army, DA PAM 550-65, 1986): 84.
8. Cordesman: 103.
9. Ibid: 103.
10. Ibid: 103.
11. Christopher N. Donnelly, Red Banner (Surrey: Jane's Information Group Ltd., 1988): 231-232.
12. Adapted from The Army Field Manual, Volume II, Part 2: Soviet Operations (London: Her Britannic Majesty's Government, 1986): 11-2 thru 11-4.
13. Donnelly: 232.
14. Dr. Graham H. Turbiville, "Soviet Logistics Support Concepts Change," Army Logistician (March-April 1987): 2. Hereafter referred to as "SLSCC".
15. Ibid: 3.
16. FM 100-2-3, The Soviet Army: Troops, Organization and Equipment (Washington DC: Department of the Army, 1991): 1-7.
17. Turbiville, "SLSCC": 6.

18. Turbiville, Ambush: 3.
19. Cordesman: 101.
21. Turbiville, Ambush: 6.
21. Cordesman: 212.
22. Turbiville, Ambush: 6.
23. Cordesman: 209-211.
24. Ibid: 209.
25. Turbiville, Ambush: 5.
26. Ibid: 8.
27. Cordesman: 212.
28. Ibid: 208.
29. Ibid: 212.
30. Ibid: 213.
31. Stephen J. Blank, Operational and Strategic Lessons of the War in Afghanistan, 1979-90 (Carlisle Barracks, PA: U.S Army War College, Strategic Studies Institute, 1991): 49
32. Cordesman: 238.
33. Julian Thompson, Major General, The Lifeblood of War: Logistics in Armed Conflict (London: Brassey's, 1991): 252-253.
34. Ibid: 253.
35. Adapted from Thompson: 7-9.
36. Thompson: 261.
37. Based on troop lists contained in: Secretary of State for Defence, The Falklands Campaign: The Lessons (London: Her Majesty's Stationary Office, 1983): 41-43 and Max Hastings and Simon Jenkins, The Battle for the Falklands (New York, London: W.W Norton & Company, 1983): 352-353.
38. Cordesman: 262.
39. Max Hastings and Simon Jenkins, The Battle for the Falklands (New York and London: W.W. Norton & Company, 1983): 353.

40. Cordesman: 262.
41. Thompson: 253.
42. Ibid: 253.
43. Cordesman: 326.
44. Ibid: 327.
45. Thompson: 277.
46. Secretary of State for Defence, The Falklands Campaign: The Lessons (London: Her Majesty's Stationary Office, 1983): 10.
47. Thompson: 253.
48. Ibid: 282.
49. Ibid: 281.
50. Secretary of State for Defense: 31.
51. Based on data contained in: William G. Pagonis with Jeffrey L. Cruikshank, Moving Mountains: Lessons in Leadership and Logistics in the Gulf War (Boston, MA: Harvard Business School Press, 1992): 7. The exact figure quoted is 183,030 passengers by air and 1,453 passengers by ship. No reference is made to specific unit compositions. XVIII Airborne Corps added by author.
52. William G. Pagonis with Jeffrey Cruikshank, Moving Mountains: Lessons in Leadership and Logistics in the Gulf War (Boston, MA: Harvard Business School Press, 1992): 1-2.
53. FM 100-5 (Draft), Operations (Washington DC: Department of the Army): 8-4 thru 8-7.
54. William L. Brame, Major, "Planning Desert Storm Logistics", Army Logistician (May-June 1992): 18.
55. Jason Karl Kamiya, Major, A History of the 24th Mechanized Infantry Division Combat Team During Operation Desert Storm (Fort Stewart, GA): 24-33.
56. Pagonis: 123.
57. Brame: 17.
58. Pagonis: 9.

59. Pagonis: 9. A detailed explanation of the movement is also provided in Peter C. Langenus, "Moving an Army: Movement Control for Desert Storm", Military Review (September 1991): 49-51.

60. Bob Porreca, "Truckstop in the Desert", Army Logistician (September-October 1991): 12-13.

61. Brame: 18.

62. Edward J. Wright, "The Topographic Challenge", Military Review (March 1992): 38.

BIBLIOGRAPHY

Government Publications

Ministry of Defence. The Army Field Manual Volume II: Soviet Operations. London: Her Britannic Majesty's Government, 1986.

Nyrop, Richard F. and Donald Seekins, editors, Afghanistan: A Country Study. Washington, DC: Headquarters, Department of the Army, DA PAM 550-65, 1986.

Secretary of State for Defence, The Falklands Campaign: The Lessons. London: Her Majesty's Stationary Office, 1983.

US Army. FM 63-3, Combat Service Support Operations--Corps. Washington DC: Department of the Army, 1983.

US Army. FM 63-20, Forward Support Battalion. Washington, DC: Department of the Army, 1990.

US Army. FM 63-21, Main Support Battalion. Washington, DC: Department of the Army, 1990.

US Army. FM 100-2-3, The Soviet Army: Troops Organization and Equipment. Washington, DC: 1991.

US Army. FM 100-2-3, The Soviet Army: Troops, Organization and Equipment (Obsolete). Washington DC: 1984.

US Army. FM 100-5 Operations (Draft). Washington DC: 1992.

US Army War College. Operational and Strategic Lessons of the War in Afghanistan, 1979-90. Strategic Studies Institute, Carlisle Barracks, PA., 1991.

US Army. ST 101-6 G1/G4 Battle Book. Fort Leavenworth, KS: Command and General Staff College, 1992.

Books

Cordesman, Anthony H. and Abraham R. Wagner. Lessons of Modern War Volume III: The Afghan and Falklands Conflicts. Boulder and San Francisco: Westview Press, 1990.

Donnelly, Christopher. Red Banner. Coulsdon, Surrey, United Kingdom: Jane's Information Group Ltd., 1988.

Hastings, Max and Simon Jenkins. The Battle for the Falklands. New York and London: W.W. Norton & Company, 1983.

Kamiya, Jason Karl. A History of the 24th Mechanized Infantry Division Combat Team During Operation Desert Storm. Ft Stewart, GA., 1992.

Pagonis, William G. and Jeffrey L. Cruikshank. Moving Mountains: Lessons in Leadership and Logistics from the Gulf War. Boston, MA: Harvard Business School Press, 1992.

Simpkin, Richard E. Race to the Swift: Thoughts on Twenty-First Century Warfare. London: Brassey's Defence Publishers, 1985.

Thompson, Julian. The Lifeblood of War: Logistics in Armed Conflict. London, United Kingdom: Brassey's, 1991.

Turbiville, Graham H. Jr. Soviet Combat Engineers in Afghanistan. Fort Leavenworth, KS: Soviet Army Studies Office, Combined Arms Command, 1988.

_____. Ambush! The Road War in Afghanistan Fort Leavenworth, KS: Soviet Army Studies Office, Combined Arms Command, 1988.

Watson, Bruce W. and Peter M. Dunn, editors. Military Lessons of the Falklands War: Views from the United States. Boulder, CO: Westview Press, Inc., 1984.

Articles

Brame, William L. "Planning Desert Storm Logistics," Army Logistician (May-June 1992): 16-21.

Byrnes, Daniel T. and Michael Christiansen. "Tires for Desert Use," Army Logistician (January-February 1992): 24-25.

Carr, John J. "Logistics Planning for Desert Storm," Army Logistician (September-October 1991): 23-25.

Constantine, Donald. "Sappers Forward: Preparing Engineers for Desert Storm," Military Review (March 1992): 14-21.

Fortner, Joe A. and Jules J. Mullen III. "Bring on the HETs! Operational and Tactical Relocation of Heavy Maneuver Forces'" Military Review (January 1992): 36-45.

Kindsvatter, Peter S. "VII Corps in the Gulf War: Deployment and Preparation for Desert Storm," Military Review (January 1992): 2-16.

_____. "VII Corps in the Gulf War: Ground Offensive," Military Review (February 1992): 16-37.

Langenus, Peter C. "Moving an Army: Movement Control for Desert Storm," Military Review (September 1991): 40-51.

McFarlin, Robert P. "Logistics Command and Control in Southwest Asia," Army Logistician (November-December 1992): 11-15.

Mertz, Michael A. "Brigade Supply Support," Army Logistician (January-February 1992): 26-28.

Pagonis, William G. and Michael D. Kraus. "Theater Logistics in the Gulf War," Army Logistician (July-August 1992): 2-8.

_____. "Observations on Gulf War Logistics," Army Logistician (September-October 1992): 5-11.

Pagonis, William G. and Harold E. Raugh Jr. "Good Logistics is Combat Power: The Logistic Sustainment of Operation Desert Storm," Military Review (September 1991): 28-39.

Porreca, Bob. "Truckstop in the Desert," Army Logistician (September-October 1991): 12-13.

Staff Feature. "HETs Will Move Heavy Forces," Army Logistician (March-April 1992): 41-42.

S. De Banzie. "Afghanistan: Coming Home to Roost," RUSI & Brassey's Defence Yearbook 1989. London: The Royal United Services Institute for Defence Studies, (1989): 99-116.

Turbiville, Graham H. Jr. "Rear Service Support: Concepts and Structure," Military Review (December 1988): 71-79.

_____. "Soviet Logistics Support Concepts Change," Army Logistician (March-April 1987): 2-7.

Wilson, Bonnie F. "Forward-Area Support in Desert Storm," Army Logistician (September-October 1992): 2-4.

Wright, Edward J. "The Topographic Challenge," Military Review (March 1992): 28-38.

Unpublished Dissertations, Theses, and Papers

Hellberg, I. J. "An Experience with The Royal Marines: Falklands Campaign April-July 1982," Document, Commando Logistic Regiment, Royal Marines, 1982.

Privatsky, Kenneth L. "British Combat Service Support During the Falklands War: Considerations for Providing Operational Sustainment to Remote Areas," Monograph, School of Advanced Military Studies, US Army Command and General Staff College, 1986.

Sulka, Daniel V. "The Palletized Load System...Just Another Truck?" Monograph, School of Advanced Military Studies, Command and General Staff College, 1992.

US Army. "Operation Desert Shield/Storm: Observations and Related Data," Fort Lee, VA: US Army Combined Arms Support Command, no date.