THE LONG HAUL

Historical Case Studies of Sustainment in Large-Scale Combat Operations

Edited by Keith R. Beurskens

LARGE-SCALE COMBAT OPERATIONS SERIES

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Cover image: Soldiers assigned to the 1st Stryker Brigade Combat Team, 25th Infantry Division, offload vehicles and equipment in sub-zero temperatures in Anchorage, Alaska, as part of Arctic Thrust, a January 2018 deployment readiness exercise. Photo by Justin Connaher, US Air Force.

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Editor
Diane R. Walker

Foreword

Since the Soviet Union's fall in 1989, the specter of large-scale ground combat against a peer adversary was remote. During the years following, the US Army found itself increasingly called upon to lead multinational operations in the lower to middle tiers of the range of military operations and conflict continuum. The events of 11 September 2001 led to more than 15 years of intense focus on counterterrorism, counterinsurgency, and stability operations in Iraq and Afghanistan. An entire generation of Army leaders and Soldiers were culturally imprinted by this experience. We emerged as an Army more capable in limited contingency operations than at any time in our nation's history, but the geopolitical landscape continues to shift and the risk of great power conflict is no longer a remote possibility.

While our Army focused on limited contingency operations in the Middle East and Southwest Asia, other regional and peer adversaries scrutinized US military processes and methods and adapted their own accordingly. As technology has proliferated and become accessible in even the most remote corners of the world, the US military's competitive advantage is being challenged across all of the warfighting domains. In the last decade, we have witnessed an emergent China, a revanchist and aggressive Russia, a menacing North Korea, and a cavalier Iranian regime. Each of these adversaries seeks to change the world order in their favor and contest US strategic interests abroad. The chance for war against a peer or regional near-peer adversary has increased exponentially, and we must rapidly shift our focus to successfully compete in all domains and across the full range of military operations.

Over the last two years, the US Army has rapidly shifted the focus of its doctrine, training, education, and leader development to increase readiness and capabilities to prevail in large-scale ground combat operations against peer and near-peer threats. Our new doctrine, Field Manual (FM) 3-0, *Operations*, dictates that the Army provide the joint force four unique strategic roles: shaping the security environment, preventing conflict, prevailing in large-scale combat operations, and consolidating gains to make temporary success permanent.

To enable this shift of focus, the Army is now attempting to change its culture shaped by over 15 years of persistent limited-contingency operations. Leaders must recognize that the hard-won wisdom of the Iraq and Afghanistan wars is important to retain but does not fully square with the exponential lethality, hyperactive chaos, and accelerated tempo of the multi-domain battlefield when facing a peer or near-peer adversary.

To emphasize the importance of the Army's continued preparation for large-scale combat operations, the US Army Combined Arms Center has published these volumes of *The US Army Large-Scale Combat Operations Series book set*. The intent is to expand the knowledge and understanding of the contemporary issues the US Army faces by tapping our organizational memory to illuminate the future. The reader should reflect on these case studies to analyze each situation, identify the doctrines at play, evaluate leaders' actions, and determine what differentiated success from failure. Use them as a mechanism for discussion, debate, and intellectual examination of lessons of the past and their application to today's doctrine, organization, and training to best prepare the Army for large-scale combat. Relevant answers and tangible reminders of what makes us the world's greatest land power await in the stories of these volumes.

Prepared for War!

Michael D. Lundy
Lieutenant General, US Army
Commanding General
US Army Combined Arms Center

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Introduction

Keith R. Beurskens

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

—General Dwight D. Eisenhower

There will not be a revolution in military affairs unless there is a revolution in military logistics.[1]

—General Dennis J. Reimer

The practice of logistics has been around since the earliest known standing army of the Assyrians at around 700 BC. It was fundamentally unchanged for more than two millennia. Logistic support consisted of feeding, equipping, and moving (i.e. horses, camels, mules, and oxen) the force. Non-combatant followers carried the materiel necessary to provide sustenance and maintenance to the fighting force. Campaign timing was synchronized to occur just after the harvest to extend the time the force could remain in one place. Alexander the Great established warfare as a year-round operation—not wintering or staying more than a few weeks away from a sea port or navigable river with his army on campaign. He made extensive use of shipping with merchant ships and horses. Alexander also used his enemy's logistics weaknesses against them.[2]

There was no truly revolutionary approach to logistics until the introduction of steam engines and the railroad. The American Civil War foreshadowed future warfare, particularly as regards logistics. It was the first major war in which railways played an important part, speeding up the movement of troops and supplies. To a great extent railroads also dictated the axes of advance or retreat, the siting of defensive positions, and the location of battles.[3] The United States' first two large-scale combat operations within the industrial age were the First and Second World Wars. These wars had both the traditional logistics requirements—only at a much grander scale—and introduced new warfare technology-based logistics requirements.

Post Korean War and throughout the Cold War, the United States as a superpower and in cooperation with her allies expanded the concept of logistical planning. The United States began to stockpile military supplies at strategic points of the world near areas of potential conventional war danger.[4] The origins of the US modern Operational Contract Support practices are from the US experiences during the Vietnam War.[5] Advances in

logistical support to strategic maneuver and within harsh environments occurred during operations in the Middle East during Operation Desert Storm and Operation Iraqi Freedom.

This book is a collection of 11 historical case studies of sustainment operations drawn from the past 100 years with lessons for modern large-scale combat operations (LSCO). The work is organized chronologically specifically including World War I and II, Korean War, Vietnam War, Falklands War, Desert Storm, and Operation Iraqi Freedom. The Commanding General Combined Arms Support Command (CASCOM) presented future sustainment trends to end the book. It is intended as a tool for the development of thoughtful reflection on past experience—good and bad. It is a work of history and should be approached as such, as a tool used to teach situational critical thinking.

We asked the authors to focus the readers and lessons learned with chapters short enough to prohibit a comprehensive telling of the story. Their orientation to the situation is brief, and only elements of the situation critical to understanding the major lesson's learned are presented. Where the authors felt it was applicable, they closed the chapter with forecasts of sustainment operations in future LSCO.

In the end we wanted the reader to have a good—not perfect—understanding of the capabilities and limitations of at least one important challenge in each major area of sustainment, the actions taken for addressing it, and the outcome. To gain the full value from these case studies, readers must engage with reflection on what they read; analyze for themselves the cause, effect, and outcome of this situation; and apply the fruit of this thought to their own lives, times, and experiences.

Chapter 1 by Leo P. Hirrel, retired Quartermaster Historian, examines the maturation of US Army sustainment functions during World War I from vague notions into a workable organization structure. Dr. Sanders Marble, US Army Medical Command (MEDCOM) Senior Historian, focuses Chapter 2 on World War I's medical functions and their effect on maintaining combat power in the US 1st Army area during the Meuse-Argonne Offensive.

The North Africa Campaign—as the US Army's entry into the west during World War II is studied in Chapter 3 against the framework of AirLand Battle and logistical doctrine by Lieutenant Colonel (Retired) Mark D. Kitchen. In Chapter 4, Battle of Metz, Major Cory D. Campbell identifies lessons from the battle within today's principles of sustainment. The logistical support and challenges of US, United Nations, and Republic

of Korea forces transition from traditional to cold war is explored in Chapter 5 by Dr. James A. Huston, Professor of History.

Chapters 6 and 7 arguably do not cover LSCO. However, these case studies explore advancements in sustainment practices that were applied to future LSCO. Chapter 6, by Isaac W. Hampton II, Quartermaster Branch Chief Historian, explores Vietnam infrastructure build-up from 1962 to 1967, as the Army's introduction to Operational Contracting Support. Lieutenant Colonel Michael J. Gunther, PhD program, King's College, presents the only non-US logistics case study in Chapter 7. Lieutenant Colonel Gunther examines the application of British joint logistics to expeditionary operations against near-peer forces without the benefit of a secure logistical base in the area of operations.

Chapters 8 through 11 represent sustainment operations in the Middle East during Operation Desert Storm and Operation Iraqi Freedom. James B. Martin, Dean of Academics Command and General Staff College, studies VII Corps logistics operations in Operation Desert Storm—examining the sheer volume of support required and the lessons learned from such a major land combat operation.

Operation Iraqi Freedom I (OIF I) is examined from three perspectives. The strategic maneuver of 4th Infantry Division (Mechanized)—from 18 installations in the United States, Germany, and Italy to Iraq through Turkey, then through the Suez Canal and Kuwait—is studied in Chapter 9 by Mr. Kelvin D. Crow, Combined Arms Center Command Historian and Colonel (Retired) Christopher D. Croft, as an example of complex and chaotic strategic maneuver. Richard E. Killblane, Transportation Corps Historian, examines the doctrine of on-time delivery and the many unforeseen challenges that prevented it from the context of the 3rd Infantry Division and bottled water in Chapter 10. Kenneth Finlayson, CASCOM Command Historian, completes the study of OIF I in Chapter 11 by examining the planning, preparation, execution, and results of the installation and operation of the Inland Petroleum Distribution Systems (IPDS) as the principle bulk fuel delivery mechanism supporting the American forces. The final chapter—by Major General Paul C. Hurley, Commanding General Combined Arms Support Command; Major General Rodney D. Fogg, 54th Quartermaster General; and Ronald Jaeckle, CASCOM strategic planner—explores the future of logistics decision-making.

This work would not have been possible without the voluntary time and work of the authors; they are the experts. Several authors are current or past Army historians with a significant depth of expertise. Some are schol-

ars who have devoted a lifetime of study to master the sources, understand the context, ponder the details, and develop a skill for narrative. The balance of the authors are experienced practitioners who have devised innovative solutions to the inevitable surprises that arise during the fog of war.

We also owe thanks to the staff of Army University Press for putting this book into physical and electronic form as part of the "Historical Case Studies in Large-Scale Combat Operations" book set. Special thanks to Colonel Paul E. Berg, book set general editor; Donald P. Wright for production; Robin D. Kern for graphics; and Diane R. Walker and Lynne M. Chandler Garcia for the copy editing and layout. As the general editors of this project, we alone are responsible for the errors, omissions, or limitations of this work.

Notes

1. Thomas J. Edwards and Rick Eden, "Velocity Management and the Revolution in Military Logistics," *Army Logistician* 31, no. 1, January–February 1999.

2. P. Antill, *Military Logistics: A Brief History*, 22 August 2001, accessed 22 May 2018, http://www.historyofwar.org/articles/concepts_logistics.html.

3. Antill.

4. James A. Huston, "Korea and Logistics," *Military Review* 36, no. 11, February 1957, 30.

5. Rufus Phillips, "Counterinsurgency in Vietnam: Lessons For Today," *Foreign Service Journal* 92, no. 3, April 2015, accessed 23 May 2018, http://Www.Afsa.Org/Counterinsurgency-Vietnam-Lessons-Today.

Chapter 1
World War I and the Emergence of Modern Army Sustainment

Leo P. Hirrel

As the United States entered World War I in April 1917, the Army was deficient in almost every aspect of sustainment for large-scale conflict. Immediately after the Civil War, the Army returned to its previous role as a frontier constabulary. During those years it not only failed to adapt to changing technologies but it lost whatever institutional knowledge of sustainment developed during the Civil War. An embarrassing performance during the Spanish-American War led to an era of reform that left the Army greatly improved, but still unprepared for the Great War. The most serious deficiencies lay in what today might be termed "sustainment," that is the logistical, personnel, medical, and related areas needed to keep the Army functioning. The emergence of viable sustainment capabilities during the pressures of combat is a vital part of the story of World War I.

Difficulties during homefront mobilization foreshadowed the problems the Army would have creating a support structure in France. At the time the logistical functions were divided among semi-independent bureaucracies that often competed against each other for scarce resources, including railroad priorities. An inflexible contracting system complicated the Army's efforts to acquire weapons, clothing, and other instruments on a timely basis. These structural problems might have been mitigated by even elementary planning before the United States declared war. Nevertheless, President Woodrow Wilson steadfastly refused to allow the nation to prepare for mobilization until the actual declaration of war, believing that it would compromise American neutrality. The Army lacked any site selection plans for the training installations that would be needed quickly. No plans existed for conversion of industrial resources to munitions, including the necessary tools for mass production. Initially the administration allowed private industry to work without government intervention, and no prioritization of resources. Finally, a December 1917 railroad crisis, combined with production delays, motivated a government reorganization. By late spring 1918, the industrial base was entering its productive phase, and American Soldiers were deploying to France in large numbers. It required roughly 13 months between the declaration of war and the first 500,000 Soldiers entering France. The United States relied upon European factories for heavy weapons, artillery ammunition, machine guns, and aircraft.[1]

Shipbuilding became especially difficult. Moving troops to Europe was a challenge, but doable partly because of British help and partly because the war reduced the demand for passenger traffic. Cargo ships were another matter. The United States simply did not possess enough ships to meet the massive increase in demand. Real progress in ship construction required new shipyards, with all the administrative complications, delaying full production until late 1918. Throughout the war, cargo shipments remained a limitation on the American Army in France.[2]

Motor vehicles, especially trucks, became another industrial mobilization problem that bedeviled the logisticians in France. With no prior planning for vehicles, the Army purchased all available models, creating a massive problem with repair parts in France. The War Department did initiate the Liberty Truck as an effort for vehicle standardization, but that came too late in the war. The Army in France had 284 different models of motor vehicles; and 81 were European models with metric specifications.[3]

In France, the American Expeditionary Forces (AEF) faced a comparable lack of forethought to the problems of sustaining a large-scale conflict. American logisticians and personnel specialists displayed remarkable determination and ingenuity to overcome obstacles, but the path to success came with unnecessary difficulties.

Problems of sustainment carried political weight in addition to military importance. British and French leaders advocated breaking the US Army into small units and "amalgamating" them into their own formations. From the outset, President Woodrow Wilson wanted an independent American force. General John J. Pershing, the American commander, displayed an unbending determination to maintain American independence in the face of fierce arguments. A functioning logistical structure was essential to the American ability to operate independently, regardless of the previous lack of preparation in logistics.

The Field Service Regulations (FSR), the contemporary equivalent of doctrine, provided detailed instructions for small unit logistics yet very little about theater level operations beyond geographical organization. The FSR provided little or no guidance about lines of authority between geographical and functional areas of responsibility. The FSR said almost nothing about the types of tasks to be performed, the necessary unit structure, or other details. Perhaps most importantly, no thought had been given to the proper ratio of support troops to combat troops.[4]

Upon their arrival the first logistical planners began to implement FSR, to the best of their ability. In keeping with the American insistence

on fighting as a separate force, the United States occupied a sector in Lorraine along the eastern edge of France. All the available ports, however, lay along the Atlantic Coast forcing the AEF to move supplies across the width of France. In response, the AEF created the Line of Communications as a subordinate organization; and it was divided into multiple base sections, an Intermediate Section, and an Advanced Section. The base sections operated the ports and smaller activities near the coast. The Intermediate Section assumed responsibility for the depots, maintenance facilities, schools, personnel support activities and all the other installations between the ports and the front. The Advanced Section provided immediate support to the Zone of the Armies. Without a clear idea of how the support system should work, the logisticians organized and reorganized units as the war progressed.

Notwithstanding the organizational deficiencies, the test for the sustainment structure came early and resulted in a dismal failure. In an effort to reassure its allies, the United States dispatched a token force of four divisions to France before the support structure could take shape. The resulting misery of the first arrivals was later described as the "Valley Forge of the AEF." The Soldiers were billeted in drafty barns, while a shortage of wool uniforms and blankets left them further exposed to the cold. Food was often lacking, leaving the Americans dependent upon the French or Canadians. One division lacked the vehicles to move its subsistence and used French trucks. Mismanagement clogged French railroads, and horses went hungry. In retrospect, these divisions performed an invaluable service by constituting a laboratory on what to do wrong.[5]

In response to the sustainment fiasco that winter, Pershing ordered the first of many studies and reorganizations in December 1917. Doctrine was so poorly defined that the board making the study seriously considered reassigning the entire sustainment responsibility as a business enterprise. The board, however, kept the sustainment as a military function but clarified the responsibilities. To establish greater independence, the headquarters for the Line of Communications moved to the city of Tours, away from the General Headquarters. Other reorganizations followed as the Americans tried to control the different functions scattered throughout France. One of the most important changes came in February 1918 when the name changed to Services of Supply (SOS), and the railroads were placed under the SOS.[6]

Railroad and port operations proved to be the most vexing of all the organizational issues. Prior to the war the Army assumed that cargo movement could be assigned to civilian railroads with minimal difficulties.

French ports and railroads were not built to carry the massive quantities of supplies needed by the AEF, and years of warfare resulted in neglect of the system. It became necessary for the United States to construct new port facilities, repair existing railroads, and operate both. On paper the Corps of Engineers had responsibility for military operation of railroads, but without any real expectation of performing that work. Therefore, the Army employed corporate railroad personnel who brought the needed expertise, but with an insistence that they should report directly to General Pershing, not the SOS. The resulting controversies consumed an inordinate amount of time and distracted from the mission of supporting the ever-increasing American Army.[7]

Even while arguing about the optimal organization, the SOC and its predecessors embarked on an enormous construction program in anticipation of the arrival of American fighting forces. During the year that the United States spent mobilizing and training Soldiers, the logisticians in France laid out the essential support structure in accordance with the geographical plan prescribed by the FSR and discussed previously. The scope of construction seemed excessive to the observers, but in reality it was appropriate for the expected millions of American Soldiers. Projects included new ports along the Atlantic and enormous depots in the Loire Valley. The depot at Gièvres had the third largest ice-making plant in the world. Other facilities included remount depots (for horses), ordnance maintenance, vehicle maintenance, shops to reassemble vehicles and railroad engines, clothing and textile repair (termed salvage), an Adjutant General's Central Records Office, personnel replacement depots, and a headquarters to manage these efforts.[8]

Building the physical infrastructure was only one part of creating the necessary support organization. The leaders needed to define how they would operate and why. Missions developed because of a perceived need, rather than any doctrinal requirements. None of this came easily, but some functions were more difficult than others. New organizations were created, then adjusted as experience dictated. When the meager institutional knowledge was insufficient, the sustainment personnel found solutions to their problems by a combination of adapting their civilian experience, looking at French or British examples, and often by innovative thinking.

For example, the most important logistical task was to move the supplies, principally subsistence, from the Atlantic ports to the Soldiers at the front. Upon surveying the situation, the Army quickly discarded plans for reliance upon local labor and facilities. Instead, they initiated massive improvement projects for both ports and railroads. To work the ports, the

Figure 1.1. Once operational, the American-constructed port at Bassens (near Bordeaux) dominated the scenery. Photo courtesy of the US Army Quartermaster Museum.

Army created stevedore units composed predominately of African Americans. At Bassens, the Army pioneered the installation of a gantry crane, which improved cargo efficiency; but it came with the risk of collapsing the wharfs. Gradually the Army relieved the overburdened French from much of the actual railroad operations. From the French, the United States adopted the idea of regulating stations, which were basically large marshalling yards where trains from the depots could be broken up and then reassembled by destination (typically by division).[9]

Inventory management developed from a combination of the Soldiers' previous business experience and new ideas. The SOS introduced "automatic supply" as a form of "push" distribution in modern parlance, where supplies were issued based upon troop strength rather than specific requisitions. The receiving Quartermasters only needed to note exceptions to the distribution schedule. Personnel at each depot conducted nightly inventories and telegraphed the balances on hand back to the SOS headquarters, where color-coded charts tracked the status of supplies. Thus, the Chief Quartermaster could understand the supply situation and adjust the automatic supply schedule.[10]

Prior to 1916, the Army relied upon horses and mules wherever the railroads could not reach. Then the expedition into Mexico demonstrated

the potential for motor vehicles, especially trucks to reach beyond the abilities of animals; but the Army lacked any concept about how to organize and employ trucks. Prompted by the pressures of war, the AEF developed a Motor Transport Corps as a subordinate organization to pool many of the trucks, standardize procedures and training, and create a maintenance program for motor vehicles.

The last task proved to be especially difficult because in the rush to acquire motor vehicles the AEF purchased 284 models, many of them European models. Management of repair parts became a nightmare. The Army attempted to alleviate the problem by creating a standardized Liberty Truck, but it arrived late in the war. The Motor Transport Corps unsuccessfully attempted to group different models so that repair facilities could service the fewest models feasible, and thus limit their repair parts problems. The Army could not implement that concept before the Armistice. Even though vehicle maintenance was abysmal, the lessons of standardized models and better repair parts management remained for the next war.[11]

Echeloned maintenance developed in World War I and lasted well into the Cold War. Vehicles needing repair first went to a service park, which corresponded to what later became direct support maintenance. Vehicles that could be repaired quickly were returned directly to the unit. Otherwise they went to an overhaul park, where they were taken apart and fully repaired before going back to the supply system instead of the unit, in a concept similar to later general support maintenance.

At that time the Ordnance Department was responsible for all facets of weapons systems, including repair of weapons. While in the United States, unit personnel could make simple repairs but anything else required evacuation to one of the arsenals. Once in Europe, ordnance officers responded to the need for in-theater maintenance through a combination of fixed and mobile operations, in ways that would last throughout the Cold War. They built a massive base shop in the Loire Valley and an advance shop closer to the front. Although incomplete at the end of the war, the base shop was capable of extensive overhaul. It employed over 1,000 Soldiers and 1,000 local civilians. Twenty-one other fixed facilities complemented the two large shops, including some specializing in aircraft weapons.

Despite the usefulness of these fixed facilities, the Ordnance Department required something more responsive to the fighting forces. The answer came with moveable maintenance shops operating out of trucks and tents. The Mobile Ordnance Repair Shop (MORS) serviced most weap-

ons, and the Heavy Artillery Mobile Ordnance Repair Shop (HAMORS) serviced the large weapons. In theory, one MORS was to be allocated per division, but not necessarily. Despite the challenges of creating an entirely new organization, the mobile maintenance concept endured. Many innovations developed in the pressure of combat endured throughout the 20th Century including limited stockage of repair parts, contact teams (on motorcycles), preventive maintenance (termed inspections), and limited operational float.[12]

Welfare of the Soldiers assumed an increasing importance as the war progressed; yet the Army lacked the institutional experience to care for the Soldiers. Procedures developed from a combination of adapting Allied procedures and ingenuity. For example, lice infestations transformed the absence of a viable laundry service into a medical problem for the Soldiers. In response, the United States adopted the French and British idea of lumbering mobile laundry machines. Although they arrived too late to be of service to the front-line Soldiers, the attempt to introduce laundry service provided a precedent for future conflicts.[13]

The Army needed to feed its Soldiers under extended combat conditions, and it responded accordingly. To prepare meals closer to the front, the Quartermaster Corps developed a rolling kitchen, which was essentially a cooking apparatus on wheels. To cover the final distance to the Soldiers, the Army first used simple milk pails; but upon observing the French practice, it created an insulated food container. When poison gas or the pressures of combat prevented normal meals, the Army used canned food. A soluble (instant) coffee heated by a canned and jellied alcohol served the Soldiers when roasted coffee was not available. Americans improved upon European water purification methods by mounting the equipment on trucks.[14]

In many respects, American standards for care of the dead exceeded the European nations. The story began in the Philippines when a chaplain named Charles C. Pierce pioneered new techniques for identification and care of the human remains. During World War I, Pierce was recalled to duty as a Quartermaster officer in charge of graves registration. Under his direction, the United States achieved an astonishingly high 97 percent identification rate for casualties. During the hostilities, casualties received only a temporary burial; but unlike other nations, American casualties were exhumed and returned home upon request of the family. The unpleasant work of handling partially decayed human remains was usually assigned to African American Soldiers.[15]

Personnel sustainment under the overall direction of the Adjutant General's Department expanded in many previously unforeseen ways. Perhaps the most important was the introduction of a systematic means of replacing casualties—both combat and non-combat. Prior to the war, new recruits were expected to receive most of their training and acculturation within their new units. That proved to be unfeasible as the intensity of combat increased. Initially the replacement process consisted of haphazardly stripping Soldiers from units in training for early designation as replacements. The problems were all too obvious as Soldiers entered combat before they ever fired a rifle (but they did know Army songs). Painfully, the Army created a network of replacement training centers in the United States and replacement depots in theater for movement of the Soldiers to their new units; but the system was just developing by November 1918. The model served the Army well in World War II; but in this war, replacement Soldiers payed a heavy price in blood for their lack of training.[16]

Other Adjutant General functions evolved with greater success. A new Central Records Office proved to be an efficient means of tracking all Soldiers, including casualty information. The confusion of two or more Soldiers with the same name led to the introduction of serial numbers. For the first time the US Mail became a military function, but only with limited success.

The Adjutant General's Department had responsibility for troop morale, but without the resources. Consequently, the Army (and Navy) turned to civilian organizations collectively termed the "welfare agencies." The Young Men's Christian Association (YMCA) was the most prominent, but other participants included the Salvation Army, the American Red Cross, the Knights of Columbus, the Jewish Welfare Board, and the American Library Association. Notably many these volunteers were young women serving in arduous conditions close to the front. The Salvation Army women became famous for serving doughnuts to the Soldiers. By World War II, Soldier morale was institutionalized under the Special Services Division of the Adjutant General's Department, but civilian volunteers continue to play an important role.[17]

Under General Pershing's direction, the Americans altered the paradigm for obtaining supplies and services from the local economy (host nation support in today's terminology). Previously each of the supply bureaus (Quartermaster, Ordnance, Engineers, Signal, Medical, Air Service, and Chemical Warfare) made all purchases independently. If two of the bureaus wanted the same product, they competed against each other, thus driving up the prices and raising concerns about inflation

among the French. A board appointed to study the matter recommended no action because of the legal independence granted to the bureaus. Not satisfied with the board's recommendations, Pershing applied his previous law school education and created a General Purchasing Board. He appointed his old friend Charles Dawes as the General Purchasing Agent. The Board reviewed all purchases to see where duplicate requirements might be consolidated to obtain the best price. As an added protection, the French government might exercise its right to requisition on behalf of the Americans in cases of excessive prices. To stay within the law, the bureaus executed the contracts.

The General Purchasing Board became such a success that Dawes suggested a similar concept at the coalition level. In response, the Allies created a Military Board of Allied Supply in the summer of 1918. Although late in arriving at the war, the Board proved to be an invaluable mechanism for coordinating the members' logistical requirements. During the critical battles ending the war, coordinated logistics enabled the armies from different nations to operate in close proximity.[18]

Local labor became an ever-increasing means of reducing the American footprint throughout the Services of Supply. The wartime shortage of men caused the Army to use French women in traditionally male roles,

Figure 1.2. Workers at the St. Pierre-De-Corps salvage depot repair winter underwear. After cleaning and mending, the used underwear returned to the supply system for reissue. Photo courtesy of the US Army Quartermaster Museum.

such as warehouse labor. French women performed the extremely important function of salvage (clothing and textile repair). Shortages of wool and shipping prevented the Army from replacing damaged uniforms, and the Soldiers tended to be rough on their clothing. Salvage became an entirely new line of operation, to keep the Soldiers suitably clothed.[19]

By August 1918, General Pershing achieved his ambition of an independent American Army, with its own sector along the front, and which would ensure a significant American voice at the peace conference. The rapid maturation of the sustainment capabilities was an essential part of accomplishing this objective and resisting amalgamation into British and French formations.

Soon the freshly organized American Army would be tested as never before during the climatic battles ending the war in autumn 1918. The United States had the responsibility for advancing through heavily fortified ground between the Meuse River and the Argonne Forrest to reach a vital railroad line. The hard-fought advance cost about 26,000 American lives, making it one of the costliest battles in American history.

Supplying the Meuse Argonne Offensive stretched the fledgling American logisticians beyond what they would have believed possible. The support structure was already understrength, especially for trucks and horses; the axis of advance lay perpendicular to the standard gauge railroad meaning that the distance from the railheads increased with every tactical success. The Americans had limited use of a narrow-gauge railroad, but the principal means of resupply lay through miserable, muddy roads. American inexperience caused them to place engineers who might have repaired roads in the rear of the columns, creating massive traffic jams. Constant rain threatened to reverse progress at road repairs.[20]

To compensate for the logistical personnel shortages, General Pershing pulled Soldiers from the ports and depots where they were preparing for the expected 1919 troop buildup, and he diverted some new infantry Soldiers to support work. Americans borrowed so many trucks from the French that even normally supportive French generals became exasperated. Despite the extraordinary efforts to move supplies forward, both men and horses suffered hunger and other privations until the battle ended with an unexpected German capitulation.[21]

After the armistice the SOS accepted another challenge, that of redeploying about two million Soldiers. The work began with cleaning and de-lousing the Soldiers. Then with the help of the welfare agencies, Soldiers were kept busy until they could go home. Near the ports the SOS

Figure 1.3. Both wagons and trucks struggled through the mud to move supplies during the Meuse Argonne offensive. Photo courtesy of the US Army Transportation Museum.

provided showers, laundry, more de-lousing, personnel actions, and payment.[22]

Without the exertions of the logistics and personnel specialists, the AEF could not have functioned as an autonomous Army. They were an essential part of the American role in World War I.

The absence of meaningful doctrine affected logistical and personnel activities throughout the war. The experience of these years shows that doctrine does more than describe tactics, techniques, and procedures. It lays out the tasks to be performed and allocates the resources for those tasks, including the optimal ratio of support to combat Soldiers. It also describes the proper lines of authority. The World War I community had none of those advantages. Throughout the war, the SOS constantly struggled to explain its requirements to the AEF headquarters, and the AEF faced an even greater challenge to explain the logisticians' needs to the War Department. Without tables of organization, new units were formed, reorganized, and disbanded, all without reaching and understanding about manning levels with the War Department. At one point, SOS leaders sim-

ply based their manpower requirements upon a guess of what might be approved in Washington. Another serious problem developed when the Secretary of War seriously considered creating a separate logistical command that would be in a coordinating capacity to the AEF commander, but reporting to the War Department. Pershing's vehement objections to that idea established the precedent that an overseas commander controls the logistics within his/her theater.

Yet in some respects, the lack of established precedents enabled the Army to experiment with new ways of supporting the force during a large-scale conflict. World War I proved to be an extraordinarily fertile time for American logisticians and personnel specialists. All the innovations discussed in this essay, plus many others, lasted well into the Cold War era or beyond.

In his memoirs, General Pershing identified one more explanation for the successful support to the AEF. The supporting Soldiers from the ports to the front made extraordinary efforts to overcome seemingly insurmountable obstacles every day. "It was this spirit of determination animating every member of the A.E.F. that made it impossible for the enemy to maintain the struggle until 1919."[23]

Through their efforts, the Soldiers of World War I left precedents and lessons to help future generations avoid the confusion of this war. The opening of the Army Industrial College in 1924 signified an interest in preserving the sustainment lessons of the war. Today this is the Dwight D. Eisenhower School for National Security and Resource Strategy (previously the Industrial College of the Armed Forces). When the United States Army initiated mobilization in anticipation of World War II, the leaders had a better understanding of the sustainment challenges ahead of them. They knew what types of units and functions would be required, and they had a fair idea of the best solutions to the problems. Experience with the railroads and motor vehicles led to the creation of a separate Transportation Corps in 1942. The introduction of a standardized 2½-ton cargo truck (aka the deuce and a half) avoided the repair parts disaster of multiple models and added new depth to maneuver warfare.[24]

In short, members of the World War I sustainment community provided the means for the AEF to function independently and they provided the intellectual legacy for future conflicts. Their example reminds us of the importance of gritty determination in overcoming unexpected obstacles.

Notes

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Chapter 2
Medical Support for the Meuse-Argonne

W. Sanders Marble

In World War I, the Army Medical Department (AMEDD) focused on the group rather than the individual patient. Certainly every patient treated for sickness, injury, or wounds was an individual, but the priority was the Army, not the soldier. Medical capabilities of the time led to an emphasis on prevention over cure, which also worked with the Army's goal of having troops on duty rather than in hospitals. The Industrial Age may also have contributed to a mindset of patients as cogs and the Army as the primary focus. Further, it was a period of paternalism in the doctor-patient relationship, and doctors decided what was best for the patient.

In the Army, doctors tried to keep soldiers healthy, promptly evacuate them from their unit if they were unfit for duty so the unit could focus on the mission, and return to duty (RTD) as many as possible and as soon as possible.

The Meuse-Argonne Offensive

General John Pershing had long focused on the Meuse-Argonne as a sector for an American offensive.[1] Critical German rail junctions were close to the far side of the Argonne forest. If Pershing's American Expeditionary Forces (AEF) could fight through 30 miles of rough ground, they could have a decisive impact on the Western Front. Around 600,000 Americans moved into the sector in only two weeks, a marvel of staff work as the rural area had a very limited road network. Many of the combat divisions were inexperienced, and when the offensive began on 26 September 1918, progress was limited. The Germans had multiple belts of fortifications and higher ground, plus flanking artillery fire. The few roads were over-taxed trying to support the enormous American force. Inexperienced divisions took heavy casualties, but pressure for progress led to repeated attacks against the same objectives. For weeks, the Americans ground forward, struggling against the terrain and the autumn rains while fighting the Germans. Divisions were down to 25 percent of authorized infantry strength before they were rotated out. Sickness (the 1918–19 influenza pandemic overlapped the fighting) and casualties both sapped frontline strength, while marching divisions in and out further sapped momentum. Nevertheless, American forces battered ahead as German resistance all along the Western Front was waning. A final push on 1 November 1918 cracked German resistance, and from then until 11

November 1918 the Americans pursued the Germans as fast as weather, terrain, and supplies allowed.

Medical Support Plans

Medical plans, like all Meuse-Argonne planning, had to be rushed. The Chief Surgeon of First Army had a staff of 32, few enough for an army of over a million men, and much of the medical planning was done by HQ AEF and only implemented by the First Army.[2] Unsurprisingly, there were urgent conferences late in the process to settle details; one key conference to settle hospitalization details was on 24 September 1918, with only one day to make final adjustments before the attack started.[3] Medical planners also had to work amid a strong emphasis on secrecy. For instance, the III Corps surgeon was given a map marked "Secret" that he alone could use, while arriving medical units had to bivouac without tents in wooded areas until the night of 25–26 September 1918 when they could erect their tents.[4] It helped that a number of French hospitals had been built during the years of trench warfare.

Fundamentally, the medical plan worked backward from a casualty estimate; the medical staff organized their finite resources to meet the estimated needs.[5] The AEF was short of hospitals, fixed and mobile alike, and the First Army had only 18,000 hospital beds for its million-plus men.[6] Some hospitals (for patients who were not bleeding) could be extemporized: five gas hospitals were pieced together from assorted personnel; I Corps created a rest camp that would handle tired men and the 7–10 days sick.[7]A psychiatric hospital would also hold "shell shock" patients 10–14 days before evacuating them to a specialty hospital.[8] Hospitals were pulled in from quieter sectors, and all hospitals that landed in France were sent to the Meuse-Argonne. Hospitals were also expanded, getting some extra personnel but also simply told to work harder; mobile hospitals that nominally had 120 beds were operating 250, and evacuation hospitals staffed for 432 beds might operate as many as 1,200.[9] The terrain limited both the road network and good hospital sites. Many hospitals were not on main roads or rail lines, and in the lightly populated region even "main roads" might only have one lane. All this meant extra delays in getting patients back to hospitals and then from the hospital to a railhead. In line with the plans for a rapid breakthrough, hospitals were as far forward as possible: evacuation hospitals were only 5 to 12 kilometers from division triage points on 26 September 1918, and mobile hospitals could be even closer to the triage points.[10]

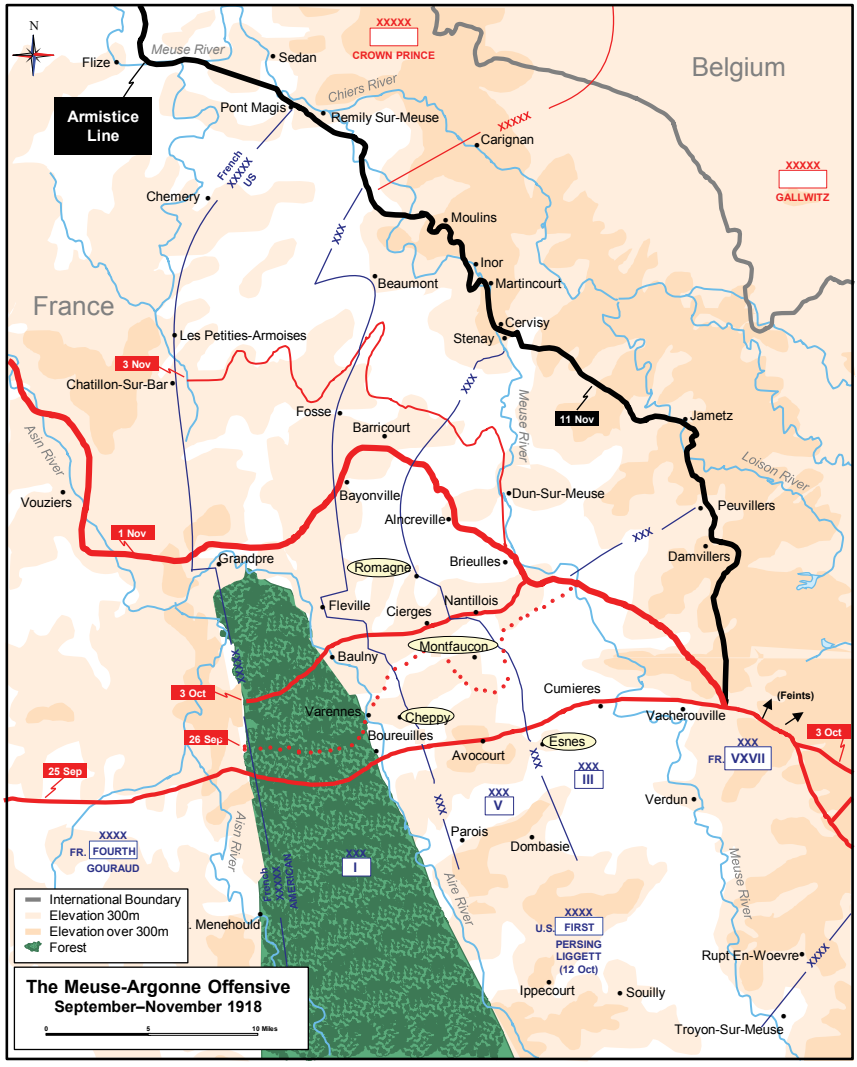

Figure 2.1. The Meuse-Argonne sector, showing the limited road network to support operations. Map created by Army University Press.

There was little that could be done about the shortage of roads, but plans were promulgated for efficient traffic management, using returning trucks as auxiliary ambulances, and using both light and normal railways.[11] Motor transport was only useful if traffic was moving at all, while the specially built evacuation cars for the light railway had too high a center of gravity, derailed too often, and were soon taken out of use.[12] The AEF had bought 19 hospital trains from the British and nine from the French (plus renting two more) and for the Meuse-Argonne borrowed a further 45, some

little more than passenger cars with racks for litters.[13] Wheeled ambulances were in short supply; no division had its full complement of ambulances (some had 25 percent or less) although the situation got better closer to 26 September 1918. [14] For instance, on 20 September 1918 the First Army had 93 ambulances, while on the 26th it had 400 ambulances, and 60 trucks and 30 buses fitted for sitting patients—progress, but still a shortage of 350 vehicles.[15] Ambulance units were assigned forward to divisions and corps; First Army assigned each corps 4 to 5 ambulance companies and 10 buses, holding back only 7 ambulance companies and 30 trucks. This would at least evacuate patients to the first-echelon hospitals.[16] At least one division was simply warned there would be little ambulance support available on the 26th; ammunition trucks would have right-of-way.[17]

The medical staff relied on reports from subordinate units; centralized control was expected to increase efficiency. For instance, trucks of medical units were pooled under Army control, and ambulances could be directed to hospitals with empty beds, while hospital trains and medical teams could be sent where required. However, central control depended on communications. The headquarters typically had reliable telephone service (but no wireless telegraphy) but subordinate units often did not, and couriers could take hours to get to their destinations.[18]

Much had been done in the little time available, but even the official history would acknowledge that the Medical Department went into the Meuse-Argonne with "critical shortages in equipment, personnel, hospitalization, and ambulances."[19]

The Medical Support Structure

A brief overview of medical units aids in understanding the operations. The infantry regiment's medical detachment, 55 personnel including seven doctors, was the farthest forward on the battlefield.[20] These men were typically attached from the regiment to the battalions, and infantry companies usually had two "dressers" or aid men (the term medic was not yet common) to provide first aid, which mainly amounted to stopping bleeding and splinting fractures. Ordinary infantrymen got little, if any, first aid training.

Ambulance companies provided the next stage of care. Divisions had four ambulance companies. Due to animal shortages, typically three were motorized and one animal-drawn.[21] They had two other sections. One was litter bearers, to collect wounded from battalion aid stations close behind the front line. A second section was a dressing station with several physicians. The actual ambulances took the wounded back to a field hospital.

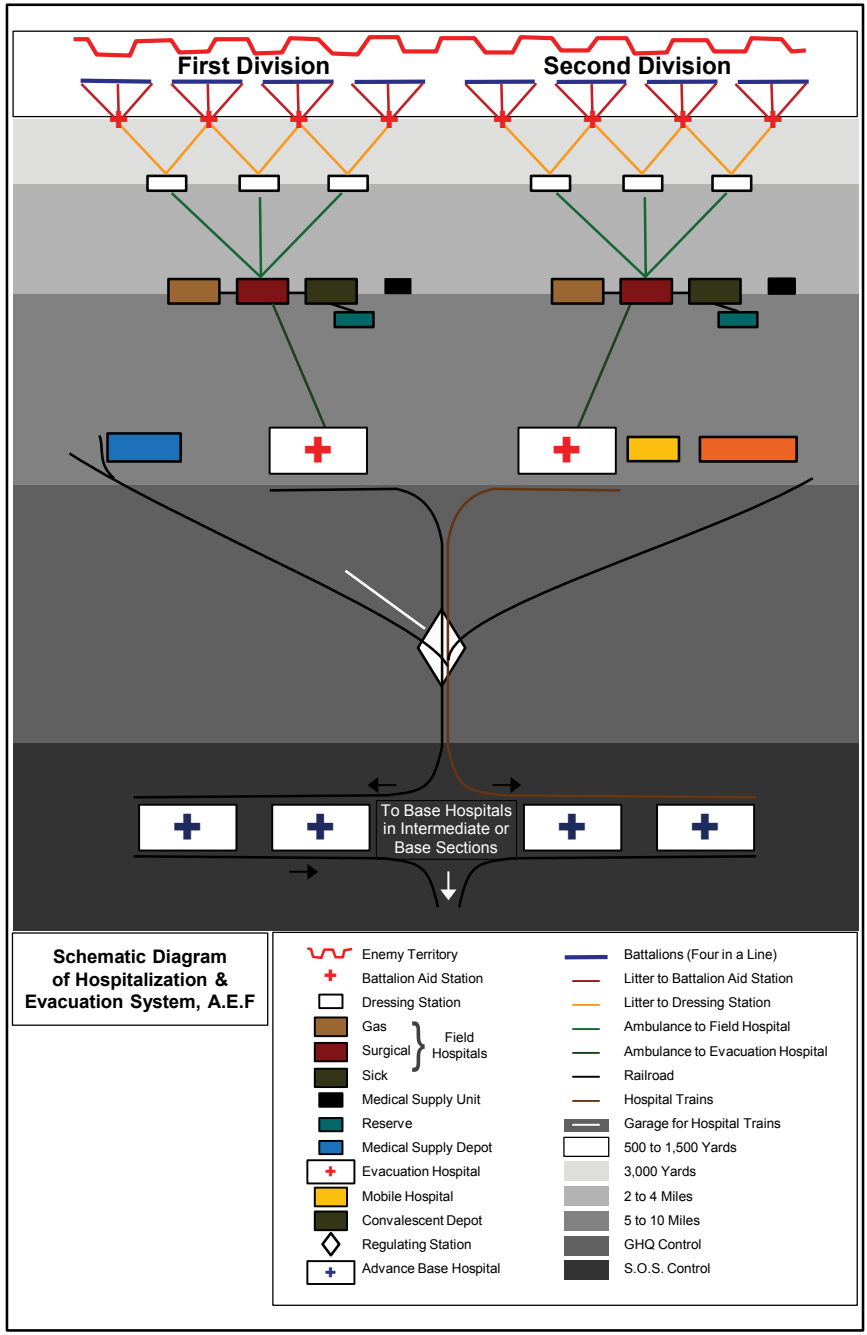

Figure 2.2. The Army had a linear evacuation and treatment system. Graphic courtesy of the Army Medical Department Center of History and Heritage.

Divisions had four lightly equipped field hospitals. Each had 89 personnel (but no nurses) and equipment that fit onto 12 3-ton trucks. Field hospitals could operate their 216 beds under canvas or in buildings, but were not equipped for acute patients—for instance, they lacked X-ray equipment. At the triage point, patients were sorted: lightly wounded, seriously wounded (sometimes further differentiated into transportable and non-transportable), gassed, psychiatric, and sick. Divisions typically assigned a field hospital each for the sick, the gassed, and the lightly wounded, and moved personnel among the hospitals to reinforce the hospital doing surgery.[22] The divisional sanitary train of four field hospitals and four ambulance companies was authorized a total of 891 medical personnel, including physicians, dentists, veterinarians, and medical enlisted men, but they were often below strength. Each corps was supposed to have another sanitary train, but few actually did in late 1918.

Two other types of hospital were deployed forward. Mobile Hospitals were deployed as far forward as possible to take the non-transportable wounded; these were the functional forerunners of the mobile army surgical hospital (MASH). With a dozen doctors and 22 nurses for only 120 beds, they might be close to the division triage or farther to the rear if one mobile hospital was supporting more than one division. Evacuation hospitals were intended to handle most of the wounded. On paper they had 195 personnel (including 13 surgeons but no nurses) for 432 beds.[23] The Army had prioritized combat units and replacements ahead of hospitals so the AEF was short of hospitals. When possible, evacuation hospitals were located near railroads to evacuate patients and send supplies forward more easily. These units were all in the Zone of the Armies.

From mobile and evacuation hospitals, the serious patients were evacuated back to base hospitals in the rear areas under the Services of Supply (theater rear). Evacuation ambulance companies each had 12 motor ambulances but lacked the litter-bearer and dressing station sections of other ambulance companies.[24] Due to the shipping bottleneck for the Meuse-Argonne, the AEF retrieved some sections of the American Ambulance Service (AAS) from the French. The AAS was a wartime organization, created from the American civilian volunteers who had gone to France (and Italy, *á la* Hemingway) to help before the war. After American belligerence, they became part of the US Army.[25] Hospital trains, more accurately ambulance trains, could move large quantities of wounded to rear areas rapidly.

Base hospitals were supposed to have 500 beds, but most were assigned extra personnel and operated well beyond the intended limit. Base

hospitals also kept patients the longest, including convalescents and starting rehabilitation for amputees.

While the number of medical units was limited, extra personnel arrived and various teams were extemporized. For example, surgical teams were pushed from base hospitals to forward areas; X-ray teams were created and equipped with mobile X-ray machines and generators to augment field hospitals and provide reasonable surgical capabilities. Nurses (all Army nurses were female at the time) were assigned to mobile and evacuation hospitals and to the surgical teams at the field hospitals, breaking ground for females in the military.[26]

The First Phase of the Battle, 26 September–3 October 1918

The battle opened on 26 September 1918 with immediate problems. Fundamentally, the number of casualties exceeded projections; they certainly exceeded the number that could be handled.[27] While the number of casualties is imprecise, reports of 13,500 casualties from just three divisions show the inadequacy of First Army's 18,000 hospital beds.[28] Problems started right at the front with first aid and litter evacuation, continued through ambulance evacuation to the hospitals, and included care in hospitals.

At the front, the 55 men assigned per infantry regiment were simply not enough to provide first aid and haul the wounded back by litter.[29] III Corps had a shortage of litter-bearers, and V Corps previously refused to allow infantrymen to be trained to give first aid or carry litters.[30] Medical personnel were casualties; aid-men and litter-bearers were delayed getting to casualties by the intensity of the fighting; and the Germans' harassing fire impeded evacuation. In some places, litter-bearers had long carries (for example, 3.5 miles under harassing fire) because ambulances and dressing stations could not move forward cross-country.[31] The belts of barbed wire had to be cleared and the roads repaired after four years of trench warfare before most vehicles could move forward, although animal-drawn ambulances had better cross-country mobility than the narrow-tired motor vehicles of the period. (It took 30 hours to push even rudimentary roads across No-Man's-Land in the 35th Division sector.)[32] Wounded might spend many hours getting to a dressing station or triage point; the 28th Division triage did not get patients until 1745 on the 27th, more than 36 hours after the start of the battle.[33] In some cases dressing stations pulled back due to heavy German shelling, not deliberately targeting medical facilities but the reasonable shelling of transport routes.[34]

Some military decisions made medical work harder. The 79th Division waited eight hours on the 26th for permission to start its ambulances

forward, while the 37th Division gave artillery and ammunition vehicles priority.[35] Problems could ripple throughout the medical system. Because the 37th Division lacked ambulances, its battalion and regimental medical personnel had to stay with the casualties and could not advance with the troops. When the division ran into stiffer resistance on the 27th, there were few medical personnel for first aid.[36]

Wounded accumulated at dressing stations and triage stations; the 35th Division's dressing station at Charpentry had 514 patients in the open in addition to those in buildings and dugouts, while the Cheppy dressing station had more than 1,000 patients in buildings, tents, dugouts, and in three rows along the road.[37] The forward units overflowed from a crisis in the evacuation system. The roads were simply overloaded as the entire First Army tried to move forward. V Corps had no good front-to-back road and had to use roads that headed diagonally into its neighbors' sectors, adding to the jams.[38] The Germans had blown huge craters (100 feet across and 40 to 50 feet deep) in the key road on the American left that took days to fill or even build a bypass.[39] Heavy rain began on the 27th, eroding the unpaved roads and further complicating cross-country movement. In the circumstances, drivers did not (and often could not) obey orders to keep the roads clear.[40] The dispersion of hospitals added to the confusion as drivers sought multiple locations.[41]

All these factors added up to lengthy evacuation times. It might take 24 hours to go 5 miles or 23 hours to accomplish a trip that normally took 20 minutes.[42] One corps surgeon found it faster to walk, leaving his staff car in a traffic jam, then finding it had only advanced 100 yards in four hours.[43] It could be 50 to 60 hours before patients got to an operating room.[44] Mobile Hospital 1, which was 12 kilometers from the front, reported "The condition of the wounded received . . . was deplorable. Some wounds had not been dressed . . . some [patients] were exposed on the field for two or three days before arrival."[45]

With the number of casualties exceeding hospital capabilities, "pre-operative" hospital trains were the extemporized solution. The lightly wounded would be moved quickly back to rear hospitals, hoping that their wounds did not worsen. A calculated risk, the pre-operative trains took 11,370 patients to base hospitals.[46] However, the delays in getting patients back to a train, poor triage, and delays on the railways led to problems: "many battle casualties did not reach the [hospital] center for four or five days after receiving their wounds. A fair proportion had not been operated upon, and severe infections were present."[47] In an era without antibiotics

Figure 2.3. With roads in Esnes congested, no aspect of sustainment could function well. Photo courtesy of the National Archives.

or even sulfas, antiseptic surgery was the best antibiotic treatment, and delaying surgery was a serious clinical problem.

Some potential problems did not develop in the first phase. Disease was apparently only a problem in the 79th Division, which had both a severe diarrhea epidemic (4,800 men reported sick and 700 were evacuated) and an early influenza outbreak.[48] Despite ambulances being the standard way to transport medical supplies forward, there were no major shortages of supplies.[49]

The Second Phase of the Battle, 4–31 October 1918

The second phase was bloodier than the first although far longer. The medical system worked under constant pressure, both from battle casualties and disease. Judging from a dwindling number of comments in reports, evacuation was somewhat better although periodically serious delays developed.

Little could be done to make anything better at the front lines. Often the fighting was heavy enough that the wounded could not be evacuated until after nightfall, and German shelling sometimes forced medical units to move.[50] When they could, litter-bearers often had a long carry (4 to 6 kilometers) that could be through deep mud (2 feet deep was noted in one report), and some units ran out of litter-bearers, pressing a mix of bands-

men, German prisoners, and volunteers from line units into service.[51] Aidmen also wore out, and at least one division rotated them at 24- to 48-hour intervals.[52] Rotating divisions for fresh combat power probably reduced psychological/exhaustion casualties. Certainly men had a breaking point: the 3rd Division noted that during its last few days in the line, many more men reported to the doctors for exhaustion.[53] (Period reports used both fatigue and exhaustion as terms, without a clear distinction. Exhaustion may have been a mild psychological diagnosis.) When 91st Division left the line after 19 days, the surgeon reported "none of the men were fit for duty owing to dysentery, fatigue, and stomach trouble."[54] As the AEF battered its way forward, evacuation distances (and times) rose again, and at times field hospitals were inserted forward of the triage station as a place for the wounded to rest and recover a bit; these did no surgery but provided fresh dressings, treatment for shock, and hot food and drinks.[55]

Sickness rose. Dysentery cases had shot up from 516 in August 1918 to 1,166 in September, but further to 1,728 in October, still a small percentage in an enormous First Army.[56] This, and diarrhea, mostly stemmed from water supply problems; troops in trenches and shellholes had few ways to get clean water and had to drink whatever was available.[57] (The First Army surgeon later commented on the difficulties of sanitation in the front lines, and admitted medical officers limited themselves to what was possible rather than arguing for an impossible ideal.) At least First Army provided more labor troops to bury corpses, both human and animal.[58]

The largest disease problem was the pandemic influenza. A wave of cases in the summer had abated until the third week of September, when there was a raging outbreak—3.5 times as many cases in September 1918 as in all of August, and it raged in October with three times as many cases as in September.[59] The flu was most severe among tired, wet, cold, and under-fed troops, precisely the conditions that prevailed in the Meuse-Argonne. The flu killed some, but 5 to 10 percent of flu patients also caught a virulent pneumonia with fatality rates up to 50 percent, sometimes within a day. There are no reliable numbers for how many were infected; the AEF only counted men who were hospitalized, so those who were told to return to duty, or who snuck into a dugout to get some sleep and died of hypothermia are uncounted. This underreporting probably made commanders over-optimistic about how strong their units were and what they could accomplish.[60] One division noted, "Everyone had bronchitis and nearly everyone had gastroenteritis and diarrhea. Only those who were absolutely unable to go forward were sent to the hospital."[61] Sickness probably caused part of the straggling problem as well, as men headed back to get

medical assistance, or at least a hot meal and sleep out of the elements. Most reinforcements were already exposed to influenza, and up to 40 percent were already sick.[62] Yet the First Army had a lower mortality rate for its flu patients than the rear areas, something attributed at the time to living outdoors with less sharing of germs.[63] However, this may be a statistical anomaly, based on different counting methods in the different areas. Of course, the medical personnel were not immune, and their sickness reduced the system's ability to cope with other patients. The influenza "so clogged the medical services and the evacuation system [and] rendered 'ineffective' so many men in the armies that it threatened to disrupt the war," and while it "did not stop military operations, it slowed them perceptibly."[64] By 1 November 1918, around 180,000 men (more than 9 percent of the AEF) was on sick report—and that did not count the men who were sick but told to stay on duty.[65]

Operations did not stop, although the number of evacuations from First Army rose. The week of 17–23 October 1918 saw 29,426 men evacuated (and an unknown number of sick in the field hospitals), a figure the AEF noted amounted to more than a month's evacuations from the Battle of Verdun in 1916. For the month of October 1918, the First Army evacuated some 110,000 patients.[66] Despite this, the attacks continued; the AEF's priority was not to take care of patients, or avoid sickness, but to win a war.

There were no more medical reinforcements, beyond the personnel of four evacuation hospitals.[67] For most hospitals, staying put made sense because they could use the railways to evacuate, while closer to the front lines they would fill up and cease being useful. Better management practices could help some; for instance making sure that ambulances were loaded with one class of patients (seriously wounded, gassed, etc.) so they could all be unloaded at one hospital rather than having to make multiple stops.[68] Headquarters demanded more reports from hospitals (every four hours from evacuation hospitals, not just once or twice a day), which in turn allowed better use of hospital trains. Initially the First Army had expected only to use a "pull" system, having requests pull hospital trains forward, but the number of patients showed a need to "push" trains up and supplement that with additional trains as needed.[69] Trains were kept moving so much that maintenance suffered.[70]

First Army medical staff also addressed problems. Pre-operative trains had been a problem in the first phase; the issue was tackled various ways. Triage guidelines were reinforced. Operating teams were told to discard their civilian standards and move more patients, not to take an hour to sew up a minor wound. Minor wounds were a special focus, with special

operating teams assigned, X-ray teams dedicated to work with the minor surgery teams, and operating rooms set aside.[71] There were only 293 pre-operative patients evacuated back to the base hospitals in the second phase of the battle.[72] In a similar vein, III Corps issued orders to limit forward surgery; patients often needed lengthy recovery periods to be transportable, and it was better to keep space in the field hospitals and move patients back to evacuation hospitals.[73] One experiment was stopped: neurosurgeons had been concentrated at one hospital, on the basis that it was safer to move neurosurgical patients before surgery than after. However, the transportation problems meant long delays getting the patients to that hospital and as the battle continued, the decision was reversed and neurosurgical teams were pushed to evacuation hospitals.[74]

The number of patients evacuated caused a crisis in the base hospitals. With every non-emergency bed full, the AEF was well into its cushion of emergency beds in October 1918.[75] (Emergency wards had fewer staff per ward and were used for lower-acuity patients.) On 19 October, Pershing ordered "immediate steps be taken to remedy the critical situation . . . a hospitalization program, more comprehensive in scope and sufficient for our future needs, be inaugurated with the least practicable delay."[76] He called for 100,000 more beds as soon as possible, and 600,000 total by 1 July 1919. While he used beds as the metric, they needed equipment and personnel. The real bottleneck was personnel, and Pershing blamed the War Department for not shipping medical personnel and equipment. The next day some temporary patches were suggested: top travel priority for the medical units that did arrive, and more labor to build and run hospitals. First Army made some adjustments that helped, creating convalescent hospitals so patients would not be sent back to the base hospitals (and incidentally would return to duty sooner) and encouraging divisions to use a field hospital to care for sick and exhausted men.[77]

Two developments in October 1918 had relatively modest effects. Second Army was formed, which took some responsibility off the First Army staff. The Meuse-Argonne operations expanded, however, to the east bank of the Meuse, although this had little effect on medical arrangements; the only medical units sent were the field hospitals and ambulance companies of the divisions engaged.[78]

The Third Phase of the Battle, 1–11 November 1918

In late October 1918, First Army prepared for what proved to be the last assault; for the Medical Department three hospitals moved forward. After a day or two of intense fighting, the German lines quickly cracked

and casualty numbers dropped: "the advance [was] more of the nature of a rapid and difficult march than of an attack."[79] The 78th Division even told its ambulance companies to go as far forward as they could and establish dressing stations where they had to stop.[80] However, since there were still many wounded in the hospitals from October's battles, the number transported back to base hospitals per day was roughly the same as in October.[81]

With the front lines moving quickly, the tactical problem became transporting wounded from the battlefield to the battalion aid stations; infantry were moving faster than the few litterbearers could cope with. The 81st Division had the happy situation of operating in misty weather, so ambulances could drive straight up to battalion aid stations.[82] The 2nd Division experimented with closing hemopneumothorax through stitching them up—even as far forward as battalion aid stations—rather than bandaging them forward with surgery at the field hospitals.[83]

The lines of evacuation lengthened (to 90 to 100 kilometers in some cases), but the limited fighting meant much less damage to the roads, so evacuation stayed within the eight-hour goal.[84] With the shortages of ambulances, the high tempo of operations led to ever more breakdowns, and some were simply wearing out. Spare parts were a problem, and some units had parts robbed from their vehicles by neighboring units.[85] Animal-drawn ambulances proved useful near the front lines but not on long evacuation routes, and at least some such units were put to mending roads.[86]

Some hospitals moved forward (two mobile hospitals and three evacuation hospitals between 3 and 10 November 1918), but there were not enough trucks to move more. Instead, key elements (the X-ray and operating room equipment) were loaded on trucks and sent forward to reinforce divisional field hospitals.[87] III Corps went further, having each division organize shock teams from its own personnel and pushing surgical teams forward to operate at the field hospitals.[88] Experience, and the limited number of hospital moves, meant that getting patients to the right hospital was less of a problem than before.[89] Divisional hospitals moved far more often, 5th Division's triage moving three times in five days, and its dressing stations moving daily.[90]

Rates of battle casualties and sickness both declined. While there was more water chlorination, dysentery rates only dropped moderately.[91] The influenza rate for November 1918 was half that for October (although still around 1 percent per year) and the pneumonia rate had dropped 65 percent, still only counting admissions.[92] Corps tried various things to reduce the number of evacuations and keep men closer to their units. I Corps es-

tablished a corps-level rest camp for the exhausted and lightly sick, while V Corps had each division dedicate a field hospital to the sick.[93]

Patients still accumulated in rear area hospitals.[94] Few were being discharged yet (either healed for RTD or recovering enough for the hospital ship journey back to the United States), but they were improved enough to move from normal beds to emergency beds or to convalescent camps. The hospital construction program had also started to have results.

The Results

When the Armistice brought the fighting to an end, the Meuse-Argonne had cost the AEF some 18,000 killed; 70,000 wounded; 19,000 gassed; 2,000 shell-shocked; and 69,000 sick. Additionally, 3,500 of the wounded died in hospital, which represented about 5 percent of the wounded.[95] Hospital-by-hospital statistics show little; various mobile hospitals had post-operative death rates of 6.7 to 41.7 percent, while evacuation hospitals varied from 3 to 15 percent.[96] Survival depended largely on the patients' conditions when they arrived. There was no right answer on where to do surgery, and nobody could be sure what the evacuation conditions would be.[97] If evacuation was possible, that was the best thing; mobile and evacuation hospitals had generally better surgical teams and certainly had better facilities for recuperation. However, a long pre-operative delay was worse than sub-optimal surgery.

Disease was not expected to be a problem, yet the influenza pandemic became an enormous challenge. Compared to the pandemic, all other diseases presented comparatively little trouble. While sanitation in the midst of battle could not be perfect, the supply problems and inexperience of the troops caused some extra cases of disease. About half the AEF's trench foot cases happened in the Meuse-Argonne, as troops could not dry their socks and boots in the wet, cold conditions.[98] However, influenza definitely was a case of disease affecting military operations. Already shorthanded because of shipping priorities, the Medical Department had to deal with massive numbers of patients. Given the medical capabilities of the time, only palliative care was possible for the flu and pneumonia. In short, doctors were next to useless in these cases: rest, warmth, food, and liquids helped patients.

The AMEDD had problems coping during the Meuse-Argonne battle. Previous battles had not been challenging enough to suggest the likely problems, and the rush did not allow thorough planning for contingencies. Units, personnel, and equipment were in short supply, and the terrain caused problems for all sustainment functions. On the other hand, the

French provided important support to their coalition partner. Casualty care got better during the battle through painful and costly experience. Medical care was limited by the abilities of the time. The war may have brought about the pandemic, but the Army leadership's decision to override medical advice meant higher morbidity.[99] Men were crammed into barracks and troopships tighter than the doctors wanted, and fighting in bad weather weakened individual resistance; those decisions caused more men to get sick and die from disease but put more troops in the battle lines to fight and win the war sooner. With a war to be won, there was little question whether the Army would take risks to win quickly, or take military risks to avoid medical ones. Despite valiant efforts and hard work, more than 200,000 wounded and sick (including from the influenza pandemic) almost overwhelmed the medical system. Only the Armistice relieved the pressure.

Preventive Medicine

With few therapeutic medicines, an ounce of prevention was truly worth a pound of cure. The AMEDD tried many things to keep soldiers healthy to train and fight. This started with unglamorous things such as physical standards to start with healthy soldiers, and continued with vaccinations (smallpox and typhoid were the only two available) to prevent disease where possible. Quarters were inspected for cleanliness, and troops were supposed to have enough space to reduce chances of communicable diseases, such as measles and mumps, that were still prevalent. Sanitation was such a high priority that a Sanitary Corps was organized, to bring expertise from bacteriologists, epidemiologists, sanitary engineers, and other non-physician health professionals into the Army. Problems with water supplies and food had led to tremendous disease problems in the Spanish-American War (1898), and the AMEDD had invested heavily in both garrison and campaign water-supply efforts. Lyster bags had been invented by Lieutenant Colonel William Lyster, and the AMEDD organized mobile laboratories to test water sources in the field.

At the front, there were severe limits on preventive medicine, beyond such well-understood things as having troops use latrines. While the Corps of Engineers was supposed to provide clean water, distribution problems meant soldiers drank what water they could get, and gastro-intestinal disease rates rose concomitantly. Dysentery and diarrhea mostly stemmed from water supply problems. Trenches were inherently unsanitary, and advancing from them into foxholes and shell-shattered villages was no better. Unit surgeons, taught preventive medicine at the Medical Officer Training Camps and/or the Army Sanitary School, did the best they could.

Evacuation and Regulating

Taking medically ineffective personnel from their unit allows a unit to focus on its mission; making as much of that process external allows the unit to focus its resources (personnel and time) on going forward. That started in World War I with aid men and litter-bearers. Linear evacuation was the rule since there were no helicopters to skip echelons through the vertical dimension.

Evacuating patients was a significant problem in the Meuse-Argonne. After the strenuous litter carry, often under fire, just to get a patient back to the Battalion Aid Station, and another litter carry to reach an ambulance company's dressing station, the roads were frequently clogged. Unsurprisingly, sometimes patients would be 50 to 60 hours before getting to an operating room.

The term "regulating" was introduced in World War I, coming from railroad operations terminology. With linear evacuation within a division, and a limited number of hospitals supporting a corps, typically it was not until patients were evacuated from the Zone of the Armies to the Services of Supply that they could be directed to a hospital with specialized capabilities. Even then, it was far more sensible to have multiple hospitals in "hospital centers." The hospitals could specialize and a trainload of wounded could go to a single hospital center rather than a train steaming around France dropping off a few wounded at various specialized hospitals.

Treatment

The AMEDD organized treatment in phases so that medical units could be as light as possible, enhancing mobility. Aid men had a belt with bandages, field medical tags, and (depending whether their battalion surgeon trusted them) potentially one tourniquet.[100] The battalion aid station had a few medical chests that could fit onto a one-horse cart, and the ambulance company's dressing station had roughly the same equipment although more transportation. Field Hospitals were little more than minimal-care units, lacking X-ray machines in the search for mobility. The AEF recognized the serious problems for patient care and took many steps to improve the quality of care forward. Mobile Hospitals, the conceptual forerunner of the MASH, were organized from scratch, copying French units. Auxiliary Surgical Units were organized, really a portable X-ray machine with a generator, a mechanic, and a hastily trained radiologist, to augment field hospitals. Surgical teams were rotated forward from the base hospitals to increase the quantity and quality of care in forward hospitals. The forward hospitals would try to hold a patient no more than 10

days. Most patients who would RTD would be ready sooner, and much of the 10 days was post-operative time. Since en-route care on hospital trains was less extensive than today's care—and hospital trains were a rougher ride than helicopters and jets—patients needed more post-operative time to be ready to travel.

Gas hospitals were necessary for both specialized care and to avoid clogging the main triage/surgical hospital in each division.[101] Care was relatively limited. Mustard gas burns were cleaned, and oxygen supplementation was provided for men suffering from inhalation agents. Gas hospitals also promoted RTD through two other routes. Some men came in with what was termed "gas fright."[102] Because soldiers had been trained on how lethal gas worked, some men panicked at smelling something unusual. These men were not actually gassed, and could be returned to their unit. Malingerers would also report being gassed since there were no outward signs from inhalation agents. These patients could be observed for a few days and many would be RTD.

Neuropsychiatric hospitals were also a key factor in RTD. In the prolonged offensive, many soldiers grew tired and discouraged. They would report to the Battalion Aid Station and be evacuated. Optimally, their field medical tag would read NYDN for "Not Yet Diagnosed, Nervous" to avoid a diagnosis that would further discourage them and encourage further evacuation. Instead, the AEF applied what they had learned from the British and used PIE treatment—proximity, immediacy, and expectancy—or "three hots and a cot." With rest, food, dry clothes, and reassurance that they were not breaking down, 60 percent of NYDN patients could be RTD in a few days. Divisions were supposed to have a trained neuropsychiatrist (the medical specialties of neurology and psychiatry had not yet separated) to help screen NYDN patients and only send those with true psychiatric problems to the rear, where the AEF had specialized neuropsychiatric hospitals. As the battle continued, some convalescent hospitals were extemporized so patients would not be sent back to the base hospitals (and incidentally would return to duty sooner), and divisions were advised to use a field hospital to care for sick and exhausted men.[103]

Veterinary Support

Veterinarians had a dual role. Their food inspections were important for human health, but animal care was vital to Army mobility in the period. The AEF was short of both horses and mules, and needed to keep available animals healthy. However, the Veterinary Corps was a very new organization (created 3 June 1916) that lacked rank and clout; the senior veter-

inarian at an army headquarters was just a major, against a full colonel or brigadier general for medical doctors. For administrative convenience, the veterinary service was subordinated to the Remount Service until 29 August 1918, which meant no priority for forward veterinary hospitals. One corps in the Meuse-Argonne did not even have a veterinary hospital. It also reduced preventive care. The veterinary service had too few units and personnel, often getting brushed off with bland assurances that plenty of soldiers knew how to take care of horses.

There were many problems for veterinary support of the Meuse-Argonne.[104] The few available animals had been worn out just moving to the Meuse-Argonne. With too few animals available to rest the sick and tired, they were increasingly worked to death; weak or sick animals were better than nothing.[105] When sick animals were turned in, the First Army staff denied them travel by railway, so they had to be walked (or driven, if trucks were available) to a hospital. A forward hospital was established when the front lines leapt forward in early November 1918, but lacked the space to make a substantial difference.[106] More than 3,300 animals died or were destroyed in under a year—the death rate over October to December was an annualized 28.2 percent, while another 11.3 percent were otherwise disposed of.[107] A telegram from AEF G-4 summarized: "Animal situation 1st Army has passed from the serious to the pitiful."[108]

AMEDD Lessons from World War I

The AMEDD had mixed success and failure in World War I. There were clinical problems that would need clinical solutions. Epidemics of childhood diseases spread through the Army while it was training in the United States. The AMEDD had known the risk but the warnings were overruled; to speed the mobilization, trainees were packed in closer than optimal. That command decision may, or may not, have brought a quicker end to the war. The AMEDD had no answers for the influenza pandemic, which (with co-morbid pneumonia) killed around 40,000 soldiers. But nobody had an answer for influenza, while pneumonia vaccines were developed in 1918 that would help in the future. Otherwise, preventive medicine was as effective as circumstances allowed: sanitation would never be good under combat conditions, but the problems in rear areas were known and addressed. Gas warfare was a problem for the Army, and postwar developments (such as better gasmasks) were supposed to help. The AMEDD developed Medical Gas Treatment Battalions to do a better job in the next war. Neuropsychiatric casualties were a great concern, and the AMEDD tried to avoid it for the future by following what seemed to be the developing science of screening men to avoid "mental weaklings" who

would be prone to breakdown. That would allow the Army to avoid the whole problem, an alluring solution.

Some improvements were partnerships with other Army elements. Water safety was an AMEDD responsibility, but water supply was an engineer task. The engineers assessed that the problem was not quantity of water-transport units but the clogged roads of the Meuse-Argonne. Similarly, skin disease rates would be reduced by improved laundry and bath access, which were quartermaster responsibilities. However, only one quartermaster laundry battalion was allotted per Army, and the entire mobile force would only have four laundry and bath battalions.[109]

Training and planning could improve medical planning and performance. In 1930, the AMEDD published "War Casualties: Their Relation to Medical Service and Replacements" as a statistically grounded way for medical planners to know what they would need for frontline and rear-area hospitals.[110] For the rear areas, they could see how many beds they would need as well as the effects on the overall force of lengthening or shortening the evacuation policy, how long a patient would be kept before evacuation

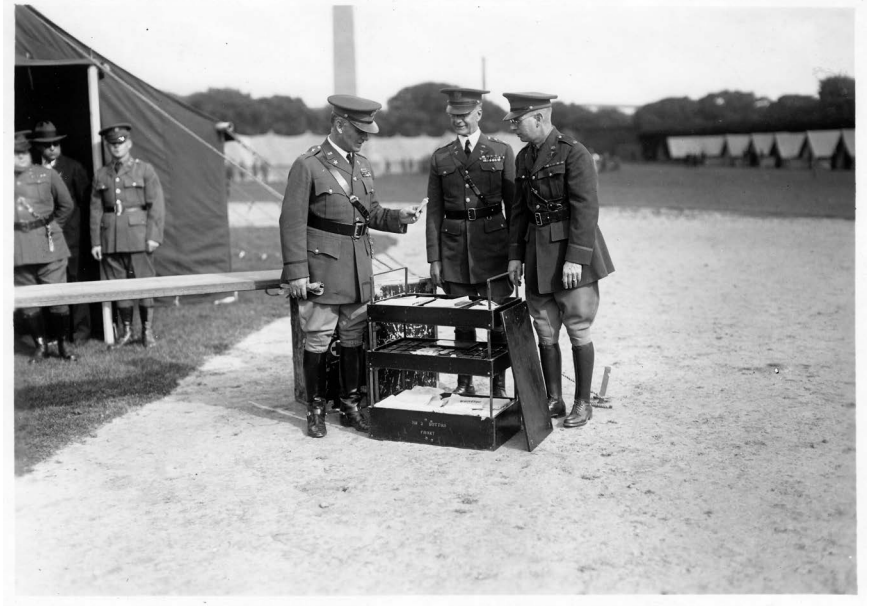

Figure 2.4. The Medical Field Service School included the Medical Equipment Laboratory and developed equipment in a phased plan, from the individual first aid packet back to evacuation hospitals. In this 1927 photo, Major John Fletcher (Medical Corps) shows Surgeon General Merritte Ireland and Chief of Staff of the Army Charles Summerall equipment developed at the equipment laboratory. Photo courtesy of National Archives.

to the United States. A longer policy needed more hospitals (and medical staff) but provided more replacements, and vice versa. For operational areas, the statistics provided guidance on the number of gassed and physically wounded per unit per day, and for both quiet sectors and intense action. (Since recordkeeping for "shell shock" patients was poor, there were no guidelines.) Based on the data, a medical planner could look at the size of the total force going into action for a quick estimate of hospitals and evacuation units needed. The AMEDD also created a Medical Field Service School to educate new officers (and Reserve Officer Training Corps cadets, when budget allowed) and prepare for the future. Medical unit tables of organization and equipment (TO&Es) were overhauled, starting with divisional medical units and moving to the rear. A Medical Department Equipment Laboratory was established to develop new field equipment, again starting at the front (with the bandage issued to soldiers) and moving to the rear. Planning tools were developed, such as casualty forecasting data so that medical planners could size the medical force needed for various combat operations. Reminding everyone of the AMEDD's role in the Army, the school's motto was—and still is—To Conserve Fighting Strength.

Notes

1. For an overview, see Richard Stewart, ed., *American Military History* II (Washington DC: Government Printing Office, 2010), chapter 1. For more medical coverage, see Mary Gillett, *The Army Medical Department 1917–1941* (Washington, DC: Center of Military History, 2009; hereafter, Gillett) with an overview half-chapter. In the 1920s, the Army Medical Department published a 15-volume series (*The Medical Department of the United States Army in the World War*, hereafter *MDWW* with volume number) that is substantially edited primary documents. I have drawn on volume 2 (Colonel Joseph Ford, *Administration, American Expeditionary Forces*, 1927); volume 6 (Colonel Weston Chamberlain and Lieutenant Colonel Frank Weed, *Sanitation*, 1926); and volume 8 (Colonel Charles Lynch, Colonel Joseph Ford, and Lieutenant Colonel Frank Weed, *Field Operations*, 1925). *The Annual Report of the Surgeon General for 1919* (Washington, DC: GPO, 1919, hereafter *ARSG 1919*), with many epitomized reports, also is a published primary source. My chapter, "Medical Support for the Meuse-Argonne," in Edward Lengel, ed., *A companion to the Meuse-Argonne campaign* (Chichester, West Sussex: Wiley-Blackwell, 2014) is the foundation for this chapter.

2. *MDWW* 8, 530; *MDWW* 2, 64.

3. *MDWW* 8, 553.

4. *MDWW* 8, 613, 614.

5. *MDWW* 2, 64.

6. This does not count the divisional field hospitals or the base and camp hospitals. Gillett, *The Army Medical Department*, 328.

7. *MDWW* 8, 555.

8. *MDWW* 2, 379–80. This was best for the Army but also good for the patient, since being told one had mental problems tended to make the symptoms permanent.

9. *MDWW* 8, 540.

10. Gillett, *The Army Medical Department,* 332; Colonel H.H.M. Lyle, "The Principles of the Surgery, Hospitalization and the Evacuation of the Wounded in the Meuse-Argonne Offensive," *Military Surgeon* 84:6, June 1939, 580–91, 587; *MDWW* 8, 531.

11. On traffic management, see for example *MDWW* 8, 549–552; Gillett, *The Army Medical Department*, 330.

12. *MDWW* 8, 46.

13. *MDWW* 2, 321–22.

14. *MDWW* 8, 70; Lyle, "The Principles of the Surgery," 586.

15. Lyle, "The Principles of the Surgery," 586; *MDWW* 8, 533 has slightly different numbers.

16. Lyle, "The Principles of the Surgery," 586; *MDWW* 8, 78.

17. *MDWW* 8, 595.

18. *MDWW* 2, 64; *MDWW* 8, 78, 80, 544.

19. *MDWW* 8, 61.

20. See *Organization of the American Expeditionary Forces* (Washington, DC: Government Printing Office, 1948), 344, and *MDWW* 8, 604, 619–20. Hereafter *Organization of the AEF*.

21. See *Organization of the AEF*, 195, 368.

22. For a field hospital unit history, see Michael Shay, *A grateful heart: the history of a World War I field hospital* (Westport, CT: Greenwood Press, 2002).

23. See *Organization of the AEF*, 270.

24. *Manual of the Medical Department 1916* (Washington, DC: Government Printing Office, 1916), 806.

25. On the AAS see Richard Ginn, *The History of the U.S. Army Medical Service Corps* (Washington, DC: Office of The Surgeon General and Center of Military History, 1997), chapter 2.

26. On army nursing in the period, see Mary T. Sarnecky, *A History of the U.S. Army Nurse Corps* (Philadelphia, PA: University of Pennsylvania Press, 1999), chapter 3.

27. I have not found casualty projections but presume the First Army was not deliberately making inadequate plans.

28. 28th Division: 3,428 casualties, 35th Division: 6,301, 79th Division: around 3,700; *MDWW* 8, 566, 576, 592.

29. *MDWW* 8, 626.

30. Gillett, *The Army Medical Department*, 337, 342.

31. *MDWW* 8, 563.

32. *MDWW* 8, 571. Meanwhile, 79th Division sent all divisional wagons (animal-drawn) out to collect wounded and kept the ambulances on the roads. *MDWW* 8, 598.

33. *MDWW* 8, 566.

34. *MDWW* 8, 591, 603.

35. *MDWW* 8, 588, 595.

36. *MDWW* 8, 596.

37. *MDWW* 8, 574, 575.

38. *ARSG 1919* 2, 1518.

39. Gillett, *The Army Medical Department*, 335; *MDWW* 8, 544–45.

40. See *MDWW* 8, 544 for a discussion of what drivers should have done, although the orders assumed optimal conditions.

41. *MDWW* 8, 70.

42. Examples could be multiplied: *MDWW* 8, 574; Gillett, *The Army Medical Department*, 331; *MDWW* 8, 597, 615.

43. *MDWW* 8, 555, 557.

44. *MDWW* 8, 585.

45. *MDWW* 8, 811.

46. Lyle, "The Principles of the Surgery," 587; *MDWW* 8, 268.

47. *MDWW* 8, 544.

48. *MDWW* 8, 591, 585.

49. *MDWW* 2, 397, 519–20; *MDWW* 8, 138.
50. *MDWW* 8, 643.
51. *MDWW* 8, 686, 660, 663, 716.
52. *MDWW* 8, 685.
53. *MDWW* 8, 717.
54. Quoted in Richard Faulkner, "Disappearing Doughboys: The American Expeditionary Forces' Straggler Crisis in the Meuse-Argonne," *Army History* 83, Spring 2012, 6–25, 15.
55. *MDWW* 8, 698.
56. *MDWW* 6, 1101. I am using dysentery as a proxy for digestive diseases, which presumably also rose.
57. *MDWW* 8, 718, 683, 842; Colonel A.N. Stark, "Medical Activities of the American Expeditionary Forces in the Zone of the Armies," *Military Surgeon* 47:3, March 1920, 154–76, 174–75.
58. *MDWW* 8, 640.
59. *MDWW* 6, 1106, 1109–10.
60. Carol Byerly, *Fever of War: The Influenza Epidemic in the U.S. Army during World War I* (New York: New York University Press, 2005), 112.
61. 5th Division Medical Department Activities in the Argonne, National Archives and Records Administration, RG120, box 5.
62. Faulkner, "Disappearing Doughboys," 15. Faulkner has the most judicious summary of straggling.
63. Gillett, *The Army Medical Department*, 334.
64. Both quotations are from Stark; quoted in Byerly, *Fever of War*, 108, and *MDWW* 8, 635.
65. *MDWW* 8, 313.
66. *MDWW* 8, 635, 282–83.
67. *MDWW* 8, 632–33.
68. *MDWW* 8, 70, 635, 641.
69. Stark, "Medical Activities," 496; *MDWW* 8, 268. Hospitals could be grouped, but it would have been difficult to find places in the rough terrain. *MDWW* 8, 672.
70. Colonel A.N. Stark, "Medical Department Program of Hospitalization and Evacuation of an Army in Preparation for Battle," *Military Surgeon* 48:5, May 1921, 493–502, 496; *MDWW* 8, 273.
71. Lyle, "The Principles of the Surgery," 587–88.
72. *MDWW* 8, 268.
73. *MDWW* 8, 699–700.
74. *MDWW* 8, 364.
75. Byerly, *Fever of War*, 116; *MDWW* 8, 310.
76. *MDWW* 8, 310–11.
77. *MDWW* 8, 312–13, 655, 678.
78. *MDWW* 8, 721–27.
79. *MDWW* 8, 776.

80. *MDWW* 8, 742.
81. *MDWW* 8, 738, 283.
82. *MDWW* 8, 803.
83. *MDWW* 8, 771.
84. Gillett, *The Army Medical Department*, 343; *MDWW* 8, 742, 752.
85. *MDWW* 8, 758, 766, 761.
86. *MDWW* 8, 746.
87. *MDWW* 8, 735.
88. *MDWW* 8, 781.
89. *MDWW* 8, 738.
90. *MDWW* 8, 790–91.
91. Gillett, *The Army Medical Department*, 334; *MDWW* 6, 1101.
92. *MDWW* 6, 1106.
93. *MDWW* 8, 742, 760.
94. *MDWW* 8, 312–14.
95. Byerly, *Fever of War*, 110. Paul F. Braim, *The Test of Battle: The American Expeditionary Forces in the Meuse-Argonne Campaign* (Shippensburg, PA: White Mane, 1998) cites 107,000 casualties without categorizing. *MDWW* 8, 809 has different numbers.
96. *MDWW* 8, 810–25. For contrast, a field hospital that did an unusual amount of surgery had 46 post-operative deaths from 222 patients, 20.7 percent. *MDWW* 8, 680.
97. Gillett, *The Army Medical Department*, 343.
98. Gillett, 335.
99. J.S. Oxford, A. Sefton, R. Jackson, et al., "World War I may have allowed the emergence of 'Spanish' influenza," *Lancet Infectious Disease* 2/2, February 2002, 111–14.
100. Peter C. Wever, Mike B.J.M. Korst, and Maarten Otte, "Historical Review: The U.S. Army Medical Belt for Front Line First Aid: A Well-Considered Design That Failed the Medical Department During the First World War." *Military Medicine* 181, no. 10, October 2016, 1187–94.
101. *MDWW* 2, 383. *MDWW* 8, 146–7 gives a lengthy description of treatment at a gas hospital.
102. 5th Division Medical Department Activities; *MDWW* 8, 723; Charles E. Heller, "Chemical Warfare in World War I: The American Experience, 1917–1918," Combat Studies Institute, US Army Command and General Staff College, Fort Leavenworth, KS, 1984, 83–86; *MDWW* 8, 655.
103. *MDWW* 8, 312–13, 655, 678.
104. *MDWW* 2, 434–39.
105. *MDWW* 2, 434–35; Louis Merillat and Delwin Campbell, *Veterinary Military History of the United States, with a brief record of the development of veterinary education, practice, organization and legislation* (Kansas City: Haver-Glover Laboratories, 1935), 2:768. Hereafter *Veterinary Military History.*
106. *Veterinary Military History,* 2:777.

107. *ARSG 1919*, 2:1235.

108. *Veterinary Military History*, 2:783.

109. Steven Clay, *U.S. Army Order of Battle 1919–1941* 4, (Fort Leavenworth, KS: Combat Studies Institute, 2010), 2029–30.

110. "Army Medical Bulletin No. 24," November 1930, accessed 1 May 2018, http://cdm15290.contentdm.oclc.org/cdm/singleitem/collection/p15290coll6/id/158/rec/1.

Chapter 3
The North Africa Campaign: A Logistics Assessment*

Lieutenant Colonel (Retired) Mark D. Kitchen

In James Huston's definitive history of Army logistics, *The Sinews of War*, he wrote that "War frequently is likened to a game of chess, but chess is no strategic game, for there is no logistics."[1] Strategic logistics dictated the when and where of America's earliest combat involvement in World War II–Operation Torch and the subsequent North Africa Campaign.

From this campaign emerged some of the most notable military leaders in the history of American modern warfare. Eisenhower, Patton, Bradley are names synonymous with the United States' most important World War II successes. Much of the credit for these accomplishments must be attributed to the hard work and creativity of the military's service and support branches. Logisticians faced the monumental task of supporting highly mechanical warfare against a formidable enemy. War would be fought in two hemispheres across vast oceans. In North Africa, Americans would encounter harsh terrain and climate coupled with a poor industrial and transportation infrastructure. The North Africa Campaign of 1942–1943 would be a first demanding test and present innumerable challenges to the US logistics structure.

A general understanding of the strategic and tactical operations is required in order to pursue and answer the following questions. How effective was the logistical support of the North Africa Campaign (8 November 1942–13 May 1943)? How could logistical shortcomings have been prevented, eased, or eliminated? What were the key sustainment lessons learned concerning support of intensive desert combat operations? What follows is a background summary which puts this study into its proper context and provides a framework for this logistics assessment.

The British in North Africa

By July of 1940, Norway, Belgium, Holland, and France were occupied and under German domination, and Italy had aligned itself with Germany. Not to be outdone by the German's success, Mussolini directed Italian forces to attack British holdings in the Mediterranean, particularly in East Africa. In September 1940, while the Battle of Britain raged in the skies of England, the Italians made their move. Using the diversion to their advantage, Italian forces stationed in Libya attacked a much smaller

British force in Egypt. The attack bogged down with little success and the Italians reluctantly agreed to accept a German offer of help.

To assist the Italian forces in east Africa, Hitler provided an armored force under the command of Generalleutnant Erwin Rommel. Rommel's force, the German Afrika Korps, was an extension of Italian forces. Under the agreement, Hitler provided Rommel general directives only after Mussolini had approved them. By April 1941, the Afrika Korps had torn across Libya until only the port city of Tobruk remained in British hands. The British decision to hold Tobruk at all cost was key to the eventual security of the region. Rommel desperately needed a suitable port from which to support future operations deep into Egypt. The British garrison survived two major attacks by Rommel and seven months of siege before being relieved.[2]

Ultimately, Tobruk fell to the overpowering strength of German dive bombers and artillery. Plentiful stocks of transportation assets, gasoline, and other supplies fell into Rommel's hands. With Tobruk now under Axis control, Rommel and Hitler believed that the capture of the Nile valley was now a real possibility.[3] When General Montgomery took charge of the Eighth Army (British) in August 1942, he brought with him a new fighting philosophy. Forces would be massed and no more small independent units would be employed. Montgomery would fight Rommel on the El Alamein line.[4] Montgomery's plan was executed to perfection and by 4 November 1942, the Battle of El Alamein had been won. With the Afrika Korps now in full retreat, Montgomery's task was now to link up with Allied Forces in Tunisia. It was hoped to isolate the Axis Forces there and force their ultimate defeat.

The Genesis of Operation Torch

By 1939, the US Joint Planning Committee had produced what were known as the RAINBOW plans. RAINBOW-5 envisioned aggressive transatlantic operations to defeat Germany and Italy in the eastern Atlantic, Africa and Europe.[5] American and British forces would fight in coalition, but would retain force integrity in most cases.

President Franklin Roosevelt and Prime Minister Churchill met at the ARCADIA Conference in Washington, D.C., shortly after the attack on Pearl Harbor. Churchill brought with him a strategic concept for the Allied liberation of French North Africa. Security and control of the region would clear the way for an Allied return to the European continent. A significant product of the ARCADIA Conference was establishment of the United States-British Combined Military Command, Combined Chiefs of Staff (CCS). The CCS, composed of the chiefs of Army, Navy, and Air Forces

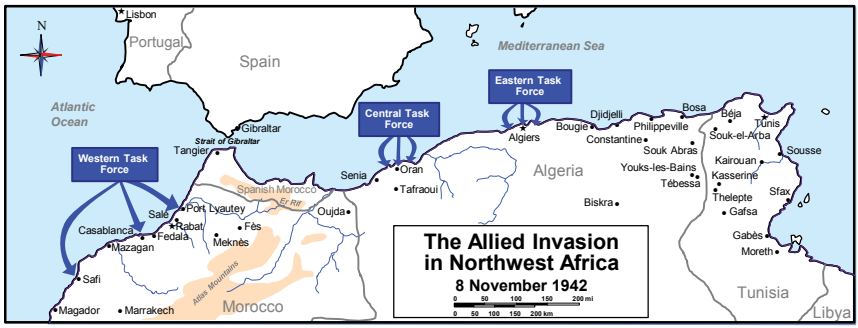

Figure 3.1. Map of Allied Invasion of North Africa, 8 November 1942. Map created by Army University Press.

of the two countries would control joint war efforts worldwide.[6] On 23 July 1942, Roosevelt threw his support behind the Churchill plan presented at the ARCADIA conference. The CCS agreed to begin planning at once for Operation Torch, the Allied invasion of Northwest Africa.

Operation Torch and the North African Campaign

Operation Torch was a three-pronged attack. The Eastern Task Force under Major General Charles W. Ryder and the Center Task Force under Major General Lloyd R. Fredendall embarked from the United Kingdom and landed in Algiers and Oran respectively. Major General George S. Patton's Western Task Force landed in Morocco after sailing from the United States. In all, more than 100,000 men in 110 ships and 90 escort vessels participated in the assault.[7] The successful landings marked the beginning of the North Africa Campaign.

The key to establishing control in North Africa was to secure the port of Tunis; therefore, the landing forces would fight eastward to Tunisia.

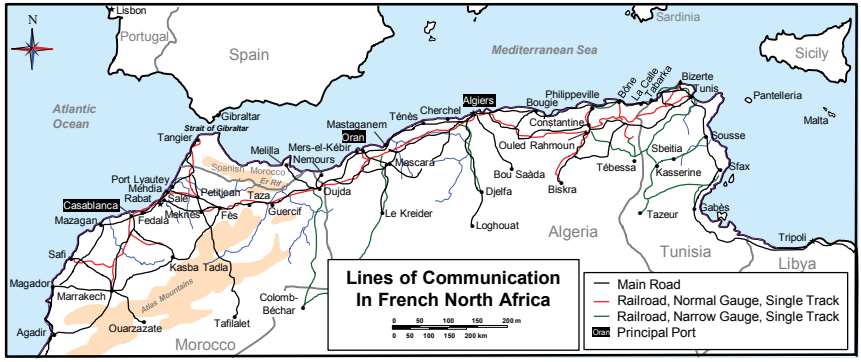

Figure 3.2. Lines of Communication in North Africa, November 1942. Map created by Army University Press.

Ahead of the Allied force lay their objective, some 1,200 miles to the east. From Morocco to Tunis, movement would be concentrated mostly along the coastal plains. Formidable mountain ranges restricted ready access to the interior. The topographies and industrial/transportation infrastructure of Morocco, Algeria, and Tunisia were poor, and logistical support in theater would be difficult.

Casablanca provided the only substantial port on the Atlantic coast. This artificial port had been constructed by the French shortly after World War I. It accommodated about 90 percent of the Moroccan pre-war traffic. Lesser ports were available at Safi, Mehdia, and Port-Lyautey. A standard gauge railroad connected the ports with Marrakesh, parts of the interior and Algiers. The limited road network primarily supported the coastal plain.[8] Algeria's coastline faces the Mediterranean. Artificial ports were constructed or natural harbors had been improved prior to the invasion. The best port and rail transloading facilities were at Oran, Algiers, Bougie, Philipeville, and Bone. Railways and roads ran primarily east-west along the coast, with some access to the interior. One-meter gauge branch rail lines additionally connected the lesser ports with the main line.[9]

Tunisia also provided a somewhat bleak logistical support outlook. Though the ports at Tunis, Bizerte, Sousse, and Sfax were adequate, the country's supporting transportation network was not. Almost all rail lines were narrow gauge. The main highway system consisted of one east-west coastal route and one roughly parallel interior route. Though these highways would support two-way traffic in most places, numerous bottlenecks were found in narrow tunnels, sharp mountain turns, and snowbound passes.[10]

The North Africa campaign would eventually be a six-month effort divided into three major phases.[11] First was a race between Allied and Axis forces to build up forces strong enough to deny the strategically important Bizerte-Tunis area to the enemy. This key port was to be the focal point for the Allied invasion of southern Europe. The Germans won this race by a narrow margin. The second phase was marked by the German initiative to develop and expand a strong perimeter defense around their holdings in Tunisia. The third and decisive period of the campaign centered on the Allied victory at Mareth, the capture of Bizerte and Tunis, and the surrender of Axis forces in North Africa.

On 28 November 1942, only 20 days after the landings, Allied forces reached Djedeida, less than 16 miles from Tunis. The Germans attacked several times inflicting heavy Allied losses and by 3 December, Lieutenant General Dwight Eisenhower, the Allied Commander, authorized the force

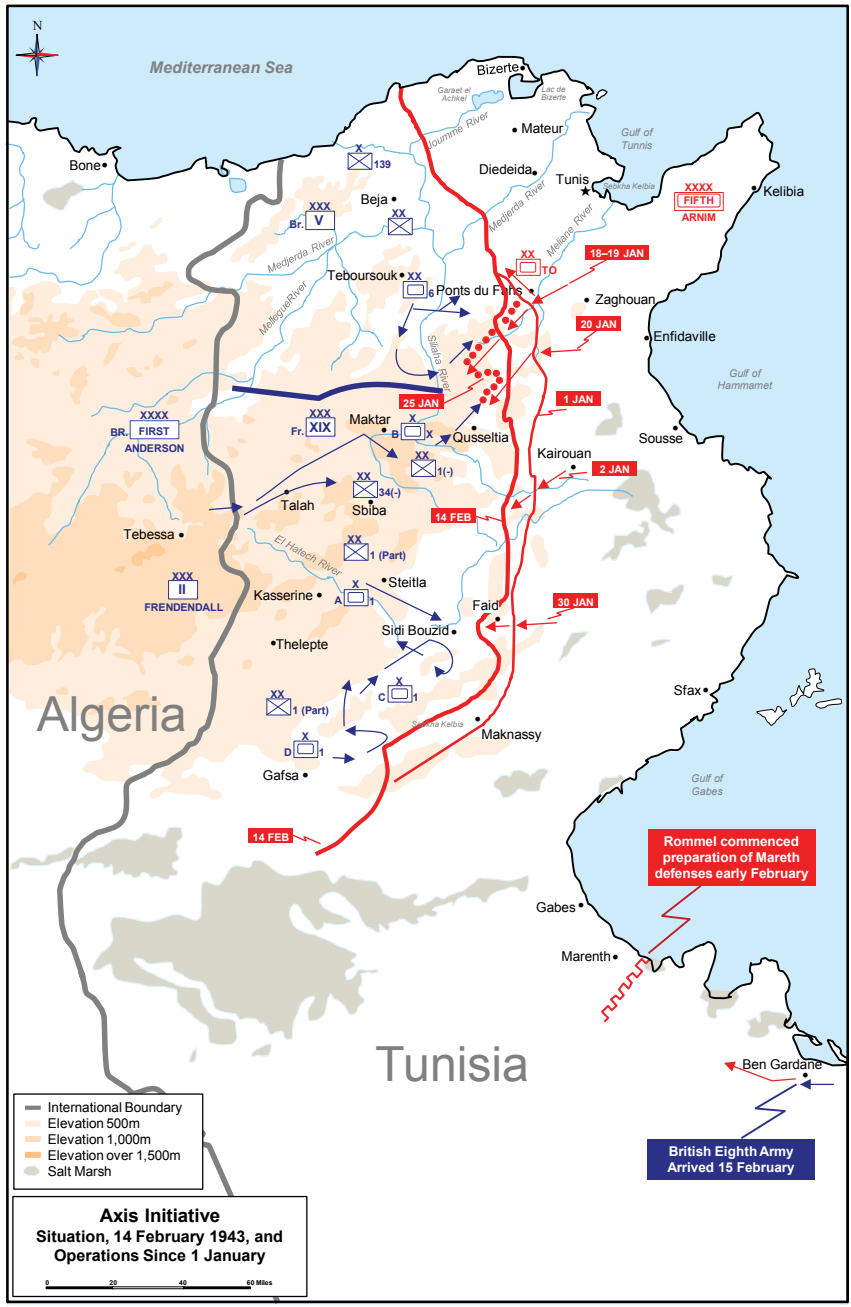

Figure 3.3. Map of Axis Initiative in Tunisia, Africa, 14 February 1943. Map created by Army University Press.

to withdraw to more defendable ground. Heavy rains hindered the withdrawal and much of the badly mired equipment was abandoned, including 15 of 18 105-mm howitzers, 50 of 62 tanks, and 84 of 122 light tanks.[12]

On 20 December 1942, Eisenhower launched another attack with Tunis as the objective. Rainy weather continued to pose significant problems for the Allies. Vehicle movement off of paved roads was impossible. Two-thirds of allied aircraft were inoperable because of mud. Supply lines were inadequate to meet the needs for steel matting and equipment to put airfields in usable condition or to provide general supplies, especially ammunition. The operation was postponed and then abandoned altogether on 24 December.[13]

Only a small force was sent to Tunis because supply activity was inadequate to support a larger force. Handicapped by lack of transportation and slowed by inadequate supply routes, the Allied force was stopped and driven back by the Germans.[14]

By early January 1943, the Tunisian Front extended from the Chott Djerid in the south to the Mediterranean Sea in the north, about 250 miles being held by the equivalent of three British divisions, part of one American division, and three weak French divisions. The Allies developed the "Sfax Project," a plan to split the German forces and secure the First Army's flank. The plan fell through, however, when General Montgomery's British Eighth Army, approaching from Libya, failed to reach Tripoli within the required timeframe. Montgomery had advanced some 1,400 miles from the site of his victory at El Alamein. His administrative and logistics support had been stretched to the limit. It would be another eight weeks after his entry into Tripoli before he would be ready to resume offensive operations—too late to stop the Afrika Korps from reaching Tunisia.[15]

On 14 February 1943, refurbished German troops attacked US II Corps elements to control key road junctions and mountain passes around Sbeitla-Kasserine. Loss of these key areas would have isolated the II Corps and laid open key lines of communication, supply areas, and airfields, and would have thrown the Allies off-balance before a serious offensive could be mounted. On 23 February, the Germans withdrew back through Kasserine Pass. During the first week of March 1943, Rommel's forces took the initiative and attacked British forces, armed with more than 500 anti-tank guns. Rommel lost 52 tanks, more than half the armor in his attacking forces. Montgomery took advantage of the situation and spearheaded the attack of Rommel's forces. Allied forces converged from all directions, overwhelming all remaining resistance and forcing the Germans to surren-

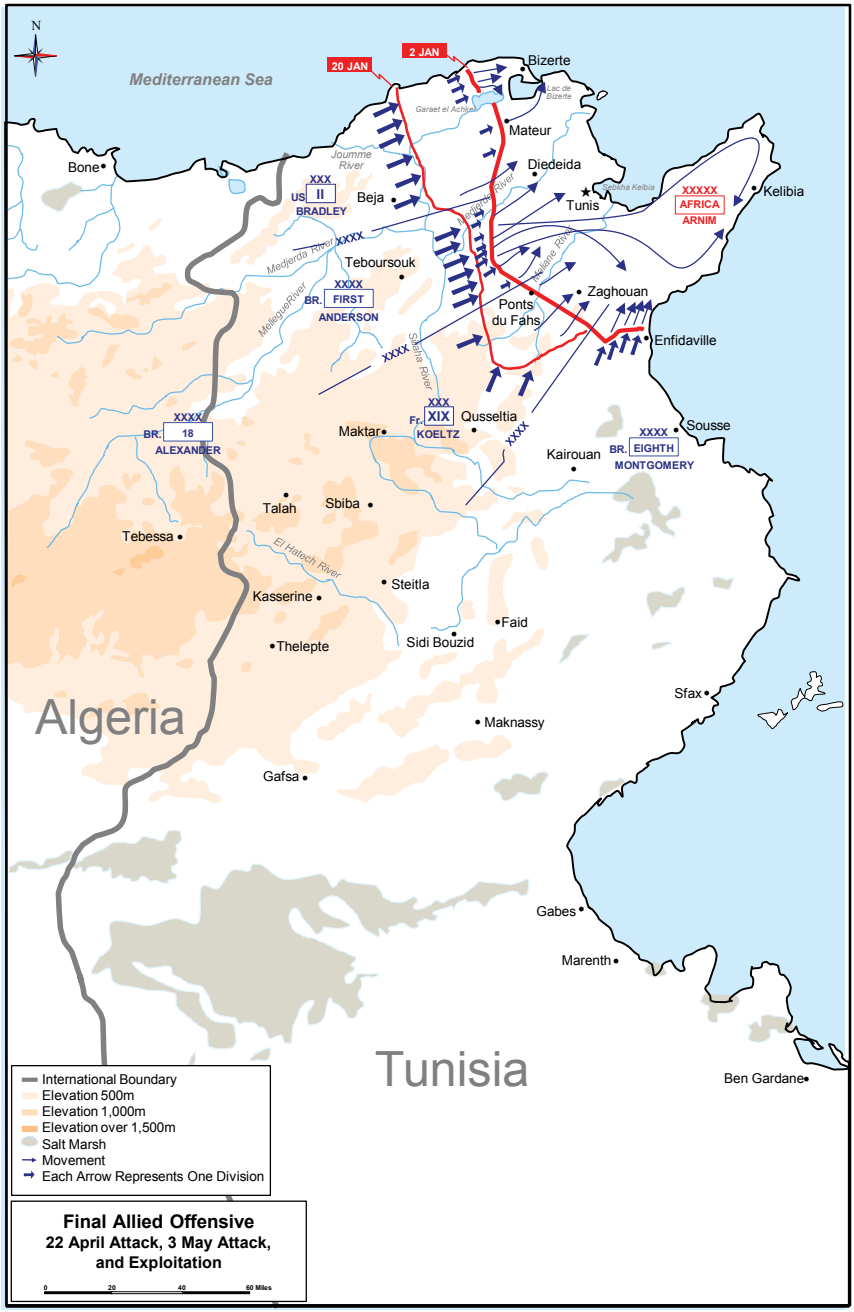

Figure 3.4. Map of Final Allied Offensive in Tunisia, Africa, April and May 1942. Map created by Army University Press.

der at Bizerte-Tunis in May 1943. In all, more than 240,000 Axis prisoners were taken, as well as more than 1,000 guns; 520 aircraft; and 250 tanks.[16]

The Sustainment Structure

Many similarities may be found in the Army of 1942 and the Army of 1991. This is particularly true of corps and division support activities. Though there have been innumerable changes in technology, equipment, strategy, and force composition, the underlying support philosophy and employment of these units is basically the same. This is not to say, however, that substantial differences don't exist. This is especially evident regarding responsibilities of the national level sustainment agencies.

There was a major War Department reorganization in March 1942.[17] The command structure would now have three major components: the Army Ground Forces (AGF), the Army Air Forces (AAF), and the Army Service Forces (ASF). The reorganization recognized the need to handle procurement and supply operations as one integrated activity.[18]

The mission of the Army Service Forces was a bold one: "to provide services and supplies to meet military requirements." In addition to the inherent procurement and supply functions, this mission brought with it many less-defined tasks. Among the many responsibilities were the development and administration of purchasing and contracting procedures, labor relations, and the basic and technical training of service soldiers and units.[19]

Five major elements fell under the control of the Army Service Forces. First were the G-1 (personnel) and G-4 (supply) of the War Department general staff. Second was the Office of the Under Secretary of War (OUSW) responsible for the supervision of the War Department's procurement activities and general economic mobilization. Third were eight administrative bureaus which would eventually become the ASF Headquarters.[20] The fourth element placed into the ASF was nine corps areas, which would shift to become the service commands executing the ASF's functions as field agencies throughout the United States.[21] Their functional responsibilities included the induction and assignment of personnel, operation of fixed communications facilities, and numerous other duties.

The last area put under ASF control was the six "supply arms and services" of the War Department.[22] These were later designated as the technical services. Transferred were the offices of the Chief of Ordnance, the Quartermaster General, the Chief of Engineers, the Surgeon General, the Chief Signal Officer, and the Chief of Chemical Warfare Service. Each of the services brought with them their headquarters as well as installations throughout the United States.

Sustainment Activities

The North Africa Campaign presented innumerable logistics challenges to the American forces. Many units were undermanned or had no experience in war. The terrain and weather, both harsh and unforgiving, did not accommodate smooth logistics operations. Tactical groupings into small task forces spread over wide fronts resulted in supply personnel operating as small independent units without the aid of proper staffing or equipment.

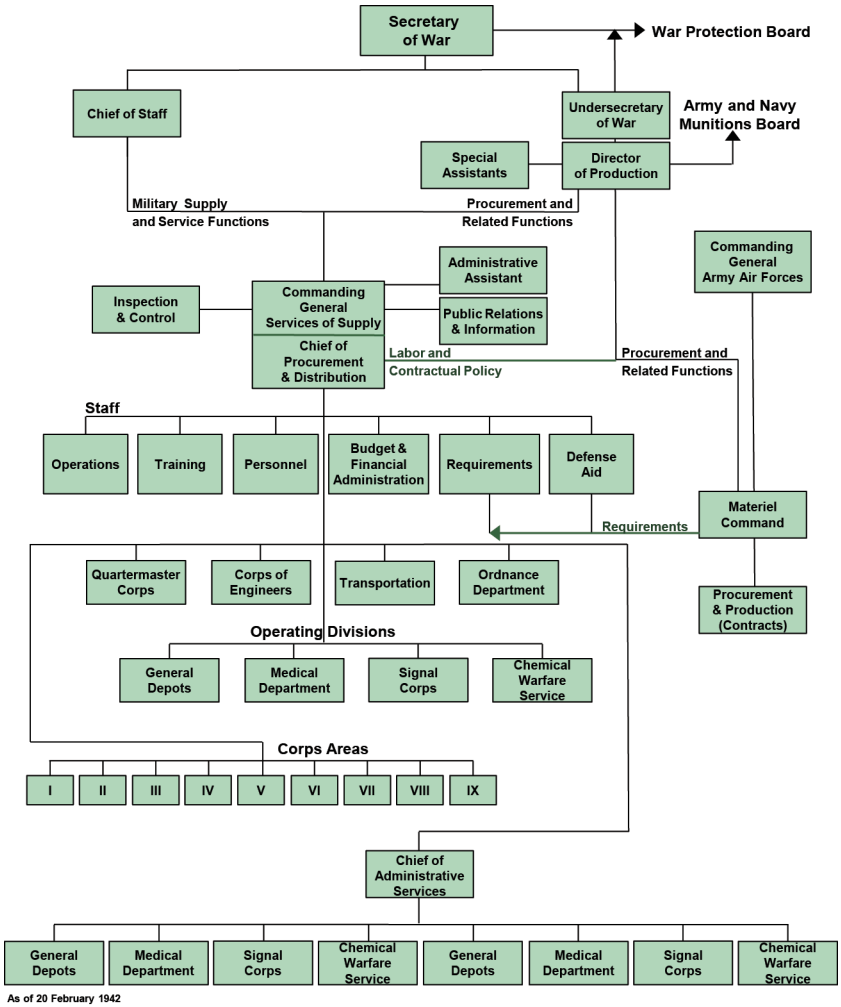

Figure 3.5. United States Organization of the Classes of Supply, 24 February 1942. Graphic created by Army University Press.

Major logistics concerns in the theater are presented in five areas: manning, arming, fueling, fixing, and transporting. The sixth sustainment function, protection of support assets, is addressed in each area.

Perhaps the biggest problems medical organizations faced during the campaign were rooted in the initial planning. Each of the three task forces was responsible for its own logistical planning and support operations. Planning for the Western Task Force was done in the United States and for the other two task forces in the United Kingdom. Each of the three task forces was significantly different. The Western Task Force was influenced by restrictions imposed because of available tonnage on transport ships. Only medical detachments and "skeletonized" medical battalions took part in the initial landing phase. The Center Task Force, given the freedom to integrate a more substantial support slice, allotted two evacuation hospitals and one surgical hospital to the assault force. The Eastern Task Force, being primarily British, incorporated a lighter US medical force. Only divisional medical battalion clearing and collection companies, augmented by auxiliary surgical groups, were needed to support US forces. Each of the task forces experienced medical organizational problems immediately following the assaults.

From the medical point of view, the invasion phase provided several salient points. First, in no instance did collection or clearing elements get ashore early enough or with enough equipment. Additional medical supplies had been scattered all over the beach, complicating an already marginal situation. Secondly, there was poor intelligence as to the conditions medical units would actually face. Lastly, the failure to establish fixed hospitals immediately after the assault made it necessary to hold mobile medical units in Oran and Casablanca to care for invasion casualties and prevented them from moving with the II Corps.[23]

In general terms, medical evacuation is defined as the movement of patients within the combat zone and to the combat zone; within the combat zone; and the evacuation from the theater of operations to the United States. Within the United States, evacuation policy was quite rigid. However, within the North African theater a more flexible policy was adopted. The tactical situation, flow of casualties, and the need for mobility limited what could be done in forward areas.

In an effort to equitably distribute patient load and concentrate patients being evacuated to the United States, they keyed on hospitals where transportation would most likely be available. This reduced patient load in the forward areas, and minimized the time patients spent waiting for troop

transports in Oran and Casablanca.[24] Methods of evacuation within the theater were challenging and innovative. On land, cross-county ambulances were the primary means when distances were short, augmented by ¼-ton jeeps and to a lesser extent ¾-ton weapons carrier and 2½-ton trucks.

Hospital trains were used extensively in the theater. Though they were not shipped from the United States, use was made of captured or improvised trains for medical evacuations. The most imaginative use of rail evacuation was in the 9th Infantry Division area. At one point in the campaign, a railroad line cut the division front. Two ½-ton trucks were fastened back-to-back with their rims fitted over the rails. One truck powered the vehicle on the way to the rear, the other on the return trip. For a time, mule pack evacuation was used in isolated instances in Tunisia.

Evacuation via water was very limited. No US hospital ships were available. Three key factors limited troopship evacuation. Originally, theater policy allowed only those patients mentally and physically capable of taking care of themselves in the event of disaster to board the ships. The next factor was that medical facilities on these ships were poor. Lastly, overland travel restrictions initially in the theater prevented casualty evacuation all the way to Casablanca.

Air evacuation was the most desirable means, offering comfort, safety, and speed. The theater surgeon met with the 51st Troop Carrier Wing and outlined a plan to maximize air evacuation. Generally, ground forces would be responsible for establishing medical facilities near airfields and providing reception and triage services. The Air Forces would coordinate communications between ground medical facilities and provide property exchange and care en route.

The first regular graves registration company was authorized only two years before the Torch invasion. In theory, this unit of five officers and 125 men could support a corps of three divisions. Functionally, graves registration was a staff responsibility, usually under the G-1 or G-4.[25]

Shipping restrictions imposed on the Western Task Force necessitated that two of these companies remain in the United States. Initially, fighting forces would be responsible for the collection, identification and burial of their own dead. The 46th Graves Registration Company, originally scheduled to deploy with the WTF finally arrived in Constantine on 2 March. There were now standard procedures for securing mortuary supplies and services and temporary burial sites.[27] However, there were still not enough assets to relieve the combat soldier of a significant role

and it did not satisfy the demoralizing experience of the ground forces handling the remains of the dead.

Personnel replacements, laundry and bath, and troop issue subsistence operations experienced major challenges. Replacements were provided to the theater in sufficient numbers throughout the campaign; however, they were not well-trained. The result was establishment of a training center in rear areas and drawing instructors from combat units, thereby exacerbating the problem. Laundry and bath units and equipment were sufficient; however, shortages of fuel and soap limited their operation. The quantity of rations was never an issue; however, fresh meat, fruits and vegetables were in short supply to a large extent because of a shortage of refrigeration capacity within theater.

During the planning for Operation Torch and the subsequent campaign, ammunition was perhaps the scarcest commodity. In 1940, only two arsenals were producing artillery ammunition; ordnance depots could not renovate ammunition; and private ammunition plants did not exist.[26] The shortage in capacity was rectified by a network of 60 government-owned, contractor-operated ammunition plants that was built between June 1940 and December 1942.[27]

During execution of the operation, ammunition stocks were adequate; however, inadequate transportation hampered its supply to units. Several key lessons were learned regarding ammunition support in North Africa. First, it was found there was little need for some types of ammunition which were shipped to the theater. These automatic shipments, based on War Department estimates, were eventually stopped and stocks depleted or shipped elsewhere.[28]

The second lesson was that the supply of Class V to the Corps was hampered by lack of experience. War Department estimates projected for ammunition consumption were highly inaccurate. This led to the development of the "Day of Combat Experience" yardstick by the II Corps.[29] This, in conjunction with newly initiated reporting, resulted in issue of daily expenditures of ammunition and less fluctuation of inventories.

The third lesson was that like petroleum consumption, ammunition usage varied greatly based on terrain. In the last battles in Tunisia, artillery and infantry forces were used extensively in the rocky hills and valleys controlled by the enemy. Tanks, vulnerable in the region, played a minor role.[30]

In summary, lack of ammunition in the North Africa Campaign was not a significant problem. Inventory inefficiency and the lack of responsive transportation were the biggest challenges faced by the Corps.

The highly mechanical nature of the American force assembled for combat in North Africa brought with it many challenges. The extended lines of communication, rough terrain, and the remarkable speed of the II Corps movement into Tunisia were all factors in the force's maintenance task.

Maintenance and spare parts support was provided to widely dispersed units throughout a wide front. Lines of communication were becoming stretched and the daily "piecemeal" shipment of supplies was becoming inefficient. With the eventual move of the II Corps to southern Tunisia, US road transportation abilities were extended beyond capacity. Shortages of automotive spare parts were acute.[31] Improvisation was the name of the game in maintenance companies. Extensive use was made of wrecked vehicles and cannibalization was commonplace.

There were many lessons learned from the maintenance support efforts in North Africa. First, there were some problems concerning the availability of technically competent maintenance personnel. Faced with high attrition rates in the infantry, personnel from technical services were moved into combat units. The efficiency and morale of some maintenance units was affected and was reflected in poor shop output.[32]

The second key lesson was that the five-echelon maintenance system worked when effectively employed. It was, however, very important to keep evacuation to a minimum and accomplish maintenance as far forward as possible.[33]

The third point to be taken was that the liberal use of civilian personnel was essential.[34] This allowed military personnel to be available for more urgent duties. Lastly, the original spare parts supply plan was by and large unsatisfactory. Automatic shipments in lot sets were inefficient and did not support the theaters' actual demand. A requisitioning system based on usage would have been extremely beneficial to readiness.[35]

Overall, spare part availability very nearly prevented Eisenhower the freedom of action he desired. Newspaper correspondent Ernie Pyle wrote, "This is not a war of ammunition, tanks, guns, and trucks alone. It is as much a war of replenishing spare parts to keep them in combat as it is a war of major equipment."[36]

Critical to the conduct of the Allies' highly mobile warfare was the reliable supply of fuel. The criticality of this commodity had been proven in the deserts of North Africa in the fluid duels between British forces and the Afrika Korps. The initiative exploited by those forces in the see-saw battles in Libya and Egypt can be tied directly to the availability of gasoline supplies.[37]

With the initiative of the southern Tunisian operations around Tebessa and beyond came the challenge of fuel distribution. The base supply dump, operated by the Mediterranean Base Section, was situated about 125 miles west of Tebessa. It was fed from the ports at Philippeville and Bone. The primary Corps site was at Tebessa with rail and truck heads at Sbietla, Feriana, and Gafsa. With such extended lines of communication, a target of seven days of supply was established.[38]

Because of the lack of bulk transport facilities at Tebessa, all fuel was shipped in 55-gallon drums. The drums had been filled at Ouled Rahmoun from storage tanks which were, in turn, supplied by pipeline from Philippeville. Drums were not practical for troop use beyond the Corps fuel dump. Petroleum, oil, and lubricants (POL) were moved in standard 750-allon tanker trucks or in five-gallon cans. One solution to this dilemma was to mount 18 55-gallon drums on a 2½-ton truck, move it to the bulk dispensing unit, and then fill the drums on the truck. From there, fuel was pumped directly into vehicles, airplanes, or 5-gallon cans and the truck returned for more fuel.

After the Afrika Korps withdrew back through Kasserine Pass and had been counterattacked, operations moved to the northern coastal plain. The II Corps dump was located in a wheat field at Sidi-Mhimech, near Beja. A forward area was established at Djbel Abiod. Both locations were selected for their tactical locations and accessibility to rail and truck heads.[39]

Though the supply line from the base section to the using unit was 125 miles long, conditions for support were more favorable. Though road and rail nets were still limited, the front was narrower and units were concentrated.[40]

Remarkably, at no time during the entire campaign did stockage levels exceed the calculated requirements and at no time did a vehicle sit idle waiting for fuel.[41] Some important lessons were learned, however, and they were applied throughout the rest of the war.

The potential of the tactical pipeline was realized. Initially tested during the 1941 North Carolina maneuvers, more than 740 miles of 4-inch pipeline was laid in six months in North Africa. This relieved a potentially overburdened transportation infrastructure of having to move millions of gallons of fuel over road and rail. It also allowed fuel to be moved day and night with relative security.[42]

Badly needed US experience tables were developed based on the Tunisian operation. One applied to cross-country marches and active combat and the other to administrative movements. In the south where supply

lines were long, the allowance of 5 gallons per day per wheeled vehicle was insufficient. The 50-gallon factor for tracked vehicles was confirmed. In the north, however, where fighting was on a narrow front, commanders made better use of armor and the figures were reversed.[43]

The estimates for the campaign made by the War Department were generally correct overall. The benefit of the tables, however, was that now the right kinds of fuel could be moved forward and more efficient fuel operations conducted.

James Huston referred to the 1942 invasion of North Africa as "a graduate school in logistics when too many officers had not yet completed elementary school."[44] If this were true, then transportation was surely its hardest course.

Whether by rail, highway, or air, supplies were provided to frontline soldiers usually when and where they needed them. The problems inherent with moving tons of materiel more than 1,200 miles were enormous. No single mode of transportation could handle the requirement alone, even in the best of circumstances. Working in concert, most demands were met.

By February1943, the Headquarters, Military Railway Service (MRS) was established in Algiers and assumed responsibility for the rehabilitation, technical development, and operation of theater rail service.[45] One of the biggest problems faced by the MRS was the placement of empty rail cars. In order to maximize efficiency, a control center was established in Algiers. Its function was to allocate empty cars which met hauling requirements to the ports. Pilferage of goods in transit was a common problem. Supply movement required large numbers of highway movements. In order to control these movements, a system of convoys was used. Some difficulty with the convoy system arose when British vehicles used the American road nets. When 10 or more British vehicles entered the US road net, they would be stopped and scheduling could be arranged. The result was delay in British movements and their "infiltration" into US traffic. They were often undetected until the traffic net was overloaded.[46]

The immediate problem was the availability of trucks. The growing non-availability of trucks was a serious problem. Serious parts shortages for trucks would have soon impacted tactical operations.[47] Intense maintenance operations managed to hold vehicles together until relief came. After the German surrender, new demands were made on truck companies. By 9 May 1943, II Corps had captured 41,836 prisoners.

Faced with overwhelming challenges to support the theater, transportation units accomplished much in the six-month campaign. Poor roads,

few railroads, and unforgiving terrain and weather all worked against their success. But responsible support and unity of effort did much to overcome those obstacles.

Challenges and Lessons of Modern Technical Warfare

The North Africa Campaign presented American commanders with many problems never faced before. Operation Torch, the ensuing campaign, and indeed the rest of World War II were unlike any war before. The increased range and lethality of highly technical modern weapon systems had changed the face of combat forever. Armies were now motorized and with the introduction of armored, mechanized, and airborne divisions, more mobile than ever. Fluid battlefields, rapid advances, and wide unit dispersion were all signature elements of the campaign in North Africa.

Logistical support in such austere surroundings could have hardly been more difficult. The sustainment effort was complicated by not only inexperience on our part, but worldwide demand for US warfighting material. The support package for the II Corps was never completely available. Physical constraints made that impossible.

In the annals of US military history, other campaigns may have had more instances of bold maneuver or heroic action. This campaign, however, marked the first widespread use of American armor forces in desert warfare. Lessons were learned at high cost: 2,715 American dead; almost 9,000 wounded; and more than 6,500 missing. By mid-May, success belonged to America and its allies. Half of that success story was logistics.

The overall logistical support of the North Africa Campaign can only be classified as a qualified success. Did US forces (in concert with the Allies) defeat the enemy? Obviously the answer is yes. Were US forces ever defeated because of a shortage of warfighting materiel? The Afrika Korps had been surprised by the accuracy and rapidity of American indirect fire. Rommel considered the Americans "fantastically well-equipped" and concluded that the Germans "had a lot to learn from them organizationally."[48] Given any operation of this magnitude and scope in peacetime or wartime, logistics operations improve as the theater matures. This was the case in North Africa.

The manning sustainment functions analyzed were performed well in spite of two major shortcomings. The first was the lack of integrated planning by the separate invasion task forces. Plans for early medical support were very different—based on limited accurate information—and led to a high degree of inefficiency. The second major problem was the failure to include fixed hospitals in the early invasion forces. Had those facilities

been made available, smaller more mobile medical units could have followed the combat forces into Tunisia. Evacuation routes were stretched beyond what are now considered to be acceptable distances. An additional side-effect was the unnecessary movement of patients between hospitals.

On a positive note, improvisation and responsiveness were key to the medical support offered to the II Corps. On many occasions, particularly soon after the landings, medical activities of a doctrinally lesser capability assumed a greater role with outstanding results. Given the extended lines of communication, evacuation methods displayed great imagination. Air evacuation of patients rearward from division areas was not employed until this campaign. Today, it is common medical evacuation practice.

The need for graves registration personnel had certainly been recognized prior to the invasion, but units were not integrated in assault forces because of shipping limitations. Improvisational support on the part of the combat units was poor and considered an unacceptable burden. Graves registration units were included in subsequent invasion forces in Sicily and Italy. In general, services—laundry and bath as well as graves registration services —were poorly integrated into the fighting force. The result, however, did not have a significant negative impact on combat power.

Organizationally, ordnance units had grown at a tremendous rate. During the summer of 1942, the Chief of Ordnance assumed responsibility for automotive maintenance and related spare parts distribution for the Army. This had previously been under the control of the Transportation Branch in the Quartermaster Department. Only 60 days before the invasion, the Tank-Automotive Center was established in Detroit.[49] This new mission was added to the already rapidly expanding arsenal system manufacturing ammunition and ordnance responsibility for its worldwide distribution.

Before the campaign, there was no single ordnance organization larger than battalion. A headquarters was needed which could provide command and control of corps maintenance and ammunition units. Approval for a regiment or group could not be obtained before the invasion; therefore, the Provisional Ordnance Group was formed.

It can be said that during the course of the campaign, ammunition was never in short- supply. It was supplied in required quantities to frontline units when they needed it. The problem was inventory levels of some lines and stockage efficiency. Stockpiles of unwanted ammunition, specifically 37-mm anti-aircraft and 37-mm tank and anti-tank ammunition, were moved numerous times. At the same time, there was an insatiable need for 105-mm howitzer ammunition throughout the campaign. In time, II Corps

gained control of the problem by intense management and requisitioning based on actual usage. Automatic shipments from the United States were halted and demand satisfaction of ammunition improved.

Maintenance organizations were integrated well into the II Corps scheme of maneuver. The major problem was the erratic supply of spare parts to the theater. Predicted spare part usage by the War Department was unsatisfactory and largely inefficient. Again, as in medical units, improvisation was the order of the day. Extensive use of salvaged vehicles and battlefield recovery of repair parts did much to ease the transportation shortage problem.

Remarkably, the fuel supply to the force was never significantly interrupted. This campaign saw the first significant use of the tactical pipeline. Pipeline construction units had wisely been included in the Deployment plus three days (D+3) convoys and by May 1943 had laid more than 700 miles of pipe. The pipelines immeasurably eased the highway and rail transportation burden experienced in North Africa.

While responsiveness may have been the keystone to fueling efforts, the system was clearly saturated with inefficiency. Separate task force planning certainly took its toll on fuel sustainment, and central organization at the theater level did not begin until January 1943.

The sole use of 5-gallon cans below corps level was highly inefficient and manpower intensive. It would seem that with the addition of several tanker trucks and trailers at the division or brigade level that workload would have decreased and mobility significantly improved.

POL overstockage in theater had a positive benefit in the execution of the campaign. Fuel estimates for gasoline and diesel fuel had been planned by the War Department. The total gallons used in the campaign came close to that estimate; however, usage rates by type vehicle were substantially different. High stockage levels allowed the flexibility needed for the increased consumption rates of tracked vehicles in the northern phase of the campaign.

Transportation was perhaps the one central weak link which limited more sustainment success. Extensive road and rail networks were simply not available. Compounding that problem was the non-availability of trucks and tank transporters. The lack of these vehicles perpetuated a spiral of high usage, little time for preventive maintenance, and excessive repair parts requirements. Urgent relief came in March 1943, just in time for the II Corps move to the north.

The North Africa Campaign was marked by three general logistical shortfalls. These problems were generally common throughout the five sustainment areas:

a. Given the nature of resistance in Casablanca and Oran, a greater support slice should have been included in the assault force. This could have been accomplished with little or no impact on current or subsequent combat operations. Units which should have been included were quartermaster, ammunition, and graves registration companies, as well as fixed hospital facilities.

b. A single organization should have been the focus of sustainment operations in the theater. Each task force had planned their own support and each technical service was working in a "stovepipe" manner. It was not until late January 1943, when all support operations were brought under theater control, that centralized management truly integrated support with the tactical forces.

c. Lines of communication could have been reduced substantially by landing a larger proportion of forces on the Mediterranean coastline. It had been the British recommendation during the first American British Conversations meeting to land all assault forces within the Mediterranean. The United States opted to ensure uninterrupted supply lines by seizing the Atlantic port of Casablanca. Additional combat force landings at Oran and Algiers could have impacted positively on the ability of the Allies to seize Tunis in December 1942. Because of limited support, friendly forces closed to within 16 miles of Tunis in December before being turned back. They consequently had to wait until May 1943 to overwhelm the Germans by mass and isolation.

Many key sustainment lessons were learned in North Africa which clearly apply today.

a. Sustainment activities must be completely integrated into the campaign plan. Failure to give them full consideration will impact combat power.

b. The five-echelon maintenance system works only when applied and is an item of command accountability.

c. Maintenance evacuation generally wastes valuable time. Equipment must be fixed as far forward as possible.

d. Inventory efficiency is critical in order to conserve manpower and transportation assets.

e. The use of local labor for sustainment activities should be exploited to the highest practical degree. This again will free service troops to work far forward and be responsive to the needs of combat soldiers.

f. Fuel consumption factors are highly dependent upon terrain, the type of movements involved, and the nature of combat which is being waged.

g. The United States and its Allies should operate two separate lines of supply and should not attempt to intermingle them.

Conclusion

North Africa had been a test bed not only for new equipment, but new Army tactical and logistical doctrine as well. Many risks had been taken in this first incursion against the Germans. Early in December 1942, when the hope of quick Allied victory in Tunisia was fading, General Eisenhower still believed those risks had been necessary. He said that operations up to that time had "violated every principal of war, are in conflict with all operational and logistical methods laid down in textbooks, and will be condemned by all Leavenworth and War College classes for the next 25 years."[50]

For the most part, Eisenhower was correct in his assessment. He was wrong on one count, however. Almost 75 years have now passed since the North Africa Campaign and the logistics efforts are still being studied for modern applicability.

Large-scale combat operations (LSCO) of the future have the likelihood of occurring throughout the world. They will be conducted in multi-national coalitions and may be executed in austere environments. Sustainment operations will continue to be a critical consideration of operational planning—depending upon innovative logisticians to meet the unforeseen challenges of combat.

Notes

* This chapter is an excerpt from "The North Africa Campaign: A Logistics Assessment," a Military Art and Science thesis, US Army Command and General Staff College, Fort Leavenworth, Kansas, 1991.

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Chapter 4
Battle of Metz, September 1944

Major Corey D. Campbell

For the Army, sustainment is the provision of logistics, personnel services, and health service support necessary to maintain operations until successful mission completion.[1]

—Army Doctrine Publication (ADP) 4-0, *Sustainment*

The Battle of Metz took place during the Lorraine Campaign of World War II, immediately following the Allied Forces breakout from the Normandy Landings. The French city of Metz was essentially a fortress with natural and manmade fortifications. The battle marked the last time in the history of modern warfare when a fortress city played a decisive role in an Army campaign. The battle raged from September 1944 to December 1944 between US Third Army commanded by Lieutenant General George S. Patton and the German First Army commanded by General Otto von Knobelsdorff. General Patton was tasked to assault through Metz because it was the shortest route into Germany and the best suited avenue of ap-

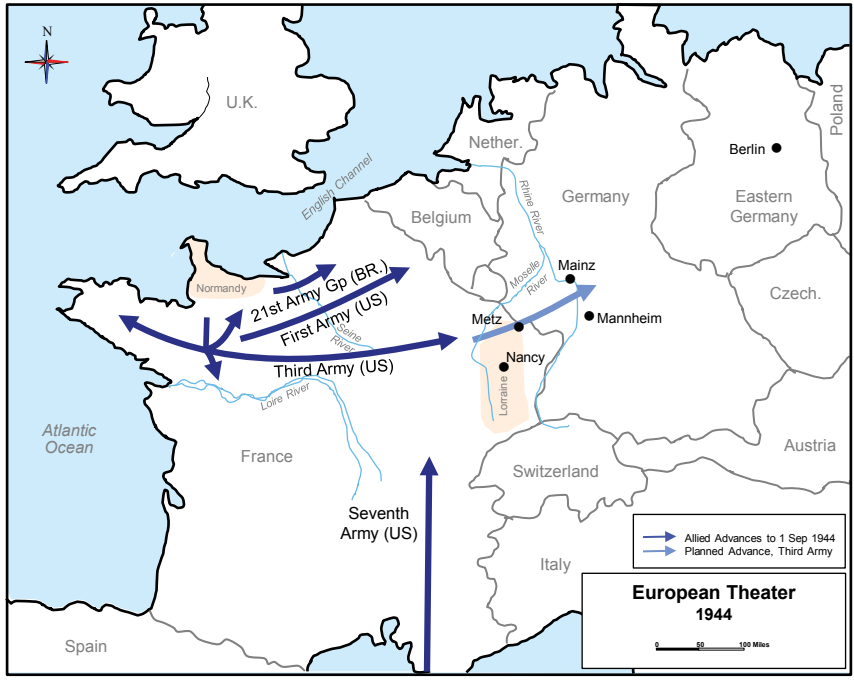

Figure 4.1. European Theater. Map created by Army University Press.

proach for modern warfare.[2] Metz was captured by US forces due to superior numbers and battle tactics on 22 November 1944. The last of the forts defending Metz surrendered on 13 December 1944 officially ending the Battle of Metz.[3]

Sustainment operations and planning efforts during World War II played a large role in the Battle of Metz between August and December 1944. Logistics shortages of Class I (rations), II (clothing and equipment), III (petroleum, oil, and lubricants), IV (construction materials), V (ammunition), and IX (repair parts) had a negative impact on the battle timeline and prolonged the battle by several weeks. Metz's fortifications and logistics shortages on the American side enabled a weak but die-hard German force to resist and stall the powerful US forces advance for several weeks.[4]

The sustainment strategies and techniques used during the build-up to the Battle of Metz provided several lessons on sustaining the force and supporting combined arms in large-scale combat. If General Patton had been given enough fuel and logistics support as well as the approval order to advance Third Army, could he have pushed the Nazi German army back across the Moselle River near Metz? The Battle of the Bulge might never have taken place and, in theory, the war could have been greatly shortened had the events been different.[5]

Setting the Stage

In 1944, Metz was one of the oldest cities in central Europe dating back to Celtic times.[6] Control of Metz transitioned from France to Germany and vice versa several times over the years leading up to World War II due to its proximity to the French-German border. The Germans occupied Metz after the Franco-Prussian War, adding fortifications to the city from 1871 until 1912. Then Germany lost Metz to France as part of the Armistice ending World War I. Metz was again occupied by German forces in 1940. At that time, the Germans further enhanced the city's fortifications, including deep moats surrounding each fort and underground bunker placement for large-caliber guns.[7] The fortress was impervious to heavy artillery and air bombardment because of the system of underground bunkers with concrete reinforcement. The fortifications to the city made its capture more challenging for Third Army. During the battle, infantry units conducted most of the fighting for US forces; the terrain was unsuitable for armor, and poor weather negated the advantage of US and Allied forces air superiority.[8]

From September 1944 through the end of the Battle of Metz, Third Army consisted of the XX and the XII corps. Four to six infantry divisions and two to three armored divisions carried the bulk of the burden for three months during of the Battle of Metz. Third Army also controlled two quartermaster groups totaling 60 companies, two ordnance groups comprising 11 battalions, and six groups of engineers.

The growth of mechanization of US Army combat arms led to great changes in warfare and support. In World War I, US Army divisions had a strength of approximately 25,000 men and consisted mainly of infantry with a limited range of fairly standard weapons.[9] The logistics requirements during World War I supported a stable front line and were not as complex as the requirements for World War II. In World War I, the combat arms unit's needs were primarily met by railways and shuttle services (horse-drawn) from the railheads to the front lines.[10]

Just 20 years after the end of World War I, the armored division, airborne forces, and amphibious units had become more prevalent and presented the need for a more robust logistics strategy to sustain them. Even the infantry divisions had become fully motorized and were equipped with

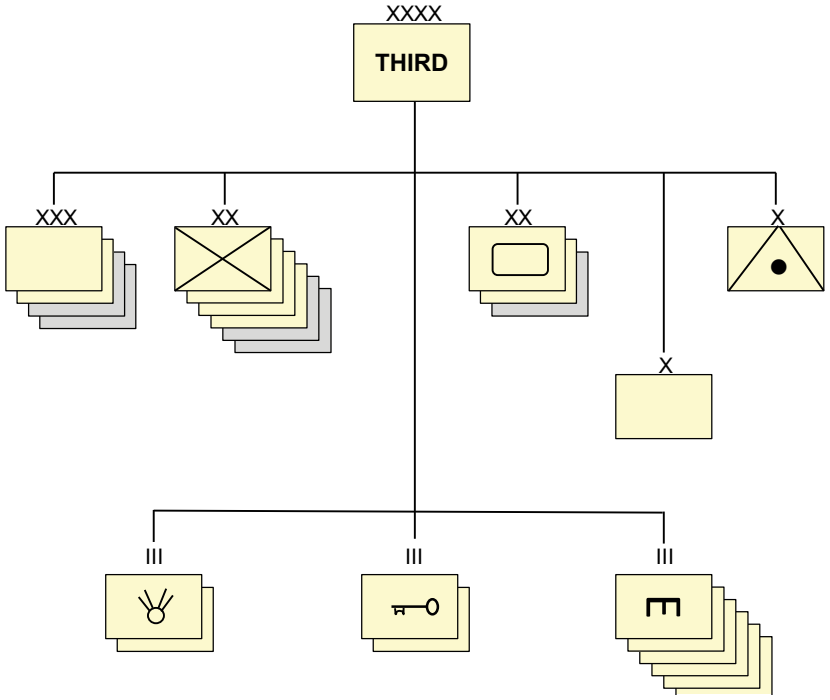

Figure 4.2. Third Army Units. Graphic created by Army University Press.

a variety of complex weapons: anti-tank guns, light howitzers, and other crew-served weapons. This in turn meant that during World War II, the number of support troops per fighting man had to increase greatly.[11] The logistics support system had to extend operational reach, provide freedom of movement, and improve endurance to enhance combat power.

While Allied logistics support to US forces during World War I was less complex, it was also much more comprehensive than in World War II. During World War I, the Allied armies in France were fighting in a country with a functioning political system and a firm commitment to winning the war. US forces had the support of French manufacturing resources, the railways, the police, and all the normal governmental functions of a developed nation.[12] In World War II, Allied forces fought in France as an enemy territory; France had been occupied by Germany in 1940, and Vichy France was established with oversight by Nazi Germany.

Metz Buildup

Unlike previous campaigns, the commanding generals did not determine the extent of support operations; the Army G-4 (assistant chiefs of staff for supply) performed those duties. General Patton relied upon his G-4, Colonel Walter Muller, to handle supply.[13] The Battle of Metz was plagued with logistics supply shortages of fuel, ammunition, clothing items, maps, and other supplies. The logistic shortage of supplies remained constant throughout the Battle from August through October 1944. The shortages ultimately prolonged the taking of Metz and Third Army's advance into Germany

It is important to note that at times during the Lorraine Campaign, Third Army was one of several units being supported in the European theater. Throughout the campaign, the priority for supplies and resources changed depending on the phase of the operation. Priority of support led to several tactical pauses due to varying levels of logistics support. General Omar N. Bradley, Commander of 12th US Army Group comprised of First Army and Third Army, had instructed the Army G4 to prioritize logistics support to the First Army and the British Allied forces to the north to enable them to come up on line with the Third Army.[14] Third Army was logistically starved at the onset of the Lorraine campaign because it was depleted in strength and denied the full use of its air assets due to distribution challenges and weather restrictions for aerial delivery.[15]

Logistics support flowed from the Communication Zone (theater support area where supplies come into theater and are stored) through the field army to the divisions, theoretically bypassing the corps echelon. In actual

practice, the corps were involved in logistics at least to the extent of designating truck heads and allocating service support units. The typical division in the European theater was comprised of 40,000 troops consisting of 15,000 organic to the division, 15,000 corps and army troops, and 10,000 Communication Zone personnel.[16] The following is an account of large-scale sustainment instances from the Battle of Metz over a three-month period.

During August 1944, Third Army forces drive from Normandy across France produced roughly 24,820 casualties with 19,506 replacements. The US forces were depending almost totally upon individual replacements.[17] The individual replacement concept was employed after all units were deployed into the European theater. The system provided the new inexperienced troops a sense of identity and afforded them some measure of security. The US method of personnel replenishment provided a consistent method of replacing personnel throughout the campaign despite the delta of casualties to replacements. The manpower reporting practices were exceptional and tracked key data to include injuries, killed in action (KIA), and missing in action (MIA). In the Third Army, non-battle casualties were 2.5 for each KIA.[18] Personnel reports were submitted up to higher headquarters on a daily basis to maintain consistency.

The US replacements were untested, because the requirements for troops outpaced the speed of training and many troops rotating into theater were fresh out of boot camp. In an effort to efficiently integrate the new troops, General Patton emphasized getting them training prior to throwing them into battle. [19] The quality and quantity of Patton's forces improved as a result. The personnel rotation plan improved over time due to lessons learned and adjusting the rotation as the campaign went on.

Supplies of fuel ran low on 28 August, slowing the Third Army advance. The Combat Command elements of the 7th Armored Division under XX Corps remained in assembly areas east of the Rhine River during the attack on Verdun, France, which was roughly 30 miles west of Metz. Several vehicles from the attacking command of the division were immobilized on the road for lack of fuel. Combat Command R stalled at Vouziers, France, which was on the Aisne River roughly 60 miles north east of Metz. Combat Command B just managed to get a spearhead into Verdun by siphoning gas from vehicles left behind.[20]

By September 1944, XX Corps units had been tasked to continue the advance toward Metz but fuel had run out again. The 5th Infantry Division had no gas supply when it completed its assembly around Verdun, and the 90th Infantry Division remained in Rheims because there was not enough

fuel to move the division. General Hugh J. Gaffey, Chief of Staff of US Third Army, told General Walton H. Walker, Commanding General XX Corps: "I hope the situation will improve this afternoon, but until gas arrives, you will have to limit movement in your area."[21] The main body of General Walker's XX Corps was immobilized at Verdun. The 7th Armored Division mounted task forces from Combat Command A and Combat Command B for a demonstration in the direction of Sedan, France, which was 114 miles northwest of Metz, by draining all other vehicles of fuel. These task forces were forced to stop for lack of fuel on the afternoon of 3 September.[22] CCA stopped at Steney, France, which was 76 miles northwest of Metz and CCB stopped at Montfaucon, France, a city 173 miles south of Metz. The fuel shortage eventually affected the majority of XX Corps.

In early September, Third Army ran out of fuel.[23] The logistics shortfall halted Third Army's advance, slowed momentum, and caused a tactical pause while units awaited fuel resupply. The fuel shortage wasn't a surprise to Third Army: First Army and the British Allied forces to the north had logistics support priority to enable them to come up on line with the Third Army. The extreme length of the supply lines and priority of logistics support were contributing factors to the fuel shortage. Lack of fuel was a continuing problem for Third Army, ultimately slowing its advance into Germany several times. Third Army also suffered shortages in other key supply areas like ammunition because resupply trucks were primarily focused on meeting fuel requirements.

During the September drive across France, Third Army consumed roughly 350,000 gallons of fuel every day. To fulfill Third Army's fuel requirement and meet similar demands from First Army, Army Sustainers organized the famous Red Ball Express to provide support. The Red Ball Express was a transportation innovation in logistics distribution; it was a nonstop conveyor belt of trucks connecting Normandy depots with the field armies.[24]

The Red Ball Express was actually established in late August 1944 and ran until November 1944. At its peak, the Express employed 6,000 trucks that ran day and night and transported more than 412,193 tons of supplies. The Express operation became more difficult to sustain with every mile the First and Third Armies advanced. The majority of the drivers for the Express were African-American; in addition to driving, they provided multifunctional logistics support by performing maintenance to keep the Express running. The average trip for resupply was 350 miles for Third Army and 400 miles for First Army. The Express was one of the largest logistics operations in World War II.[25]

To meet the demands of logistics to maintain the Express, three newly arrived infantry divisions were completely stripped of their trucks and left immobile at Normandy; one of many cross-leveling tactics used to support Third Army. The use of the Red Ball Express represented a calculated gamble that the war would end before the trucks broke down permanently. The vehicles were grossly overloaded, and preventative maintenance was all but ignored. The Red Ball Express itself consumed 300,000 gallons of precious fuel every day, nearly as much as a field army.[26]

There was a negative logistics impact on nearly all other classes of supply due to the fuel shortage. Over the course of a month, rations, clothing, mattress covers, coffee, tires, tobacco, antifreeze, winter clothing, and overshoes all were in critically short supply.[27] The fuel shortage had a big impact on ammunition, particularly in the larger artillery calibers that had not been in great demand during the fluid advance. When Third Army operations became static along the Lorraine border, there was no way to build up ammunition stocks because all available trucks were carrying fuel. By 10 September, Third Army's artillery batteries received only one-third of the unit of fire per day.

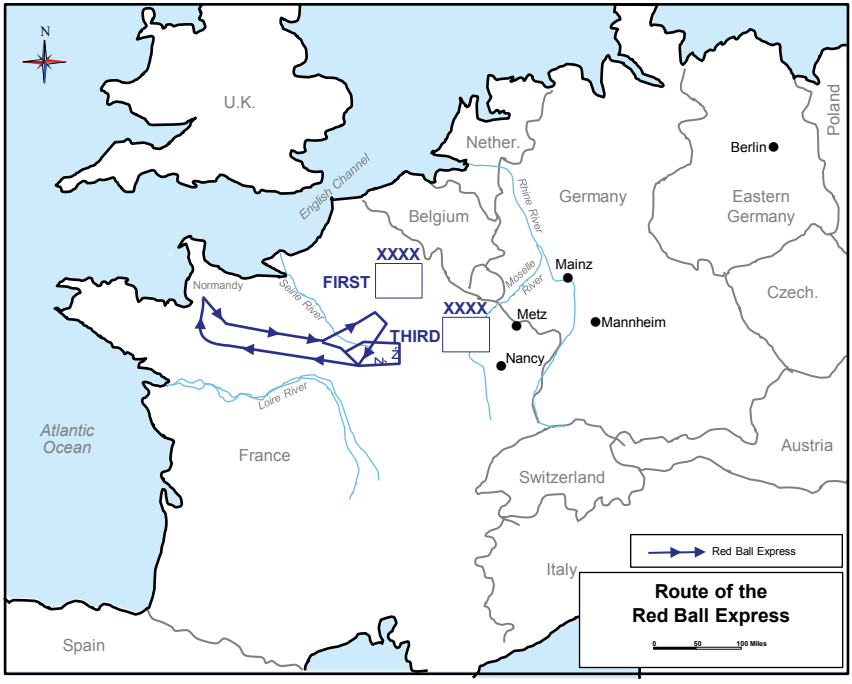

Figure 4.3. Route of the Red Ball Express. Map created by Army University Press.

On 25 September, Third Army operations came to an abrupt halt again south of Metz near the Seille River due to lack of fuel. Even with the Red Ball Express running at full capacity, logistical support was inadequate to sustain operations for all of the Allied forces in the European theater.[28] Eisenhower decided that the main Allied effort would come from the British 21st Army Group, which was granted transportation priority. Third Army had to hold its present positions outside Metz until the logistical crisis receded. This forced Third Army to remain relatively dormant from 25 September to 8 November.[29]

The tactical pause imposed on General Patton by the fuel shortage at the beginning of September permitted the Germans to complete their assembly, assume positions, and receive reinforcements; the Germans proceeded with the work of refitting and absorbing large numbers of replacements from the Schutzstaffel Panzer Grenadier brigades.[30] The reconstituted German force was able to stall the superior American forces because of the extra time they were afforded.

During the logistics-induced tactical pause, Patton ordered Third Army to build up reserves for the continued advance into Germany. The pace of advance before the pause put the unit at risk of having its lines of communication cut by the long distance from the communication zone at Normandy. There were inadequate distribution resources in country to deliver supply from Normandy to the forward line of own troops (FLOT) over the course of the advance. Every additional mile advanced by Third Army in September would have proportionately increased their line of communication, requiring more and more trucks to keep up the flow of supplies—trucks that were in desperately short supply because of the multifaceted attack strategy employed by the US and Allied forces.

On 3 October, General Patton ordered a stringent fuel rationing plan. Although fuel receipts for the month were only 67 percent of requested amounts, Third Army managed to amass a small reserve. The larger calibers of ammunition were also strictly rationed. To mitigate the ammunition shortage, tank destroyers and mortars were surveyed for use as artillery; extensive use was also made of captured German ordnance.[31] The rationing plan did not completely erase the supply deficit, but it did improve Third Army's logistics posture.

A number of factors facilitated Third Army's logistics reconstitution of supplies. One factor was the speed with which the French railroad system was rehabilitated and put to military use. Although the railroads in Normandy had been thoroughly interdicted prior to and during the invasion,

those in central and eastern France were relatively undamaged by Allied aircraft and had been abandoned almost intact by the retreating Germans. During the October tactical pause, Third Army brought its railheads as far forward as Nancy, which was 35 miles outside Metz. The French national support also supplied personnel to supplement Third Army's quartermasters via local business and manufacturing assistance.[32] Captured German supplies were another important source of materiel during the tactical pause. In addition to weapons and ammunition, Third Army used captured fuel transported in captured jerry cans (fuel containers), spark plugs rethreaded for American engines, and thousands of tons of food that fed both Soldiers and local civilians.[33]

As noted earlier, the 7.35 million gallons of fuel received during October amounted to only 67 percent of the requests for Third Army. As the result of rationing, the average daily issue of fuel was approximately 216,000 gallons in contrast to the average issue of 313,000 gallons during September. Third Army's reserve stock of fuel at the end of the month totaled 638,235 gallons.[34] At the end of October, the ammunition supply was still tight and units in contact voluntarily instituted a system of self-rationing when the seriousness of the situation became known to them. Classes II, IV, and V supplies were in improved condition at the end of the month, although fire control equipment was still critical. The shortage of small arms was greatly alleviated because of a battlefield recovery drive instituted earlier in the month. During October, Third Army ammunition personnel handled 124,361 tons of ammunition and attached quartermaster truck companies traveled 450,000 miles to haul supplies.[35] Third Army's requirements show the complexity of the different sustainment tactics needed to provide large-scale sustainment to a combined arms unit with support.

This tactical pause provided Third Army the time it needed to refuel, refit, and resupply the force. Third Army's use of rationing and local procurement resulted in the creation of four days of Class I and five days of Class III supplies when the eastward advance was resumed. Except for heavy artillery shells, the ammunition shortage was no longer critical.[36] By the time full-scale operations resumed in November, Third Army had greatly improved its logistics posture to continue the drive into Germany.

At the end of October, the Germans benefited from favorable environmental circumstances in the form of a rainy season that produced the worst floods in 35 years. On two different occasions, floodwaters washed out the Moselle bridges behind Third Army in the midst of heavy fighting. Almost all operations were limited to the hard roads, a circumstance that

the Germans exploited through the maximum use of demolitions. Third Army engineers built more than 120 bridges from October to November. The weather was so bad that it negated American air superiority. The XIX Tactical Air Command was assigned to Third Army for air support. XIX Air flew roughly 12,000 sorties (aerial supply missions) in August but only flew 3,500 in November. There was no air activity at all for 12 days out of the month because of the poor weather conditions.[37]

Third Army units were rotated out of the line to rest, refit, and integrate (RRI) replacements from the end of October into the first week in November. During the RRI, Third Army unit replacements included XX Corps—losing the 7th Armored Division and acquiring the 95th Infantry and 10th Armored Divisions in return. In addition, XII Corps obtained the 26th Division, which raised Third Army's strength to six infantry and three armored divisions.[38]

As the weather got worse due to excess rain during the autumn months, trench foot became a serious problem for Third Army. Troops were constantly exposed to water and cold, resulting in a sharp increase in trench foot casualties. At the peak of the outbreak in November, 4,587 cases of trench foot were admitted to division clearing stations, and it was estimated that 95 percent of the patients would not be suited to go back into the combat zone during the winter months. Subsequently, all possible efforts were made to prevent trench foot, and the falling rate was evidence of success. From five peak days (12 to 16 November inclusive) when the rate averaged 444 cases a day, incidents dropped to 125 cases a day.[39] The medical service corps showed great adaptability during the trench foot outbreak.

The French civilian economy provided host nation support, which helped mitigate some of Third Army's logistics shortages. The Gnome Rhone Engine Works in Paris retooled to repair American tank engines. Other manufacturers produced tank escape hatches and track extenders that greatly facilitated mobility in the Lorraine mud. When November's colder weather precipitated a critical shortage of antifreeze, French industry supplied thousands of gallons of alcohol in lieu of Prestone antifreeze. Local sources also produced fan belts; and when tires became so scarce that all spares were removed from their racks and put into use, French tire manufacturers turned their production over to US forces. Third Army's ordnance units used existing French facilities, which improved ordnance production.[40]

Lessons from Metz

Improvisation—the ability to adapt sustainment operations to unexpected situations or circumstances affecting a mission—is one of the eight

principles of sustainment. It includes creating, inventing, arranging, or fabricating what is needed from what is available.[41] Improvisation is an important part of sustainment because it requires the sustainer to adapt to any sustainment issues that arise at any given time. This principle was illustrated in the Battle of Metz by the way Third Army had to adapt to shortages and weather restraints.

General Patton's supply at Third Army level was handled by his G-4, Colonel Walter Mueller, who had served him in that capacity since 1941. Mueller successfully juggled captured stocks and the limited amounts of issued supply to keep the Third Army moving. Several tactics were used over the course of the campaign, including the use of supplies from other Army units when possible. Mueller excelled in using improvisation to keep Third Army moving. Third Army raiding parties made forays to First Army dumps to salvage usable scrap and considerable quantities of usable supplies.[42] Mueller's tenacious logistics acumen and improvisation were critical for the type of warfare Third Army was involved in, especially when considering the number logistics challenges they faced.

The creation of the Red Ball Express was a prime example of improvisation in the wake of a major logistics challenge. The Red Ball Express was a defining logistics moment in the campaign which helped to temporarily extend Third Army's operational reach by lengthening its line of communication. Its implementation highlighted the importance of distribution and, more importantly, multi-modal distribution. Multi-modal distribution is a method of distributing supplies and services using different modes of transportation to include land (trucks, rail), sea (watercraft), and air (aircraft). With rail head use hindered in Normandy and flights limited due to weather factors, leveraging of ground assets helped to mitigate the loss of the other distribution methods. This strategy facilitated moving supplies forward to supported units and was a successful improvised logistics gamble that temporarily mitigated the logistics shortfall.

The Red Ball Express served as a temporary solution to help mitigate the greater systemic problem of supporting units as close to the FLOT as possible with no intermediate logistics hub between the line and the communication zone (logistics staging area). There was no way the Express could run indefinitely. With its heavy fuel consumption rate, the Express began to impact the Third Army's fuel allocation. When General Patton's spearheads arrived in the vicinity of the city of Rheims, which was 135 miles outside Metz, Third Army's fuel allocation fell 100,000 gallons short of requirements; since all reserves had been burned up in the course of the advance, the pace of General Patton's advance began to

suffer almost at once. The simple truth was that although fuel was plentiful in Normandy, there was no way to transport it in sufficient quantities to the leading elements. With fuel tanks running dry, General Patton's spearheads still managed to capture Verdun city 51 miles outside Metz and cross the Meuse River.[43] The Red Ball Express was supposed to alleviate the logistics distribution problem, and for a time it did. However as we see here, the resource-intensive logistics strategy became less effective and unsustainable the farther away the troops advanced.

In addition to *innovation*, the tactical pause in October 1944 showcased Third Army's use of *anticipation*—the ability to foresee operational requirements and initiate actions that satisfy a response without waiting for an operations order or fragmentary order.[44] General Patton's decision to implement rationing practices in preparation for the battle to come was a critical decision because it allowed Third Army to greatly improve its logistics posture. The *anticipation* principle was important for the Battle of Metz because if Third Army had remained complacent during this period, they would not have built up enough supplies to continue the drive forward and might have further delayed the taking of Metz.

Host nation support was also a factor in the Battle of Metz. Although host nation support decreased during World War II in contrast to World War I, it was still an important part of the sustainment effort to support American and Allied forces. Third Army showed exceptional economy by utilizing host nation support and assets such as railways, local purchasing, scavenging, and local manufacturing. This economic sustainment strategy postured Third Army for the advance though Metz.

Economy is providing sustainment resources in an efficient manner to enable a commander to employ all assets to achieve the greatest effect possible.[45] *Economy* is achieved through efficient management and discipline, prioritizing and allocating resources, and capitalizing on joint interdependencies. It can also be achieved by contracting for support or using host nation resources to reduce or eliminate the use of military resources.[46]

Consistency of personnel services during the Battle of Metz was important because manning the force was critical to the success of the battle—especially when the need for troops outpaced the pool of troops. *Consistency* involves providing uniform and compatible guidance and support to forces across all levels of operations.[47] Consistency was best illustrated by the personnel rotation strategy throughout the Lorraine campaign.

The individual rotation strategy used to rotate personnel in and out of theater during the campaign was essential to keeping troops in Third Army

to support the mission of advancing into Germany through Metz. The consistency of personnel inflow helped provide Third Army with fresh troops and kept personnel from becoming mentally and physically battle-fatigued over long periods of time. This personnel practice is a vital part of sustaining the force and providing endurance over the course of a conflict.

Additionally, Third Army's engineer corps demonstrated *survivability* in all aspects of protecting personnel, weapons, and supplies while simultaneously deceiving the enemy. *Survivability* is a quality or capability of military forces which permits them to avoid or withstand hostile actions or environmental conditions while retaining the ability to fulfill their primary mission.[48] A prime example of *survivability* not only against the enemy but also against the elemental challenges of the floods was in the supply of Class IV construction materials to the Corps of Engineers and the construction of bridges to support the advance during the Battle of Metz.

The last push to capture Metz proved difficult due to the unusually heavy autumn rains that flooded the Moselle and Seille rivers. Engineers constructed 20,000 foot bridges, most of which were built over the major water obstacles caused by the streams raised to flood stages by incessant rains and aggravated by small lakes formed by Maginot line dams. The engineer support required extensive Class IV construction materials and Class V demolition materials. Bridging activities were higher during the final assault on Metz before the fortress was reduced; 120 Bailey bridges, 111 Treadway bridges, 64 timber spans, and two heavy pontoon bridges were all constructed during the last push.[49]

Health Service Support—which falls under sustainment—showed great flexibility when dealing with the trench foot outbreak. The principles of the Army Health System (AHS) guide medical planners in developing operational plans which are effective, efficient, flexible, and executable.[50] Cross-coordination with the logistics support channels was essential in procuring appropriate winter gear to combat the outbreak, mitigate future outbreaks, and enhance combat power.

Conclusion

The logistics planning efforts for the Battle of Metz provides an in-depth look at large-scale sustainment operations for a combined combat arms element. The principles of sustainment focus on how the elements of sustainment—logistics, personnel services, and health services—support operations by providing Army forces operational reach, freedom of action, and prolonged endurance.[51] The principles of sustainment are as important today as they were in the Battle of Metz—prior to becoming doctrine.

The multi-modal transportation strategy used throughout the Battle of Metz provided several lessons that apply to sustainment operations in large-scale combat operations. Multi-modal transportation is the use of rail, sea, air, and road lines of communication to distribute supplies. When the US and Allied forces were deprived of rail support because of a destroyed rail system from Normandy and air support was limited due to inclement weather, the road lines of communication became an important mode of distribution. The strategy provided responsive support to the forward line of troops via the Red Ball Express. Multi-modal transportation is still just as relevant today for modern combat operations and sustainment.

The Trans-Arabian Network (TAN) is a contemporary multi-modal distribution network which provides distribution support to the Central Command Area of Responsibility (CENTCOM AOR). The TAN uses land, sea, and air assets to provide support to various units within the CENTCOM AOR. The TAN's establishment and use is a modern example of multi-modal transportation put into action during a time of war—similar to the methods used in the Battle of Metz. The level of logistics support the TAN provides extends operational reach to US and Allied forces, provides prolonged endurance, and gives freedom of action to enhance combat power.

The Battle of Metz illustrates the Third Army's use of the following principles of sustainment: *improvisation*, *anticipation*, *economy*, *consistency*, *survivability*, and *flexibility*. When reflecting on how large-scale sustainment is practiced today, the same principles of sustainment are still just as important. Specifically, the shortage of fuel challenges and the cascading negative effect on various other classes of supply show how the sustainment principles are interconnected and how they affect large-scale combat operations.

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Chapter 5
Korea and Logistics*

James A. Huston

In the movement and support of her own forces, in the support of the forces of the other members of the United Nations, and in the support of the forces of the Republic of Korea, the United States was involved in one of the greatest logistical undertakings of her history.

The total tonnage of supplies of all classes shipped from the United States to the Far East during the three years and one month of the Korean conflict—approximately 31.5 million measurement tons—was more than twice the tonnage shipped from the United States in support of the American Expeditionary Force in World War I during the 19 months from June 1917 through December 1918. It was 82 percent greater than the total shipment of supplies (17,277,000 measurement tons) for the support of Army ground and air forces in the Southwest Pacific Area—General MacArthur's command—in World War II in the 37 months from August 1942 to August 1945.

World War II a Prerequisite

There could have been no Korean conflict without a World War II preceding it. It generally is true to some extent that the supplies and equipment produced in one war tend to become the reserve of the next. Modern warfare requires a substantial cushion for meeting materiel requirements during the first one to two years of a conflict before industrial mobilization permits current demands to be met from new procurement.

Equipment left over from World War II provided the only cushion in the Korean conflict. Without it, combat operations in Korea simply could not have been supported. In this case the preceding war had been so recent, and its scope had been so vast, that huge quantities of materiel still were available.

Stocks maintained in various materiel reserves were almost entirely of World War II supplies, for there had been virtually no new procurement in most items since the end of World War II. In addition, great quantities of World War II equipment remaining on the Pacific islands fed the rebuild plants in Japan to make up serious shortages.

But the importance of World War II in the logistical support of the Korean conflict went beyond the matter of essential materiel reserves. The very procedures by which the ports of embarkation and the technical

services were able to fill requisitions and build up shipments of supplies quickly were the result largely of practices which developed during World War II.

United States support in the conflict in Korea was one of *the greatest logistical efforts in our history. The lessons learned and the procedures developed there should prove of tremendous value in the future.*

Korea Logistical Challenges

Probably no item of supply attracted more public attention than ammunition. It seemed incredible to many that American production still had not been able to overcome all shortages of ammunition more than two years after the outbreak of war in Korea. Locally, shortages could be attributed, not to the exhaustion of available supplies, but generally to difficulties of local distribution.

Yet it was true that total stocks in the Far East Command, for a number of significant types of artillery and mortar ammunition, frequently did fall below the *authorized level* of supply (90 days), and at times dropped well below the 60 days of supply defined as the *safety level.* Reasons given for the failure to maintain full authorized levels were:

1. The unusually high rate of fire deemed necessary by General Van Fleet to offset the enemy's large numbers in particular situations.

2. The fact that no ammunition production lines of any consequence were in operation in the United States.

3. The long lead time—about a year and a half—required to establish production lines and get quantity production.

4. The fact that the Department of Defense, holding to an assumption of early termination of the conflict, set restricted budgetary guidelines for ammunition procurement.

Yet the real shortage was not in Korea. There all the ammunition needed for any particular operation was available to the extent that it could be moved with existing transportation. The real shortage, although this was not the aspect receiving most public attention, was in the Army's total ammunition resources in relation to its worldwide commitments and responsibilities.

The burden on transportation imposed by the unusually high rates of expenditure of artillery ammunition in Korea at various times—particularly when the days of fire and authorized levels were increased—was as significant as the drain on the ammunition supplies themselves.

Land transportation in Korea probably was the key to the entire logistical effort in support of operations there. This meant dependence on the Korean railways for major supply shipments, supplemented to some extent by highway transportation. Delivery to forward units was mostly by motor trucks, augmented in areas of rough terrain by the hand carriers of the Korean Service Corps. Perhaps the most serious continuing bottleneck in the transportation system was in moving goods out of the port areas, and this situation was aggravated by the concentration of depots in the Pusan area, near the port facilities.

A very small part (less than 1 percent) of the supplies shipped from the United States went by air; the planes available could not approach the speed of Liberty ships in delivering 10,000-ton quantities, and air transportation was far more costly than sea transportation.

In the period of the Korean conflict, sea transportation still was normal. But air transportation did make important contributions in at least two ways—in delivering small quantities of essential items quickly, and particularly in the evacuation of casualties. Its greatest value was in its being—so that it would be available for emergencies.

The evacuation and hospitalization system generally was about the same as had been used in World War II. Probably the most significant developments in this connection were the general use of Mobile Army Surgical Hospitals, the use of helicopters for battlefield evacuation, and the general reliance on air transportation for the evacuation of casualties to Japan and to the United States.

Difficulties in the maintenance of equipment in Korea appeared almost from the outset of hostilities. The additional strain put on vehicles by intensive use over poor roads and mountainous terrain, mechanical weaknesses in certain of the tanks, and periods of intensive firing of artillery contributed to these difficulties. But much of the trouble in the early months of the conflict seemed to be more the result of a lack of well-trained men to handle the necessary organizational and field maintenance than of defects in the design or materials of the equipment itself. Another difficulty, at least until 1952, was the inevitable shortage of spare parts. This was an especially acute problem for the great variety of highly specialized engineer equipment which had to be kept in operation.

Neither the Far East Command nor the Department of the Army appeared to have any prepared plan for support of military operations in Korea. The decision to go into Korea with ground forces apparently was

an off-the-cuff decision supported by a spontaneous recommendation from the Far East without reference to logistical plans and analyses.

In meeting the first critical demands, Army leaders in Washington, Tokyo, and Pusan mostly had to "play it by ear." Detailed planning did begin at once, of course, but that planning might have been done more quickly and more effectively had there been some planning preceding it.

Perhaps this experience would suggest that something might be gained by developing detailed plans for supporting various types of possible operations in potential areas of conflict in all parts of the world. It is patently impossible to have concrete plans to meet all eventualities. Yet there is an advantage to be won in the very process of planning, even if the plans themselves have to be "thrown out the window" when the emergency comes.

Challenges Met

In the planning process, certain data must be gathered and evaluated, procedures considered, limitations studied, and assets analyzed. This makes simpler and quicker and more efficient the actual support when the necessity arises. New data may be put to use more quickly and effectively if only the basic questions have been sought out in advance. Improvisation depends upon imagination, and imagination depends upon experience—personal and vicarious. This is a major contribution of the service schools, and it is a function of continuous on-the-job planning.

Scores of examples could be cited where imagination triumphed over adversity in providing support for the Korean battles. As the early North Korean offensive gained momentum in July 1950, the 2nd Division moved in record time from Fort Lewis, Washington, to the Korean battlefield.

After the Chinese intervention, imaginative officers both in Japan and in the United States got emergency shipments of equipment quickly. Such procedures as MARINEX and CONEX provided means for rapid sea transportation of high-priority cargo to supplement the airlift.

Improvised cable lifts performed valuable service in delivering supplies and bringing out casualties from almost inaccessible battle positions in the Korean mountains. Korean hand carriers and helicopters soon became almost indispensable for supply and evacuation across the rugged mountain country.

The perfection of Quartermaster service centers was one of the outstanding developments of the Quartermaster Corps in Korea. The combination of shower and clothing exchange points and repair and maintenance facilities in the same vicinity went a long way toward saving clothing

while contributing to the health and morale of the troops. On the other hand, a great deal of waste in clothing and equipment, particularly in the discard of unpopular items, was evident at various times. The unfortunate failure to get winter clothing and equipment to many of the troops in North Korea before the onset of cold weather in 1950–51 indicated how events might nullify particular plans in that kind of a situation.

Korea provided the first operational use of the Mobile Army Surgical Hospital in the evacuation and hospitalization system. This hospital had been organized as a 60-bed unit to be located with or near division clearing stations for the purpose of providing surgical treatment for casualties too badly injured to be evacuated further to the rear without first having such attention.

Actually, the Mobile Army Surgical Hospitals supporting the Eighth Army were expanded to 200-bed units, and they served as small evacuation hospitals during most of the conflict. Apparently the limited and channelized surface transportation facilities in Korea, and the growing reliance on air transportation, made it less practical to use these hospitals in the way originally intended. In the last months of the conflict, some of these mobile hospitals were cut back to 60-bed units; and it seemed likely that the use of the 60-bed units with divisions would continue to be regarded as standard practice in places where communication facilities would permit it.

Evacuation of patients both to Japan and to and within the United States was mostly by air. Army Medical Service officers in Japan developed a system for receiving patients by medical holding companies at three different airfields, and for screening them at three separate hospitals so that congestion at a single receiving hospital could be eliminated. Within the United States the hospital train practically was a thing of the past, as patients arriving from the Far East were flown to hospitals chosen near their respective homes for convalescence.

For other uses than the evacuation of casualties, air transportation within the Far East Command was most valuable for emergency delivery of specific items of equipment and supplies—such as the dropping of supplies to elements of the 1st Marine and 7th Infantry Divisions isolated in the Chosin Reservoir area in November–December 1950, including the parachute delivery of an *M-2* treadway bridge.

In the control and operation of air transportation, the division of responsibility among the Air Force, the Transportation Corps, and the Quartermaster Corps was not clear-cut and firm. This was a question demanding further study.

Various modifications in techniques and procedures developed in Korea recommend themselves for future consideration. Soldiers thriving on fresh vegetables flown from hydroponic farms in Japan are not likely to expect a less attractive bill of fare in the future. Engineers facing an "impossible" task of railway bridge building sometime in the future could recall the reconstruction of the Kilra-Chon bridge south of Wonju in April 1951. The effort called for the erection of two prefabricated replacement towers 103 feet high, the fabrication of a continuous girder 270 feet long and weighing about 130 tons by bolting and welding I-beams, and the launching of the girder by means of special rollers made in Japan.

Supply officers looking to the setting up of Class IV supply projects for some future operation might turn to the five-quarters (15-month) engineer Class IV supply forecast system. Such a system was developed late in the Korean conflict to assure a more uniform flow of Class IV materials by providing a constant review of requirements and revision of the current status of supply for the benefit of each supply agency concerned.

There is something to be said for a suggestion that the United States, in cooperation with her allies, should stockpile all kinds of military supplies at strategic points near areas of potential danger in various parts of the world. Under such a plan, cadres of logistical commands could receive, store, and protect the supplies; then, if an emergency developed, service troops could be flown to the bases maintained nearest the threatened area to begin full-scale supply operations.

Manpower—The Special Challenge

Most of the Army was not in the combat arms—the infantry, armor, and artillery; most of it was in the technical services—the engineers, quartermasters, medics, and chemical, signal, and transportation units, and in the administrative services and the headquarters which guided and supervised the tactical and service units from the combat zone to the Pentagon. The Army's administrative and supply and service functions were not confined to the support of its own units; it also had broad responsibilities for supporting the other services—especially the Air Force, and in Korea the Marine Corps—and for executing the military aspects (and sometimes civilian aspects, too) of the Government's Foreign Assistance Programs.

Perhaps the general problem from which it was most difficult to draw definite conclusions was the question of personnel to perform all the logistical functions needed. In Japan, American forces had the services of an effective labor force which could not be counted upon in all possible

theaters of operations. The Japan Logistical Command estimated that if all the supply and service functions of that command had been carried out without the use of Japanese workers, an additional 200,000 to 250,000 service troops would have been required.

The use of local labor in Korea was much less efficient, although hardly less significant, than in Japan. By the fall of 1951, US forces in Korea were employing more than 77,000 native workers in the rear area in addition to the 50,700 members of the Korean Service Corps and 30,000 other laborers within the corps areas. Without close supervision, Korean laborers often were careless and undependable. But without their assistance, it scarcely would have been possible to deliver supplies to frontline units or to complete when needed many of the engineering construction projects.

Contract labor, which put a premium on inefficiency by making the contractor's payment dependent upon the expense of the labor he furnished, was so unsatisfactory that in the summer of 1951 the Army resorted to a policy of direct hire labor whenever possible. But the greatest shortcoming was in the lack of training and doctrine for the employment of indigenous labor in the Army. Here was something upon which the Army was depending for its very existence in the Far East, yet no one had thought about it sufficiently to include planning, training, and indoctrination of Army staff officers in the proper use and supervision of such labor.

In the 2nd Logistical Command, General Paul F. Yount set up a school, intended originally to train Koreans in American methods, but which became a school for training Americans to supervise Korean workers. A firm Army policy was needed which would spell out clearly the responsibilities for the procurement, training, organization, control, assignment, and administration of indigenous personnel.

Curiously enough, the number of service troops actually used in the Far East (in 1951) approximated closely the 43 percent of theater forces (not counting the organic service units of the divisions) established in the Army's planning data.

Finding enough skilled technicians for logistical support activities was a problem which became more pronounced with each technological advance in the conduct of warfare. A shortage of trained specialists in the Army already had become so acute, even before the attack in Korea, that in June 1950 the Department of the Army published a directive providing for the ordering of qualified men to specialists schools involuntarily if enough qualified were not available.

Logistical Organization

In administrative organization, the Far East Command had developed a theater structure closely paralleling that outlined in established doctrine. The principal deviation from the "normal" was in the designation of the Korea Communications Zone (KOMZ) and in the organization of a single section J headquarters under it. In a unified command where an Army officer was commander in chief, it was to be expected that he would command military operations directly through the field army commander (or army group commander if there were one). With no tactical functions, the theater army headquarters—in this case Army Forces, Far Eas—was concerned almost wholly with administration and logistics.

Perhaps more serious was the "layering" of logistical headquarters in Korea resulting from the establishment of a single section headquarters—Korea Base Section—under Korea Communications Zone Headquarters (KCOMZ). It is true that the supervisory functions of KCOMZ were broader, including control of the 3rd Military Railway Service and responsibilities for area administration, prisoners of war, and civil affairs. Yet in supply functions, duplication of effort often appeared in practice between KCOMZ and Korea Base Section until the two headquarters were combined and subordinate area commands set up at the end of hostilities. Ultimately, the soundness of the logistical command concept—the idea of having a headquarters organized under an approved table of organization and equipment for certain types of logistical missions—appeared to be well-established.

The logistical organization of the Department of the Army in the United States proved to be able to meet the shock of the Korean emergency with some expansion of personnel, but with only relatively minor readjustments in organizational structure. *This was a significant achievement. It was the first time that the Army's peacetime administrative machinery had been able to provide the essential services and supplies of a war situation without a far-reaching reorganization.*

In some ways the Army's service and supply organization still seemed to embrace too much red tape, to encourage too much duplication of effort, and to be too ponderous for speedy operation. But many were satisfied that the organization of G4 and the technical services—which had been effective in peacetime and in the Korean emergency—could serve as well in any future emergency. The entire field of administration and logistics was one in which the Army had been forced to excel in modern warfare. In the mid-20th Century, fighting was becoming—for the Army—secondary to

administration. Becoming noticeable in World War II, this trend received further acceleration in the Korean conflict.

Learned Valuable Lessons

In the long run, it was possible that the experience gained in supporting the other United Nations forces might provide the most valuable lessons of the whole conflict. While the relative number of troops furnished by other members of the United Nations was small and the supplies and services furnished them an almost insignificant fraction of the total, the real significance of United Nations participation was not to be measured alone in terms of the numbers of troops involved.

The problems of coordination, negotiation, and accounting were as great as if the troop contributions had been several times as large. It took about as much paperwork to record the disposition of 10 vehicles as of 100. Negotiations for concluding satisfactory agreements on financial arrangements were hardly less involved for the settlement of accounts amounting to $1 million than for accounts of $100 million.

Aside from the demonstration of solidarity for United Nations principles which the military contributions of the other nations indicated, probably the most important result of those contributions was the experience in international logistical cooperation which was likely to prove invaluable in any future collective police action or coalition war. While it was unlikely that any future allied military effort would adopt altogether the same policies as those applied in Korea, the very fact that some experience had been gained would provide at least some standard for planning where heretofore practically none was to be found.

Patterns for Future

Above all it might be expected that in the future serious consideration would be given to flexible methods, of providing and financing military equipment for allies in wartime. Many Americans felt a sense of disappointment in seeing the Korean conflict ended on terms less than total victory. But perhaps there was something even more important gained in this demonstration of restraint in the conduct of limited war for limited objectives. *In an age when total victory was associated with total destruction, perhaps it was more urgent than ever that total war be avoided as long as the national safety and essential freedoms were not sacrificed.*

Indeed that presumably was the objective of the whole United Nations effort in Korea. If the United States were engaged in a limited war in Korea in order to forestall a third world war, then that effort was suc-

cessful. If the United States were engaged in Korea in order to prevent the extension of Communist domination to South Korea, then that effort, too, was a success.

What probably was the most important result of the Korean conflict for the United States *was that it served to alert Americans to the general danger of Communist attack at a time when they were looking hopefully toward trimming their defense expenditures and commitments for logistic support for allied nations.* Actually, it was the Chinese Communist invasion in November and December 1950 rather than the original North Korean attack of the preceding June that was the more important stimulus to the rearmament program. It was only after the Chinese intervention that the President proclaimed a national emergency—largely for the benefit of logistical expansion. *The Communist attack in Korea consequently set in motion a long-term rearmament program by which the United States would be made more nearly prepared to meet future emergencies, and particularly to accept total mobilization should that become necessary.*

A series of top-level decisions followed which had far-reaching consequences for the military position of the United States. The first of these was that *Korea must be regarded in a worldwide setting*—as the most emphatic warning of the threat of Communism in the world at large. The defense of Western Europe continued to hold a high priority. Indeed, because of the attacks in Korea, reinforcements were sent to Europe.

A second major decision of the Army high command was that *materiel mobilization should take precedence over personnel mobilization.* Secretary of the Army Frank Pace Jr. regarded materiel procurement as the controlling factor in the expansion of forces, and he resisted pressure to embark on a vast personnel mobilization program which might, in fact, retard materiel procurement and so military preparedness.

Another basic decision—actually a matter of national policy—was for *"creeping mobilization."* That is to say, industrial mobilization would be partial rather than total, and it would be accomplished with the least possible dislocation of the domestic economy. This was a decision based upon an assumption—shared by George C. Marshall and Robert A. Lovett, his successor as Secretary of Defense, and by Army officials—that world tension would continue for an indefinite time in the future. Too rapid industrial mobilization would invite the risks of obsolescence of weapons when they were most needed, and would make more difficult the maintenance of satisfactory materiel preparedness for the long pull against world tension which seemed to lie ahead.

Closely related to that policy was the further decision *to develop a broad industrial production base.* This put primary emphasis in the rebuilding of military strength upon long-term industrial mobilization aimed more at developing *capacity* to produce in great quantities than at immediate quantity production at the expense of greater capacity later. This decision was based upon the assumption that rapid industrial mobilization was the key to meeting emergency threats to the national security.

Under this policy, orders for arms and equipment to support operations in Korea and to build up stockpiles in Europe and the United States were placed in such a way that long-range industrial preparedness would be best served. Smaller orders with several companies were favored over large orders with a single producer. Three production lines running on single shifts were preferred to a single production line running on three shifts because of the obvious advantage in expanding output quickly. This program required greater effort on the part of people administering it and sometimes, perhaps, was a little more costly, but such a policy was essential for the military preparedness of the United States.

"Creeping mobilization" and the broad production base probably were the fundamental logistical concepts of the Korean conflict. They shaped the whole war effort in treating Korea as a limited war while preparing for a total effort should that become necessary.

In still another sense, the Korean conflict had worldwide logistical ramifications. While it is true that the attacks in Korea stimulated the sending of additional troops and supplies to Europe, it must be recognized that beyond a certain point Korea loomed as a competitor with Europe and other areas for what materiel resources were available. It was a repetition in a way of the World War II contest for resources between Europe and the Pacific. The Truman and Eisenhower administrations recognized the vital importance of Western Europe in the world strategy against Communist expansion; however, the Eisenhower administration put greater emphasis on Asia than had been the case earlier. One of the most outstanding examples of this new emphasis was the decision *to accept the full program of arming and equipping 20 divisions for the Republic of Korea Army.*

This, too, was a decision having worldwide implications. Since no plan for a corresponding increase in the procurement program accompanied it, the decision to expand the South Korean Army to 20 divisions amounted to denying that equipment for further buildup of European forces or for replenishing American reserve stocks. But the possibility of emergencies

elsewhere could not be ignored. This decision, like so many military decisions by their very nature, belonged in the realm of "calculated risks."

Even the significance of the ammunition shortage was less a matter of concern for support of the Korean conflict than a significant element in the big picture. Ammunition, while frequently below that authorized in the theater, never was short on the battleline except on occasions when available transportation could not keep up with the rate of fire. The really dangerous situation which the expenditure of ammunition in Korea created was the depletion of reserve stocks in the United States. Again this meant more of a restriction on defenses in Europe and other areas than in Korea.

Summary

Logistical support of the Korean conflict had far-reaching consequences for the American position in the Far East, and it also had far-reaching consequences in the worldwide struggle against the spread of communism. *For the United States, the Korean conflict was the second greatest of her wars from the standpoint of its logistical contributions. The best measure of success in that effort would be the extent to which it might help avoid a future conflict which might become the greatest war.*

Future large-scale combat operations (LSCO) will also rely on coalitions and host nation resources. LSCO will have similar challenges of balancing sustainment support to hot spots and potential new conflicts across the globe. And, national preparation for LSCO will face political and economic obstacles with continuous pressure on the military budget.

Notes

Chapter 6

Building for Peace and Battle in Vietnam: The Origins of Modern Contracting

Isaac W. Hampton II

US aid to Vietnam began in May of 1950, due in large part to the 1949 Communist victory in China headed by Mao Zedong. This pushed the State Department to reformulate its entire policy toward the entire Far East.[1] America sent $10 million in support of the French government's efforts to bring the former colony back under French control and to crush any designs on Vietnamese independence by factions led by Ho Chi Minh. The French adventure in Vietnam culminated in defeat at Dien Bien Phu in May 1954. During the First Indochina War, the United States spent more than $2 billion supporting the French. From 1954 to 1974, modest estimates of total American aid to Vietnam were $25 billion, which equates to approximately $121 billion in 2018 dollars.

US support from 1954 to 1957 was more of a humanitarian relief effort. The French purposely did not modernize the general infrastructure of roads, ports, and power grids in Vietnam so they could maintain a grip of colonial rule and keep parts of the country in a pre-19th Century state. Following their defeat, the retrograde effort by the French after Dien Bien Phu was non-existent. According to a US Army study, a myriad of military hardware was spread across Vietnam—trucks, tires, tanks, small arms, engines, jeeps, aircraft, and spare parts that numbered in the millions and needed to be removed from the country.[2] The next stage would be a long-term development operation of America's aid program in South Vietnam known as "Nation Building." This effort began with 692 US military personnel in 1956 and would grow to nearly 549,500 military personnel in 1969. What is often forgotten are the more than 130,000 civilians who provided unprecedented levels of logistical support for transportation, supply maintenance, general logistics services, and construction in a combat theater.[3]

Contractors and the US Military

In western military history, the first documented account of civilian contractors serving on the battlefield is traced back to the 16th Century. Because of price gouging and profiteering in the early years of the American Revolutionary War, private contracting was forbidden until February 1781. That year, Robert Morris was appointed by the Continental Congress as the Superintendent of Finance with the responsibility of managing the Army's procurement system. An experienced merchant from Philadelphia,

Morris adopted the proven European model of having private contractors supply the Army. While contracting proved more efficient, there was also a healthy suspicion from George Washington and Alexander Hamilton that financial gain and profits at the expense of the Army were the motivation of many contractors who worked with the Army.[4]

An Evolving Military and the Need for Contractors in Vietnam

Juxtaposing the necessity for construction in Vietnam to other US building projects in previous wars such as the European Theater in World War II, the lack of infrastructure did not present the same obstacles. The war in Europe did require the construction of major troop accommodations, roads, or deep-water port facilities. For the Korean War, which was similar to Vietnam, the United States and United Nations would send large numbers of troops to fight in that undeveloped country, but fewer facilities were needed because a smaller number of Soldiers were deployed. The conditions in Vietnam necessitated the use of civilian contractors like no other war before it for several reasons. Combat plans for Vietnam, like in most US military operations, called for combat forces to deploy first, while combat service support troops had second priority.[5]

In a well-planned military operation, a balance is achieved—with priority given to combat elements while including an adequate number of sustainment units. The construction projects in Vietnam up to 1965 largely focused on infrastructure and domestic development within Saigon, Da Nang, and Cam Ranh Bay and not to support troops. In fact, the buildup of combat forces after 1965 was so great that the demand for troop structures and service accommodations quickly overtook the civilian construction effort and capacity of support forces in place.[6]

President Dwight D. Eisenhower's "New Look" military strategy of the 1950s focused on decreased expenditures for the Army and Navy in favor of increased expenditures for the Air Force and for nuclear weaponry. The need for civilian specialists in Vietnam was magnified due to the reduction in the size of the Army throughout the 1950s and into the 1960s. Unfortunately during times of fiscal cuts and demands for economic austerity, support troop occupations are not viewed as essential as combat arms so logistical personnel are often the first casualties when a reduction in force occurs. Therefore, once the military buildup in Vietnam began in earnest, there was a shortage of combat support units in the mid-1960s. Adding to this problem was President Lyndon B. Johnson's refusal to call up the reserves, who made up a significant number of logistical personnel

(as they do today) that would have been available for support functions from 1965 through 1968 in Vietnam.[7]

The Army changed exponentially from a technological standpoint between 1942 and 1965. The World War II Army needed Soldiers with automotive or mechanical skills. Both they and logistics Soldiers were readily available through the draft. By the time of the Korean War, jet engine specialists were needed; for the first time, civilian engineers from the private sector were brought in to service jet aircraft. By the time of the Vietnam War, many of the weapons systems relied on computers and were built with electronics the military had not caught up to by the mid- and late-1960s. There was a particular need for avionics technicians, sheet metal specialists, and aviation maintenance personnel. The Army Aviation Systems Command did send 151 Department of the Army civilian specialists to mitigate these shortages between June and August of 1969. During the same period, contractors from Lear Siegler, Dynalectron, and Lockheed sent nearly 1,900 high-tech aviation specialists to plug the gap.[8]

All of this necessitated the need for civilian high-tech specialists who would often train military personnel in Vietnam. However, with a one-year rotation policy in Vietnam and regulations against back-to-back tours, this specialized technical knowledge left with the Soldier after 12 months. The process would start all over again, with civilians doing the work until a replacement arrived. By the end of 1965, the Army adjusted tours of duty through the personnel management system to ensure that no more than 25 percent of a unit would rotate out of Vietnam in any one month. Options such as short extensions, tour curtailments, "exchanges of troops with similar units," and voluntary extensions were all viable options for the Army to keep skilled personnel in place.[9] Along with manpower issues, material challenges had to be addressed.

US contracting companies in Vietnam often had a difficult time procuring materials for construction projects. Since they could not obtain needed materials on their own as they would have in the United States, they were dependent on the Army supply system and treated as if they were a regular unit within the Army needing supplies. For most of the war, the Army supply system failed to forecast the contractors' material requirements, which led to project delays. One reason for this was that contractor projects often called for special or non-standard materials and equipment not typically stocked by local Army supply warehouses. Contracting companies often went around the Army to get supplies by using contractor procurement sources. While these sources proved more responsive and faster, they were

also more expensive, which drove up costs. In 1974, one lessons-learned analysis indicated that in future operations, large-scale contractors should get their supplies directly from the depot instead of local units.[10]

Price Tag and Scope of Construction in Vietnam

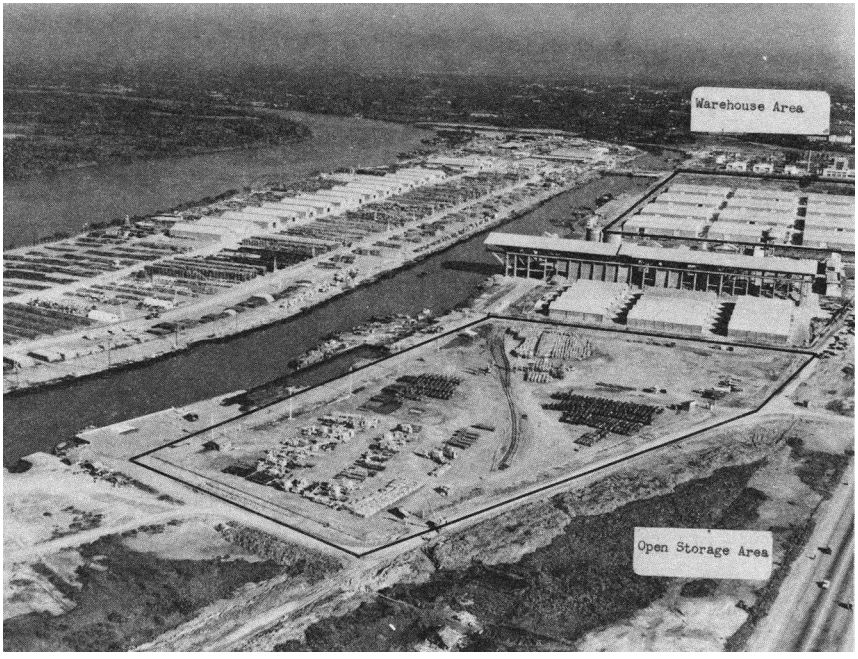
By the end of 1968, there would be more than 530,000 American military personnel in Vietnam. US construction companies such as Raymond Morrison Knudsen (RMK) and Brown & Root Jones (BRJ) supported unprecedented levels of military construction by the Army Engineers and Navy Seabees. Their efforts led to the creation of six deepwater ports with 29 deep-draft berths, numbers of airfields, nearly 20 hospitals, and base camps that could house roughly 450,000 service members. Between 1962 and 1967, US financial assistance to Vietnam totaled more than $3 billion, with one-third of those funds spent on horizontal and vertical engineering projects. Military commanders called it the "construction miracle of the decade" in 1969.[11]

Prior to 1962, the Department of Defense (DoD) gave the Navy responsibility for construction in South Vietnam, and one of the first significant projects it oversaw was constructing a network of roads in the Central Highlands. This project kept South Vietnamese workers, civilian engineers, and US contractors busy from 1955 to 1960. Other projects could serve a dual purpose. For example, the US Military Assistance Advisory Group (MAAG) located in Saigon saw the need to build military runways. However, this effort would violate the Geneva Accords. Creative thinking circumvented this restriction when the US Operations Mission hired a contractor and used aid intended for economic assistance for developing countries to build a concrete runway at Saigon's international airport that could not only receive modern commercial jet aircraft but military ones as well.[12]

From MAAG to MACV

By 1961, the Kennedy administration was in power and in December, Secretary of Defense Robert S. McNamara led a theater-planning conference at US Pacific Command in Honolulu. At this meeting, McNamara was resolute that everything except combat troops would be offered to the government of the Republic of South Vietnam. DoD did not authorize the use of Soldiers from the Army Corps of Engineers to execute any construction projects at this time. McNamara reiterated that construction would be done by civilian contractors and continue under the auspices of Navy management. US Soldiers served as advisors in country starting in 1956 under MAAG. In February 1962, DoD established the US Military

Figure 6.1. These images show the Field Depot Thu storage area five miles north of Saigon circa 1965–1967 before and after improvements. Photos courtesy of Lieutenant General (Retired) Joseph M. Heiser.



Assistance Command Vietnam (MACV), paving the way for the subsequent US military build-up.[13]

By 1965, the advisory effort was a failure, and US policy in Vietnam shifted from an advisory role to one of assistance with MAC. These actions led to more US Soldiers on the ground who would take on more of a combat role in fighting the Vietcong and North Vietnamese Army.[14]

Reshaping the Department of Defense

Secretary of Defense McNamara was entering his fifth year in office by 1965 and was confidently leading the Department of Defense as none of his predecessors had before. McNamara, a graduate of the Harvard Business School, served in the Army Air Corps during World War II, working in the Office of Statistical Control analyzing US bomber efficiency and effectiveness. After the war, McNamara became an executive at Ford Motor Company in November 1960—eventually becoming the first president of the corporation from outside the Ford family. However, his title at Ford was short-lived when President John F. Kennedy asked McNamara to serve as his secretary of defense. McNamara exercised unusual control over DoD—reshaping the department and greatly influencing the conduct of the war in Vietnam. He applied his "managerial principles of

Figure 6.2. President Lyndon B. Johnson and Secretary of Defense Robert McNamara attend a 21 July 1965 national security meeting on Vietnam. Photo courtesy of Yoichi Okamoto, LBJ Library, Serial Number A886-8.

cost efficiency and economy to every aspect of DoD and pushed the military services to change entrenched habits."[15] McNamara's young civilian staff members at the Office of the Secretary of Defense (OSD) were known as the "whiz kids," because McNamara applied a computer-driven methodology known as "systems analysis" to the decision-making process in nearly every aspect of how he managed DoD. For McNamara and his Whiz Kids, quantifiable analysis was largely reduced to objective numbers "that often ignored military expertise and opinion, dismissing service dissent as a product of parochialism and resistance to both civilian authority and change."[16] Nevertheless, the political realities at home and Vietnam proved more complex than systems analysis could account for in Vietnam.

Major Construction Corporations in Vietnam

> *There are no more pyramids to build. We have just about completed the largest construction effort in history.*[17]
>
> —John B. Kirkpatrick
> Former General Manager, RMK-BRJ

With the inevitable arrival of more US military personnel, Vietnam required substantial infrastructure advancements—especially at its deepwater ports. From 1955 to 1961, the numerous private sector construction companies and engineers carried out a dizzying array of refurbishment and new building projects for canals, airfields, hospitals, bridges, and roads costing nearly $1 billion to support nation-building plans (78 percent of funding was for military purposes). However in early 1962, the major American construction company RMK would take on the majority of building and development contracts. The Navy furnished RMK with materials and equipment and paid its transportation costs. RMK employed nearly 2,900 Vietnamese workers by the end of 1962. In 1965, RMK construction contracts grew so fast it could barely keep up with DoD's demands. That same year, Brown & Root joined with RMK, and the American construction consortium operated as RMK-BRJ. In fact, RMK-BRJ was given the responsibility for building the majority of new support facilities for the growing American commitment in Vietnam, which accounted for 90 percent of their work by 1966. US contractors trained Vietnamese nationals and third-country workers for construction projects.[18]

The maximum construction effort began in 1965 and peaked in 1969. Twenty percent of US contract workers trained local nationals and third-country construction workers. Vietnamese nationals provided 83 percent and third-country nationals 12 percent of the civilian contractors who were doing transportation, construction, supply, maintenance, and

general logistics support. Fifty-two thousand employees at roughly 50 locations in Vietnam worked for RMK-BRJ in 1966.[19] So much work needed completion prior to an escalation of the war that senior executives at RMK-BRJ knew of the "imminent American expansion in South Vietnam well before most others."[20]

While not a private entity, the organization that had oversight and administered service contracts was the US Army Procurement Agency, Vietnam (USAPAV). In 1969, USAPAV oversaw the execution of $233 million in service contracts. Base camp operations and maintenance were the most significant USAPAV contracts across Vietnam. Field maintenance for generators, pumps, refrigerator units, and generators at base camps and other facilities all fell under the responsibility of Pacific Architects and Engineers (PAE). The number of contractors working for PAE peaked at 24,000 during the war. Strikingly, while PAE supplied the workforce, the US government provided tools, repair parts, and equipment to the workers. Vinnell Corporation collaborated with PAE to service the electric power generators, because service members did not have the training to maintain and operate heavy commercial generators that produced 1,500 kilowatts.[21] The 1968 presidential election signaled that US policy in Vietnam would soon change.

In 1969, newly elected President Richard M. Nixon was seeking ways to extract US forces from Vietnam without appearing to renege on the country's commitment to support the South Vietnamese government in their fight against the North. Nixon chose to build up the Army of the Republic of Vietnam (ARVN) in what was called the Vietnamization of the war. This stage of the war quietly began under President Johnson in 1968, but Vietnamization became a cornerstone of the Nixon doctrine to reduce American casualties and put more onus on the South to do the fighting.

As Nixon's strategy took effect, RMK-BRJ began to steadily wind down its work in Vietnam as Seabees, Army Engineers, and Vietnamese nationals replaced contractors in 1969. By 1971, the Vietnamization of the war was well underway, with troop drawdowns along with retrograde operations that raised support personnel to 47 percent while the percentage of combat Soldiers was reduced to 53 percent. RMK-BRJ officially ended its construction projects in Vietnam on 3 July 1972.[22] By the end of the Vietnam War, approximately 35 "American companies deployed in support of military units."[23] Their efforts represented the first time in US military history that contractors and civilian workers "assumed a major construction role in an active theater of operations."[24]

Emerging Army Logistics in Vietnam and Challenges

In March 1965, the first combat troops consisting of two Marine battalions arrived in Vietnam. By the end of the year, nearly 184,000 US troops would be in Vietnam compared to 23,000 in 1964. US Army Pacific Command (USARPAC) designated the 1st Logistical Command (1st LOG) to oversee the logistics mission in Vietnam, excluding the Air Force and Navy missions. 1st LOG was deactivated at Fort Hood, Texas, and provisionally reactivated in Vietnam on 1 April 1965. Commanded by Colonel Robert W. Duke, the official activation ceremony occurred on 28 April.[25] The Army's initial plans called for the employment of 4,000 Soldiers to staff 1st LOG by December, but an increase in total troop strength pushed logistical troop strength to 7,900 Soldiers.[26]

1st LOG's responsibilities included construction, engineer, accounting, finance, medical, and procurement missions for the Army in Vietnam. MACV advisors, military police, aviation, and communica-

Figure 6.3. 1st Logistical Command served as the logistics headquarters for all units in the theater 1 April 1965 to 7 December 1970. Photo courtesy of Quartermaster Museum, Fort Lee, Virginia.

tions all fell under the US Army Republic of Vietnam (USARV) component command echeloned under MACV. In September 1965, 1st LOG began to assume the Headquarters Support Activity Saigon mission. It would not be until March 1966 that this transition was complete.[27]

1st LOG did experience challenges when it first arrived in Vietnam, such as not having potable water since no water purification units were available beyond what came with the Table of Organization and Equipment (TOE). 1st LOG and the entire logistics mission from 1966 through 1968 suffered early growing pains because of the concurrent planning and implementation process. This was due to a hastened buildup of Soldiers and material driven by the decisions of the Secretary of Defense and MACV senior officers at a force level-planning meeting in Hawaii from 9 to 11 April 1965. In the years to come, there would be more planning meetings in Hawaii to discuss troop increases in Vietnam. However, this was the beginning of a rushed buildup in South East Asia; that decision point is traced back to the approval for deploying the 173rd Airborne brigade's 33,000 Soldiers from Okinawa to Vietnam on 21 April 1965.[28] More boots on the ground led to an increased level of combat operations by the end of 1966, which resulted in 5,008 American Soldiers killed and more than 30,000 wounded.

As the Soldiers and their weapons of war began to arrive, they quickly learned there were not enough general-purpose tents for dispensaries, kitchens, and mess halls. A shortage of sandbags and concertina wire for security purposes exacerbated the problem. The logistical troop-to-combat support at this time was 25 percent; optimally the ratio would have been between 45 to 50 percent with well-thought-out operational planning. The reason for this lower percentage at this early stage of the war was that there were no long lines of communication to support. [29]

From Fiscal Year (FY) 1965 until FY 1971, Congress authorized roughly $970 million for construction in Vietnam. At the apex of American combat power in 1969, the percentage of support personnel strength grew to 39 percent. The principal cause for this enlargement was that supply lines of communication were expanding across Vietnam as congested ports and depots pushed out supplies to support combat operations. The logistics concept plans from 1st LOG and MACV called for two central base depots and "five support commands." 1st LOG used Vietnam waterways to deliver the bulk of supplies to parts of the interior and along the Vietnam coast to smaller ports. Once adequate roads were built, supplies were delivered to the interior by trucks and trains. After the supplies reached the various sup-

port commands, they were to have 15 days of supply (foodstuffs, ammo, fuel, and materials) while depots would have 45 days of stock.[30]

As more logistics personnel arrived in Vietnam from June 1965 through June 1967, logistics support units suffered a shortage of Soldiers experienced in supply management, depot operations, and maintenance. Between 1965 and 1967, 977,000 new Soldiers with no prior service experience entered the Army. While the Army's workforce grew by almost 50 percent, it was losing more than 24,000 trained personnel every month. The shortages were most glaring at senior noncommissioned and junior-officer levels where key logistics experience was needed the most since these were the Soldiers responsible for training and supervising logistics operations at brigade-sized elements and in lower echelons throughout South Vietnam.[31] Civilian contractors helped to offset these losses.

By the end of the war, between 130,000 and 150,000 civilians supported the military in Vietnam. The total non-combatant workforce in Vietnam was made up of 1 percent US civilian employees, 3 percent US military contractors, 12 percent third-country nationals, and 83 percent Vietnamese nationals. Logistical services that supported the war not only came from the United States, but also from the countries of Thailand, the Philippines, Japan, and Taiwan.[32] Although civilian contractors could augment many construction and technical jobs in Vietnam, leadership roles and training in the field still called for experienced military personnel to lead and mentor Soldiers.

The Evolution of Contractors since Vietnam

Private contractors in Vietnam provided a wide variety services—from facilities construction, running power generators, petroleum distribution, subsistence, stevedoring, all echelons of maintenance, supply, transportation, and services to repairing high-tech equipment in jet aircraft and helicopters. For the United States, contractors were an attractive option because they possessed a number of critical skills that military personnel did not possess; nor was there time to train large numbers of Soldiers to do these jobs in the middle of a war where specialized labor was needed in combat arms occupations. Other key reasons centered on the acceptable cost factor of using contractors. The significant savings and excellent work that contractors did in Vietnam were fundamental reasons for the 1970 Joint Logistics Review Board to state, "US forces committed to the conflict have never been better supplied than those in Southeast Asia."[33]

Conversely, senior Army officers such as Lieutenant General Joseph M. Heiser Jr. felt some areas were "overly civilianized." In a book

on logistical lessons learned in Vietnam that was written shortly after the war, Heiser argued that one of the root problems was the inadequate number of trained and experienced military personnel in ammunition operations, warehouse operations, and supply management. This shortfall hurt the Army during the rapid buildup phase in Vietnam. Heiser's solution was that an increase in "military strength or Continental US civilians in [those] facilities should be used to support an overseas buildup until the Continental Army Command School" could train enough Soldiers to do the job instead of civilians.[34] Arguably, using more contractors in lieu of Soldiers was by design due to smaller defense budgets and the cost savings analytics of McNamara's corporate systems analysis measures.

Origins of LOGCAP

Similar to the end of every American war, a drawdown of the military along with cuts in the defense budget took place after 1973 and into the early 1980s. The vast majority of senior military leaders who oversaw the Reagan administration's military buildup in the 1980s were Vietnam veterans. Their memories of contractors supporting the mission in South East Asia played a part in the December 1985 publication of Army Regulation 700-137, *Logistics Civil Augmentation Program* (LOGCAP), which states that LOGCAP consists of the following:

Advanced acquisition planning which provides for the use of civilian contractors during wartime and unforeseen military emergencies to augment the US Army combat support and combat service support capability. The contract support will be arranged through combined advance acquisition and operations planning.[35]

Five years later, DoD Instruction Document Number 3020.37, "Continuation of Essential DoD Contractor Services During Crises," left little doubt regarding how the Pentagon viewed the role of civilian contractors when it came to supporting peacetime and wartime missions:

> The DoD Components shall rely on the most effective mix of the Total Force, cost and other factors considered, including Active, Reserve, civilian, host-nation, and contract resources necessary to fulfill assigned peacetime and wartime missions.[36]

For the Army, this policy represented a measured step toward institutionalizing the use of contractors into the force. Other factors were that private sector innovative business practices such as outsourcing options influenced the armed forces to expand outsourcing programs that fit conveniently into the LOGCAP concept.

Ultimately, this shift led to Army Central Command (ARCENT) awarding the first LOGCAP contract in support of the US 3rd Army in July 1989. Other government agencies such as USAID also began to outsource much of their work in the final years of the Cold War. Outsourcing work to cut costs was saving US businesses billions of dollars, and DoD was prudent to follow the trend; defense spending shrank to three percent of the country's gross domestic product by 1998. Contractors were also a legal alternative to circumvent troop-ceiling levels while having Soldiers on the ground in forward areas. Collectively, these factors pushed the Army and DoD to create a robust system that standardized the use of civilian contractors through LOGCAP.[37]

Limitations of LOGCAP

The use of civilian contractors does not come without its limitations. First, these workers augment the Army's capabilities and do not replace force structure; however, they must still contribute to the overall military or peacetime effectiveness of the mission. Other areas of concern that should be part of the planning factor are potential strikes, untimely rotations, confusing contract language in regard to the work that is to be performed, wavering morale, recruitment, medical care, and measures put in place so contractors who voluntarily serve in war zones do not forfeit

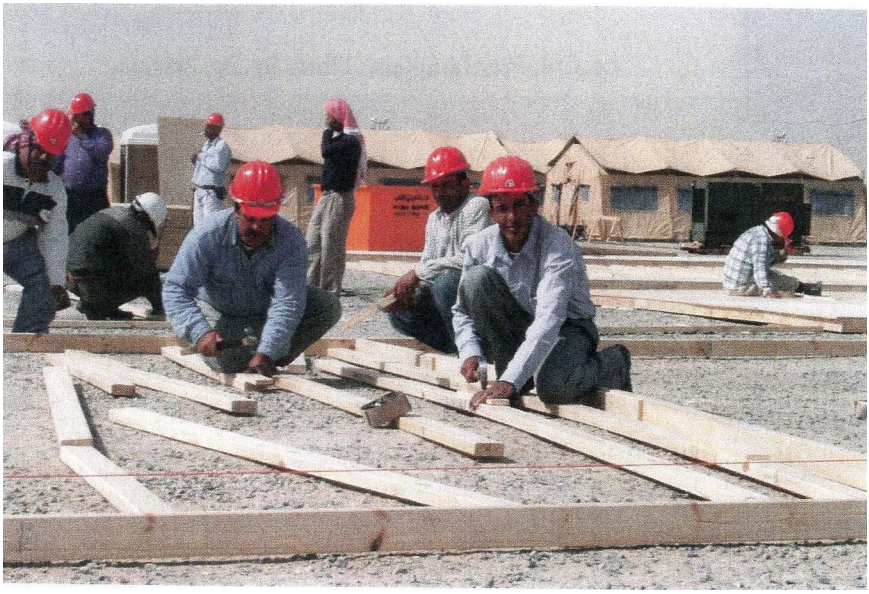


Figure 6.4. LOGCAP contract workers construct facilities during Operation Iraqi Freedom. Photo courtesy of US Army Materiel Command.

medical benefits and/or life insurance policies. By law, contractors cannot perform armed combat operations; they also cannot command and control civilian or US military personnel. The very presence of contractors on the battlefield raises questions about their noncombatant status under international law. Other issues with contractors include the ambiguity of formal rules that contractors must follow in the operations theater when not working. Since contractors are not Soldiers, they do not fall under the Military Code of Conduct. Discipline and authority is another concern since contractors are not subject to the Uniform Code of Military Justice unless Congress declares war, which has not happened since World War II. Only then would contractors fall under military justice or the discipline of the commander. If a state of war does not exist, contractors fall under the laws of the host nation just like any other American citizen in country.[38]

Given these points, civilian contracting has come a long way. In World War II, there was one contractor deployed for every seven Soldiers. During the First Gulf War in 1991, more than 9,000 contractors were used along with 5,000 government civilians.[39] Nearly all provided similar services to those carried out by contractors in Vietnam 20 years prior. The preponderance of contractors grew even larger when the Soldier-to-contractor ratio was one-to-one during peacekeeping operations in Bosnia for Operations Joint Endeavor, Joint Guard, and Joint Forge from 1995 to 2004. During the Second Gulf War (2003–2011), the use of LOGCAP to support US forces was the largest in history; as a result, 74 civilians under LOGCAP died in Iraq. In the early years of the war, contractors were approximately one in two personnel in Iraq; by 2006, civilian contractors outnumbered Soldiers. Ten years later in Afghanistan, there were three contractors for every US service member. DoD records indicate the majority of contractors during this period carried out logistics and maintenance services to United States and Afghanistan forces.[40] Of note, the majority of contractors since 1991 have been local nationals who carried out unskilled labor functions in support of base operations.

Causation of Reform

Collectively, the wars in Iraq and Afghanistan demanded the heavy use of contractors on an immense scale that produced cracks in the Army's acquisition and contracting system by 2007. Investigations by the Army Criminal Investigation Division (CID) confirmed numerous cases of bribery schemes (one was more than $14 million), fraud, waste, and abuse—particularly in Kuwait and Iraq. This resulted in the Secretary of the Army establishing a six-member independent commission chaired by Dr. Jacques S. Gansler, a former Under Secretary of Defense for Ac-

quisition, Technology, and Logistics. The members included two retired Army generals and one Navy admiral. In November 2007, the Gansler Commission produced a candid report that called for essential reform in the Army's contracting and acquisition system in order to support future large-scale expeditionary missions.[41] For Army contracting, the Gansler report recommended the following:

- Increase stature, quantity, and career development for contracting personnel—both military and civilian—particularly for expeditionary operations.
- Restructure the organization and responsibility to facilitate contracting and contract management.
- Provide training and tools for overall contracting activities in expeditionary operations.
- Obtain legislative, regulatory, and policy assistance to enable contracting effectiveness—important in expeditionary operations.[42]

The Gansler Report also identified a need for the warfighting/operational commands to translate requirements into statements of work that would quickly result in a viable contract to support the mission. The

Figure 6.5. Army Logistics University. Photo courtesy of Army Logistics University Library.

area of greatest concern noted in the commission's report was the lack of trained personnel to monitor and ensure contractors were performing and providing the services needed by the warfighter.[43]

In response to these findings, the Army's Combined Arms Support Command (CASCOM) saw that educating its leaders on contracting was part of the way ahead and in 2009 developed the Operational Contract Support (OCS) course at the Army Logistics University at Fort Lee, Virginia. The OCS course was primarily designed to prepare non-acquisition professionals assigned to tactical and operational unit staffs (brigade through theater Army) to assist in planning, integrating, and managing contract support during deployed operations. Students who completed the two-week course were awarded the 3C additional skill identifier. As of the writing of this chapter, the course served as a starting point for students from all US military branches for ranks E-6 and civilians GS-11 and above. [44]

Conclusion

The experience from the war in Vietnam introduced the Army to the flexibility and cost-savings measures of using contractors for construction missions and base development in an active theater of war. It validated the feasibility of bringing in civilian expertise and capacity, with corporations like RMK-BRJ undertaking and completing impressive construction projects such as deep-water piers, modern power grids, and developed roads to support the war effort in Vietnam. The memory of how successful the civilian contracting effort was in Vietnam was a significant influence that broadened the Army's view of how contractors could support wartime missions in the future. Today bringing in private corporations such as KBR (formerly Kellogg Brown and Root), DynCorp International (Veritas Capital), and Washington Group International to support operations in Kuwait, Iraq, Bosnia, and Afghanistan is a standard practice. In retrospect, today's contracting companies are hired for many of the same reasons contractors were used in Vietnam from the mid-1950s to as late as 1975 when South Vietnam fell to the North.

Since Vietnam, the Army has greatly expanded its use and understanding of how to employ contractors in active theaters. While today's battlefields are different than the ones in South East Asia, many of the challenges are still the same. One similarity is the way the Army views contractors. While contractors are vital, some military leaders believe as Washington and Hamilton did during the American Revolution that private contractors are necessary outliers to fill support gaps that the armed forces cannot. The Army is still unenthusiastic about integrating contrac-

tors into wartime planning—especially during the first 90 days of combat operations. The cultural hurdle for the Army is that contracting companies have taken over many functions traditionally done by Soldiers. Some critics of contractors feel the military's heavy reliance on them takes away from the prestige of the armed forces.

This is a doubled-edged sword for the Army; while contractors do save money, the Army is failing to develop some essential skills in its Soldiers, which has eroded its "know-how" in previously fundamental areas of Army expertise. Some critics of private contracting insist the Army should bring in more Soldiers and grow the logistics force to offset the number of contractors, but this is unlikely in the age of shrinking defense budgets and a focus on putting more warfighters in combat theaters with fewer logistics Soldiers on the ground in life support roles. Contractors are here to stay, and their use for peace and wartime mission support has forever changed the way the Army operates on the battlefield.

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42. Lee McMahon and Gary Sheftick, "Gansler Commission Cites Systemic Problems in Army Contracting," US Army Public Affairs website, accessed 4 May 2018, https://www.army.mil/article/5906

43. Email to author from Mr. Rodney M. Palmer, "TCM-OCS OCS Lessons Learned Integrator, CASCOM," 9 May 2018.

44. Palmer email, "TCM-OCS OCS Lessons Learned Integrator;" Lieutenant Colonel (Retired) Robert Gould, "Operational Contract Support: Not Just for Contingencies," *Army Sustainment*, July–August 2012, accessed 9 May 2018, http://www.alu.army.mil/alog/issues/JulAug12/Operational_Contract_Support.html.

Chapter 7
Getting Ashore: Joint Logistics at the Battle of San Carlos

Lieutenant Colonel Michael J. Gunther

On the night of 21 May 1982, the British ships of Task Force 317 started sailing south into the Falkland Sound toward San Carlos Water. Aboard those vessels, the reinforced 3 Commando Brigade prepared to execute Operation Sutton, the amphibious assault of East Falkland. This operation arguably marked the crux of the British effort to reclaim the Falkland Islands. The landing force was less than half the size of the Argentine defenders. Once ashore, British land forces needed to maintain the pace of operations to prevent the Argentinian force from massing against them on the beachhead when the British were most vulnerable. The Royal Commando Logistic Regiment played a critical role in the battle to ensure this outcome.

The success of Operation Sutton and the resulting breakout were due in part to the Regiment's ability to improvise and adapt their plan to the conditions on the ground. The Falklands War stretched the logistical capabilities of a small professional British military shrunk by cuts in defense spending and whose closest secure logistical base at Ascension Island was located almost 4,000 miles from the battlefield. Logisticians needed to support both the landings and establish a logistics base ashore that could quickly transition to support Brigadier Julian Thompson's Commando Brigade as it moved inland to attack Argentine forces at Goose Green and Darwin. The logistics plan developed to support the landings assumed that the British established air superiority prior to landings, which allowed for the transfer of supplies and units under administrative conditions. However, these assumptions proved false, and the loss of several British ships including the MV *Atlantic Conveyor* had significant effects on the transportation, supply, and medical evacuation plans.

Although the operation at San Carlos Water was the largest amphibious landing since the 1956 Suez Crisis, the logistical aspects of the battle remain largely ignored. Only one author, former US Army Major General Kenneth Privratsky, attempted to chronicle the logistics effort of the entire campaign in his book, *Logistics in the Falklands War: A Case Study in Expeditionary Warfare.*[1] The logistical aspects of the campaign are worth examining in detail. Each phase of Operation Corporate—the British campaign to recapture the Falklands—presented its own challenges for logis-

ticians, from the initial mobilization in the United Kingdom until the final surrender of more than 11,000 Argentine soldiers and marines on the Falkland Islands. Although some background information is needed to establish the context of the Royal Commando Logistics Regiment's role in the campaign, this chapter is only concerned with the initial amphibious landing of 3 Commando Brigade (Reinforced) at San Carlos Water on 21 May 1982 through the effort to establish the logistics beachhead to support further operations against the main Argentine garrison at Stanley. This particular phase, codenamed Operation Sutton, was arguably the hardest phase of the logistical operation. For the logisticians supporting the land campaign, it represented both the intersection of planning and executing operations and the transition of operations afloat to ashore. It highlighted the challenge of supporting forcible entry operations without the benefit of air superiority in an area where logisticians needed to operate without infrastructure to support to their efforts.

Operation Sutton is a worthy case study to examine the role of logistics under the harshest conditions. Royal Commando, army, and Royal Navy logisticians coordinated their actions to support land forces conducting decisive action on East Falkland. They performed their tasks without the advantages that Western forces have enjoyed since the latter half of the Cold War. In the Falklands, logisticians conducted theater opening, reception, integration, and onward movement without port facilities and air bases. They executed these operations without freedom of movement and air superiority. Finally, they lacked a significant contractor force to facilitate theater opening. The British conducted Operation Sutton at the end of an 8,000-mile line of supply against a near-peer enemy that had a numerical advantage on the ground and in the air.

The British landings at San Carlos, and its logistical support, were ultimately successful despite a number of planning assumptions that were never realized. Logisticians extended the Task Force's operational reach in a manner that maintained the momentum of offensive operations against the Argentine defenders.[2] They developed adaptable plans that integrated all elements of sustainment, anticipated and responded to operational requirements, and could provide continuity of services as operations transitioned from sea to land to accomplish this mission. Furthermore, as plans changed when the British failed to gain air superiority, logisticians demonstrated the survivability of their plans and the ability to improvise based on changing battlefield conditions.

The Road to Sutton

On the evening of 1 April 1982, Argentine military forces conducted Operation Rosario, to capture the Falkland Islands from the British. Their

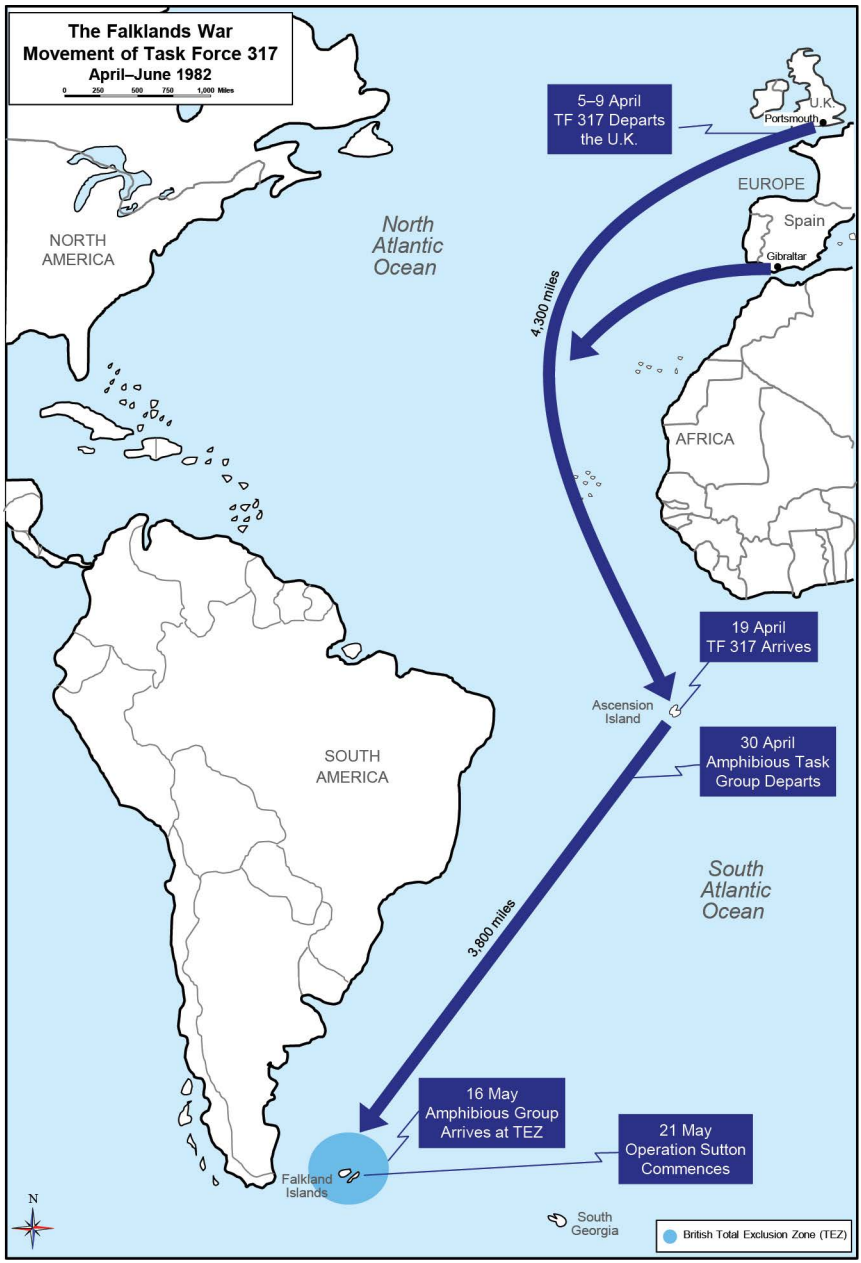

Figure 7.1. Task Force 317's Route to the Falklands. Map created by Army University Press.

operation was swift and decisive. The Ministry of Defence (MoD) in London received word of the islands' surrender the following day. Interestingly, the decision to recover the islands occurred before the Argentine invasion took place. On the night of 31 March, British Secretary of State for Defence John Nott requested a meeting with Prime Minister Margaret Thatcher to discuss intelligence from the South Atlantic. During the meeting, he stated without equivocation that the Falkland Islands could not be defended with the existing token force of Royal Marines. Furthermore, he believed the British lacked the ability to retake the islands.[3] Fortuitously, the First Sea Lord, Admiral Henry Leach, interrupted this meeting to provide the Prime Minister with the military's advice. He could sail a Task Force within 48 hours with an eventual mission "to bring about the withdrawal of Argentine forces from the Falkland Islands and dependencies, and the re-establishment of British administration there, as quickly as possible."[4]

At the beginning of the war, the British military had recently started a new round of defense reductions. The United Kingdom's commitment to the North Atlantic Treaty Organization (NATO) and to the global strategy of containing the Soviet Union's influence remained the Thatcher government's first priority.[5] Although the 1981 Defence White Paper, *The Way Forward*, instructed the Royal Navy to conduct long-term force projection exercises in the South Atlantic Ocean and recognized the importance of sustaining overseas responsibilities, it clearly established that commitments in Western Europe took precedence over most peripheral interests, including the Falklands.[6]

However, as the specific provisions of the reduction program were implemented, it appeared that the MOD needed to gradually wean its commitments as its ability to project power diminished. As part of the Royal Navy reductions, one of Great Britain's two existing aircraft carriers—HMS *Hermes*—was earmarked for decommissioning. In the coming years, the Navy would also decommission both amphibious assault ships, *Fearless* and *Intrepid*, and assume risk that if they needed these ships' abilities that other members of the Coalition could make up for any force deficiencies.[7] When these fleet reductions were combined with personnel redundancies of 8,000 to 10,000 officers and sailors, long-term force projection in the South Atlantic was going to be difficult to sustain. In other words, the government had chosen "to attach the highest importance to deterrence of the Central Front at the cost of power-projection capabilities on the high seas."[8] Nott rightly pointed out that the country's ability to deter aggression in the South Atlantic had been in decline for 15 years.[9]

The Commando Logistic Regiment was the primary unit responsible for providing support to 3 Commando Brigade during the landing at San Carlos. At the time of the Falklands War, the regiment was commanded by a Royal Marine, Lieutenant Colonel Ivar Hellberg.[10] The unit was comprised of commando, army, and Royal Navy units. Unlike most British logistics units, the regiment was essentially modular, with a troop dedicated to support to each of the three commando groups. It also had organic medical, transportation, ordnance, and higher-level maintenance (workshop) squadrons.[11] The squadrons were trained to support ground operations from land or afloat and deployed with 30 days of combat supplies and 60 days of other supplies. The regiment deployed to the Falklands with 346 soldiers and officers, roughly 55 percent of the regiment's assigned strength because of the decision to leave the Transportation Squadron in the United Kingdom. Additionally, the Petroleum Troop was a reserve unit, which was not activated before the Task Force sailed. However, the regiment received an augmentation of three surgical support teams (SSTs).[12]

Although the Regiment deployed understrength, it needed to support a reinforced commando brigade. Initially, the brigade received the 3rd Battalion, Parachute Regiment (3 Para), two medium reconnaissance troops of Blues and Royals equipped with Scimitar and Scorpion light tanks, and a battery of 12 Rapier surface-to-air missile systems as attachments. While the Task Force consolidated and reorganized at Ascension Island, military and political leaders decided that additional forces were needed to prevent a possible military defeat. They added 2nd Battalion, Parachute Regiment (2 Para); another 105-mm artillery battery; additional engineers; and medics to the 3 Commando Brigade's organization. This decision brought the unit's strength to approximately 5,500 personnel, roughly half the strength of the Argentine contingent. None of the attached units had trained with the commandos, and the Logistic Regiment had never trained to support a unit of this size.[13]

The Commando Logistic Regiment had just returned 1 April from a three-month winter exercise in Norway. Early the next morning, Hellberg received the notification to mobilize his unit for deployment to the Falklands. For the next three days, the regiment worked to move the 30 days of War Maintenance Reserve from depots across the United Kingdom to ports in the south of the country. Since the mobilization order came on a holiday weekend, the regiment had to accomplish their mission without support from British Rail. They had their Landing Ships Logistic (LSLs) and Royal Fleet Auxiliary Ships (RFAs) loaded and ready to sail ahead of schedule by midday Monday, 5 April.[14] The only hiccup with the regi-

ment's deployment was out of their control. Thirty days of extra supplies were normally kept afloat at sea on board a Royal Fleet Axillary (RFA) ship. The ship docked once every three years for maintenance and the supplies transferred to a new ship. Unfortunately, the Falklands crisis coincided with this period, and the new ship could not be readied to sail in time to leave with the Task Force.[15]

The rest of the Task Force's loadout did not proceed as smoothly. The government needed augmentation from civilian ships to support the movement and sustainment of the Task Force. These ships were procured through the Ships Taken Up From Trade (STUFT) program. Many of the ships needed retrofitting to operate as part of a military formation. One ship, the MV *Elk*, was designated an ammunition ship and carried several thousand tons of the ammunition to support the initial landings.[16] While contractors and military experts converted the ships, units frantically packed their holds, common areas, and even hallways with military stores. When the first STUFTs started the journey south on 9 April, there was little understanding of where supplies were loaded. Supplies that were left in Great Britain or later determined as necessary were flown to Ascension Island ahead of the Task Force's arrival on 19 April. When the fleet sailed from Ascension 11 days later, logisticians had finished a partial cross-loading of supplies to support operations on the Falkland Islands.

Planning for Sutton

As the British sailed south, the staffs working on military options knew that the terrain and weather favored the defenders. The terrain of the Falkland Islands was not conducive to military operations. The landscape was comprised of primarily peat bog and loose rock. At the time of the war, there were few roads outside of the few scattered settlements, so leaders decided to leave most of their organic vehicles in Great Britain. These factors meant that soldiers would need to move primarily on foot or by helicopter once ashore. However, this mode of transportation had its own dangers. The islands were almost completely devoid of trees to conceal the movement of troops, which left them vulnerable to attack. Furthermore, there were few sources of potable water, which meant that soldiers would need frequent resupply while they carried their entire combat load across the challenging terrain. Additionally, the British force was sailing into the South Atlantic winter. Woodward and other military leaders believed that they had until the middle of June before the weather would prohibit operations. As the weather worsened, the soldiers' loads and their logistical requirements would increase.[17]

The various staffs conducted most of their planning in an information vacuum during the movement from Great Britain to Ascension Island. The ships observed a strict radio and communications blackout. While the Task Force's leadership on *Fearless* worked on where to land, Hellberg's staff worked aboard a different ship to generate two flexible options to sustain units once ashore. The first option could support a full brigade landing to establish a single beachhead. The landing forces would receive material and supplies from two LSLs—one inshore to support the land forces and one held in reserve outside of the nautical Total Exclusion Zone (TEZ).[18] Each LSL would carry two Daily Combat Supply Rate for the Force (DCSR) stocks. As inshore LSL exhausted its supplies, it would rotate with the reserve one, receive new supplies from the MV *Elk* and RFA *Stromness*, and prepare to replace the LSL in the combat area. Option two allocated a single LSL to support separate landings by a commando group in two locations with eight DCSRs for the group. In both options, the BSA (Beach Support Area) would be established ashore as soon as possible and the supported units would "pull" supplies. The majority of the supplies remained afloat since the British assumed they would have air superiority established before execution of the landings. All causalities would be evacuated to the SS *Canberra*, where two of the three SSTs were stationed.[19] The Task Force leadership approved the options on 10 April.[20]

Eventually, Admiral Sandy Woodward, Commodore Michael Clapp, and Brigadier Julian Thompson picked San Carlos Water for the initial landings. The three commanders assessed the area as advantageous to the British for a number of reasons. First, it had several beaches that facilitated the landing of men and materiel and allowed for their movement inland. The topography of the islands near the bay made targeting of British ships with Exocet missiles difficult for the Argentine pilots, and the area surrounding the beaches favored the British landing force once they were established. Furthermore, the Argentines lacked a significant military presence at San Carlos, and its distance from Stanley prevented a rapid reinforcement of the force guarding the bay. Admiral John Fieldhouse approved their recommendation on 8 May. Significantly, the plan failed to incorporate any branches or sequels if the British failed to gain air superiority and the logistics plan was disrupted.[21]

The logisticians did not need to significantly alter their approved course of action once the landing site was selected. The logisticians needed 10 days to land the supplies needed to support the commando breakout. Hellberg completed his concept of logistical support on 12 May. He stated that their plan needed to be "sufficiently flexible to cater adequately for foreseen

events and be able to react to the unexpected."[22] The LSLs were part of the third serial, approximately four hours after the initial landings. San Carlos Water had advantages and disadvantages. The logisticians could take advantage of the protection provided by the terrain to mass their ships during the initial offloading. The landing sites were well-sheltered, so the water tended to remain calm, which facilitated the use of mexeflotes and landing craft to get men and supplies quickly onto the beach. However, Ajax Bay, the largest of the landing beaches, lacked sufficient space to properly establish a BSA where supplies could be spaced to facilitate resupply operations and survivability in the event of attack. Furthermore, there was only one hard stand building at the bay, an old mutton refrigeration plant.[23]

Landing at San Carlos Water

Despite a two-hour delay during the initial landings, the execution of the amphibious assault generally followed the plan. Diversionary attacks by special forces at Stanley and Darwin and poor weather conditions in the Falkland Sound created sufficient confusion among the Argentine defenders to preserve the element of surprise. The beachhead was secured by sunrise, and the logisticians were busy establishing the BSA at Ajax Bay. The five LSLs were anchored in a dispersed row to facilitate their offloading. Clapp established a picket line of six warships at the western end of San Carlos Water to protect the support ships.[24]

Unfortunately, the mist that concealed the landings lifted by early morning. The Argentine defenders sent more than 50 sorties of fighters to target the British ships. At the end of the day, five of the six ships on the picket line sustained damage and one of these, HMS *Ardent*, was sinking. Clapp ordered the larger civilian ships to leave the sound and sail to the edge of the TEZ. The new order had a significant effect on the concept of support. The SFUFTs contained most of the supplies to support the land forces for the first 48 hours, and two of the three SSTs were on the *Canberra*. Fortunately, one SST got ashore with a limited supply of surgical equipment. The departure of these ships left the logisticians with only the two DCSRs loaded on the LSLs. As a result, the Logistic Regiment had to immediately start providing rations and ammunition to the landing force instead of using the first 48 hours to concentrate on consolidating their position in Ajax Bay.[25]

On 24 May, the Argentine pilots targeted the LSLs, which further affected the concept of support for the logisticians on the beach. Three of the six LSLs—including the *Sir Bedivere*, which had just arrived in the Falklands—were struck by bombs that failed to detonate during the day. The

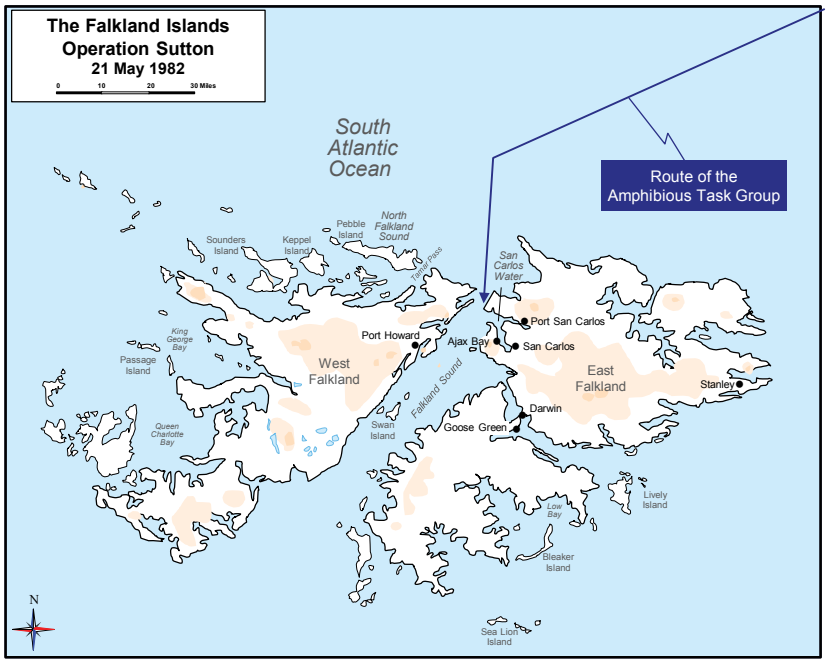

Figure 7.2. Falkland Islands. Map created by Army University Press.

Sir Galahad and the *Sir Lancelot* were on fire, and the crew of the *Galahad* resorted to beaching the ship in order to save it. *Galahad* was out of service for a week, while it took three weeks to conduct repairs to *Lancelot*.[26]

Clapp and Woodward determined that the plan to keep a floating sustainment base was no longer acceptable in the absence of British air superiority.[27] The ships took their place outside of the TEZ, where the carrier group provided additional protection. Hellberg called forward the LSLs loaded with the supplies necessary to support the brigade. However, an LSL needed approximately 20 hours to sail from their holding position to Ajax Bay. The sailing time made the forecasting of needed supplies more important, since they needed to be cross-loaded from the civilian ships. Frustration with the new arrangement mounted between the Task Force leadership and Thompson's brigade. Woodward's staff could not understand why the commandos had not moved out of the bridgehead. Conversely, Thompson continued to stress that there was no reason to push the advance until the Logistic Regiment built up sufficient supplies to support the advance.[28]

However, the Argentine air attacks were not the primary problem in getting supplies ashore. It was a lack of dedicated movement assets. Once the logisticians started to establish the BSA, they found themselves competing with the rest of the brigade for use of the helicopters and landing craft. In accordance with British amphibious doctrine, Clapp held these assets at his level and his staff prioritized requests. Hellberg recalled that their requests were generally placed lower on order of merit due to their logistical nature.[29] This problem put the leadership in an interesting predicament. The establishment of the BSA and prepositioning of enough supplies to support a breakout operation was considered as a necessary condition to allow the commandos to transition to the next phase of the operation; however, by prioritizing logistical requests for transportation assets lower, the Task Force leadership effectively hindered the tempo of operations. After the war, Hellberg argued that if the British fought another operation of this character, logisticians needed dedicated transportation assets.[30]

Another issue that Hellberg's logisticians experienced while establishing the BSA dealt with fuel. Distribution of fuel forward to the line units to run generators, Rapier missile systems, and the few vehicles taken to the Falklands relied on the exchange of 5-gallon jerry cans. While the concept of support called for an equal exchange of an empty jerry can for a full one, this system was rarely practical or reliable. Additionally, the flexible fuel pods normally used to transport fuel on the mexeflotes were vulnerable to strafing, so the regiment relied on smaller rigid pods. Once the fuel was transferred to pods ashore, logisticians had to use a hand crank to fill the jerry can.

Events on 25 May further exacerbated this problem when Argentine pilots stuck the MV *Atlantic Conveyor* with an Exocet missile. The *Atlantic Conveyor* was a SFUFT container ship that was converted to an air platform transporter, carrying extra Harriers and helicopters. Significantly, it carried most of the rotary wing platforms designated to support land operations, including the movement of supplies, on East Falkland. The ship also carried all of the tents for the landing force, the matting for a temporary Harrier runway at San Carlos, ammunition, logistical support vehicles, fuel handling equipment, desalination plants, and generators. Additionally, it had most of the spare parts for fixed and rotary wing aircraft already in operation. All but one Chinook helicopter, which was aloft at the time of the missile strike, was lost when the ship sank.[31]

On 27 May, an Argentine Sky Hawk attacked the BSA. The pilot dropped 12 400-kilogram parachute-retarded bombs. Four exploded, kill-

ing six commandos and wounding 26. One of the bombs hit struck the Ammunition Holding Area, which caused a chain reaction of explosions for the rest of the night. Much of this ammunition—already netted for sling-load operations—was allocated to support 2 Para's attacks against the Argentine garrison at Goose Green the next day. Finally, three unexploded bombs struck the dressing station in the hardstand building. Not only were surgeons and medics actively treating casualties at the time of the raid, but most of the senior logisticians were gathered in the building for the daily logistics meeting. This attack was nearly catastrophic for the logistical efforts of the landing party; however, Thompson later praised Hellberg's efforts to calmly restore order and work through contingencies to support the next day's attack.[32]

In the end, political considerations trumped the military conditions agreed on to execute the breakout. The Thatcher government was concerned with maintaining international support for their operations, and they were upset with the perceived inaction on East Falkland. Although the Commando Logistic Regiment had not finished moving all of the supplies ashore to support a breakout, Thompson was ordered to start the next phase of operations. On 28 May, 2 Para attacked Argentine forces in Goose Green and Darwin. The expenditure of indirect fire shells—primarily 105-mm high-explosive and 81-mm mortars—more than four times exceeded the planned rate of expenditure. Since all of the supplies were not ashore at the time of the breakout, 2 Para ran out of 105-mm rounds during the battle and the BSA's supplies of food and medical equipment were down to a few days' reserve.[33]

The Argentine defenders at Goose Green surrendered the next day, which relieved some of the stress on the logistics system. By early June, Hellberg had developed a system to support operations in other locations on the island. Ajax Bay continued to serve as the BSA until after the Argentines surrendered on 14 June. The regiment offloaded more than 9,080 tons of combat supplies at Ajax Bay, including 3,500 tons of ammunition and 1,200 tons of rations. They also moved an additional 9,080 tons of petroleum products. The medical squadron treated 202 surgical cases and 710 minor injuries from the abandoned mutton station at Ajax Bay. Only three soldiers died of wounds after reaching the dressing station.[34] Although little of Hellberg's original concept of support survived the first day, the logisticians overcame adversity and changing battlefield conditions to allow 3 Commando Brigade to maintain the pace of offensive operations. Writing after the war, Hellberg credited his men for the success of the operation, "There can be no doubt that, even in a limited war of this nature, plans have

to be changed by the minute, and success or failure (even with logistics) often rests with the initiative and determination of some of our youngest and most inexperienced NCOs [noncommissioned officers]."[35]

Lessons of Operation Sutton

According to Hastings's account of the war, the battle at San Carlos Water was the decisive point of the war. It was the last point where the British operation could have floundered. [36] During the operation to retake the islands, several military leaders, including Woodward, expressed that the Task Force was "one major mishap" from failure.[37] The judgment that Operation Corporate nearly failed is technically correct at the tactical level. Most of challenges faced by the British were inherent to projecting military force 8,000 miles from its bases in Western Europe and the logistical challenges associated with it. Had the British experienced a major mishap during Operation Sutton, it would have taken days or even weeks to rectify. The loss of the *Atlantic Conveyor* and the attacks against the BSA and the LSLs could have easily broken the logistics system, allowing the Argentinians to consolidate their defense.

The Ministry of Defence submitted a final report on lessons learned during Operation Corporate to Parliament in December 1982. They concluded that the logistics support was a major success.[38] According to Army doctrine, "a successful sustainment plan will extend operational reach, prevent culmination or loss of the initiative, manage transitions, exploit possible opportunities, and mitigate risk."[39] Hellberg's concept of logistics—and his subsequent adjustments to the battlefield conditions—met these criteria. Even when political considerations accelerated the breakout from San Carlos, his unit ensured that Thompson maintained freedom of action without being encumbered by logistical considerations. Certainly, the fact that the Logistic Regiment had just redeployed from a winter exercise in Norway fully trained when they embarked for the Falklands assisted their performance in the Falklands.

However, Operation Sutton also demonstrated some of the shortfalls in the training conducted by the commandos. The annual exercises conducted in Norway and other NATO locations failed to simulate theater opening. The Regiment's LSLs sailed to a port and administratively downloaded their vehicles and equipment. As a result, the LSL captains had not practiced beaching their ships to facilitate off-loading. During Sutton, Clapp decided not to beach the LSLs because the crews were not trained.[40] Instead, the logisticians had to load supplies onto mexeflotes barges and LCUs, ferry them to shore, and unload them. These additional steps added

precious time to effort to bring the BSA to operational strength. Although the British relied on SFUFTs in time of war, they did not involve them in exercises. Consequently, they failed to discover that the cargo doors on the civilian ships were located significantly higher in the water than the mexeflotes. Although logisticians improvised ramps during Sutton to fix this problem, training under battlefield conditions would have identified this issue prior to the war. The MoD Committee responsible for lessons captured this problem and rectified it by assigning advisors to shipbuilders on the future design of ships to aid in their quick conversion. Finally, at the tactical level, the commandos and the logisticians found that ammunition expenditure rates exceeded the planned rates developed from training by 400 to 500 percent.[41] This problem may be due to the fact that the commandos had not recently conducted an exercise at the brigade level, let alone as a reinforced brigade.

Remarkably, the Royal Logistic Regiment had few problems supporting a joint formation despite having not trained with the British Army. The organization of the Regiment provided a partial explanation for this feat, since Hellberg had specialists from every branch of service that could provide expertise. The lone exception applied to the Rapier battery. Few logisticians were familiar with the system and greatly underestimated its demands in terms of transportation, fuel consumption, and spare parts. As a result, the battery was nearly nonoperational by Deployment plus three days (D+3) despite being a critical system. However, as with some of the other problems, the Rapier system had never been incorporated into training exercises.[42]

If Argentina had invaded the islands a year or two later following full implementation of the Nott defense cuts, it was doubtful the British would have had the military capability to reclaim the islands.[43] Hellberg reinforced the point by writing, "without adequate shipping, helicopter, and air power, the operation could not have been mounted or sustained. It was a close-run thing and even a year later we might not have been able to contemplate the operation from a logistic point of view."[44] Although the committee agreed to replace two of the LSLs damaged in the war, the new ships lacked the ability to offload supplies on a beach. Part of the reason the Regiment was successful in conducting an expeditionary operation of this type was redundancy in the system. Hellberg's concepts of support only required four LSLs to support the landings, but had the military not sent six LSLs to the Falklands, the temporary losses of the *Galahad* and *Lancelot* on May 24 could have had catastrophic effects on the logistical buildup. Equally important was future procurement in helicopters. Subse-

quent purchases of Chinooks lacked the ability to fold their blades for deployment aboard a ship, which precluded their use in a similar operation.[45] In these cases, the war's lessons were ignored.

Operation Sutton is still relevant to logisticians and military leaders as they prepare for possible contingencies. Amphibious operations are among the most complex to plan, and the assaulting force assumes significant risk with regard to logistics. The battle produced lessons at both the tactical and strategic levels. For logisticians serving in tactical units, Hellberg's ability to create a flexible sustainment plan to enable his commander's freedom of maneuver is worth study. It was stressed, but not broken, by the changing conditions. However, it also served as a cautionary note. Logisticians should strive to train every part of their mission under battlefield conditions with all of the systems that they are expected to use in wartime. Furthermore, since forcible entry expeditionary operations are likely to be joint in nature, they should advocate for exercises that test systems in a joint environment. Operation Sutton also demonstrated the need for robust contingency planning, including the development of mobilization plans. At the strategic level, logisticians need to clearly articulate the risk and opportunity in future procurements and defense cuts across services. With a renewed interest in planning against possible contingencies in the Pacific theater, it is conceivable that a joint force could operate thousands of miles from its closest logistical base against a near-peer enemy.

Notes

1. The current body of literature includes a number of pieces that discuss the different aspects of the war. The definitive accounts of the campaign include Lawrence Freedman's *The Official History of the Falklands Campaign* from the British perspective, while the Argentine narrative was told in Ruben Moro's *The History of the South Atlantic Conflict* and the Informe Oficial del Ejercito Argentino's (Argentine Army) *Conflicto Malvinas*. Several British politicians involved in the War Cabinet captured their memories of the war in biographies, archives, or books including Prime Minister Margaret Thatcher's *The Downing Street Years* and Secretary of State for Defence Sir John Nott's *Here Today, Gone Tomorrow*. At the tactical level, military leaders documented their perspective of the war in memoirs before official records were available through the Ministry of Defence. Admiral John "Sandy" Woodward's *One Hundred Days: The Memoirs of the Falklands Battle Group Commander*, Commodore Michael Clapp and Ewen Southby-Tailyour's *Amphibious Assault Falklands: The Battle of San Carlos Water*, and Brigadier Julian Thompson's *3 Commando Brigade in the Falklands: No Picnic* described their roles as commanders of their respective task forces. Several other subordinate military leaders wrote books about their experience during the 74-day war. All of these works generally contribute to the narrative that the war was closely fought.

2. Joint Publication (JP) 3-0 defined operational reach as "the distance and duration across which a unit can successfully employ military capabilities." Joint Chiefs of Staff, Joint Publication 3-0, *Joint Operations* (Washington DC: 17 January 2013), GL-13.

3. John Nott, *Here Today, Gone Tomorrow* (London: Politico, 2002), 257–59.

4. Lawrence Freedman, *The Official History of the Falklands Campaign* II (Abington: Routledge, 2005), 193.

5. Secretary of State for Defence, *The United Kingdom Defence Programme: The Way Forward*, Command Paper 8288 (London: Her Majesty's Stationery Office HMSO, 1981) 3–5.

6. Secretary of State for Defence, 11.

7. The *Fearless* and the *Intrepid* were the only two Landing Platforms (Dock) still in service in the Royal Navy. Each ship was outfitted with four Landing Craft Utility to facilitate the landing of troops. The *Intrepid* was already in dock awaiting decommissioning when the war broke out, and it took nearly two weeks to return the ship to service. Gregory Fremont-Barnes, *A Companion to the Falklands War* (Stroud, Gloucestershire: History Press, 2017), 90–92, 147–48; Hansrad House of Commons Debate 8, 7 July 1981, col. 280.

8. James Wyllie, *The Influence of British Arms* (London: Allen and Unwin, 1984), 90.

9. Other measures signaled a shift away from the South Atlantic, including making the Commander in Chief, South Atlantic position redundant; the closure of the naval base in South Africa; and the withdrawal of a frigate permanently

stationed in the South Atlantic. Following the 1976 crisis with Argentina, the government decided not to extend the runway in the Falklands to accommodate larger military aircraft. Nott, *Here Today,* 254–255; Peter Beck, "Britain's Antarctic Dimension," *International Affairs* 59, no. 3, Summer 1983, 429.

10. The regiment's command rotated between the Royal Marines and the British Army.

11. In many aspects, the regiment's organization was similar to the modern US Army Brigade Support Battalion.

12. Due to the restrictive terrain on the islands, most units left their wheeled vehicles in the United Kingdom. Hellberg insisted on bringing the Regiment's Bv202 over-snow tracked vehicles, 9 forklifts, and 10 fuel-podded 4-ton trucks. He successfully argued for some additional personnel to join the Regiment from the United Kingdom to form a BSA defense company. Ivar Hellberg, "An Experience with the Commando Logistic Regiment Royal Marines," in *The Falklands Conflict Twenty Years On: The Lessons of the Future*, eds. Stephen Badsey, Rob Havers, and Mark Grove (London: Frank Cass, 2005), 111, 114.

13. Julian Thompson, *3 Commando Brigade in the Falklands: No Picnic* (Barnsley: Pen & Sword Military, 2008), 27.

14. Ivar Hellberg, "Falklands Logistics: Have We Learnt the Lessons and Could We Do It Again Today?" *The RUSI Journal* 152, no. 3, June 2007, 61.

15. Valerie Adams, "Logistics Support for the Falklands Campaign." *The RUSI Journal* 129, no. 3, June 1984, 45.

16. The decision to load the *Elk* with the majority of the ammunition was one of necessity. The voyage south to the Falklands was rough and some of the ammunition was dislodged from its pallets, which then hindered the efforts to cross-load it with other ships at Ascension. The fact that the *Elk* had most of the ammunition had severe consequences after Clapp ordered the SFUFTs to leave San Carlos Water when the British failed to gained air superiority. "MV Elk" Annex G to HQ 6/8/82 (10 May 1982), *Records of the Admiralty* (AD) 202/805; Kenneth L. Privratsky, *Logistics in the Falklands War: A Case Study in Expeditionary Warfare* (Barnsley: Pen and Sword Military, 2014), 42, 77.

17. The mid-June timeline was derived from a combination of weather and maintenance issues. Many of the ships in Task Force 317 had been at sea for an extended period and needed maintenance. One aircraft carrier, HMS *Hermes*, was rushed out of scheduled maintenance to join the Task Force and the other, HMS *Invincible*, sailed part of the way to Ascension with a broken propeller shaft. Thompson, *3 Commando Brigade in the Falklands*, 27; Sandy Woodward, *One Hundred Days: The Memoirs of the Falklands Battle Group Commander* (Annapolis, MD: Naval Institute Press, 1997), 82, 92–94.

18. The British government declared a Total Exclusion Zone of a 200-nautical-mile circle around the Falkland Islands. Any aircraft or ship inside the zone was assumed hostile. Fremont-Barnes, *A Companion to the Falklands War*, 285–86.

19. The *Canberra* was an important piece of the medical evacuation plan. The British converted a civilian cruise ship, *Uganda*, into a hospital ship by add-

ing laboratories and surgical suites, as well as modifying the decks to accommodate helicopters. However, the *Uganda* was kept outside of the combat area in a "Red Cross box" with the Argentine hospital ship. An agreement between the two governments stated that any casualties evacuated to these ships could not return to duty. Therefore, the *Canberra* had to take all minor casualties. Hellberg, *Falklands Conflict*, 113–114; Privratsky, *Logistics in the Falklands War,* 97.

20. "Commander's Diary, Commando Logistic Regiment Royal Marines, 2 April 1982–28 June 1982," 10 April 1982, ADM 202/850

21. "Commander's Diary, Commando Logistic Regiment Royal Marines, 2 April 1982–28 June 1982," 10 May 1982; Privratsky, *Logistics in the Falklands War*, 103.

22. "Operation Corporate – Log Concept of Support," 12 May 1982, ADM 202/857.

23. "Operation Corporate," ADM 202/857.

24. "FALKREP 3," 22 May 1982, ADM 202/866.

25. Michael Clapp and Ewen Southby-Tailyour, *Amphibious Assault Falklands: The Battle of San Carlos Water* (Annapolis, MD: Naval Institute Press, 1996), 146–47.

26. "SITREP 24/02," 24 May 1982, ADM 202/866; Clapp, 173.

27. Clapp and Southby-Tailyour's *Amphibious Assault Falklands*, 172–73; Hellberg, *Falklands Conflict*, 117.

28. Max Hastings and Simon Jenkins, *The Battle for the Falklands* (London: Pan Books, 1997), 252–253; Thompson, *3 Commando Brigade in the Falklands*, 75.

29. Hellberg, "Falklands Logistics," 61.

30. Hellberg, *Falklands Conflict*, 126–27.

31. "SITREP 26/01," 25–26 May, ADM 202/866.; Freedman, *The Official History of the Falklands Campaign* II, 481–82.

32. *Commando Logistic Regiment Royal Marines: Annual Historical Diary*, 27May 1982, ADM 202/912; Hellberg, *Falklands Conflict*, 118–119; Thompson, *3 Commando Brigade in the Falklands*, 91–92.

33. "Op Sutton SITREP 28/01," 27–28 May 1982, ADM 202/866; Hellberg, "Falklands Logistics," 62–63.

34. Hellberg, "Falklands Logistics," 63.

35. Hellberg, *Falklands Conflict*, 117.

36. Hastings and Jenkins, *The Battle for the Falklands*, 262.

37. Woodward, *One Hundred Days: The Memoirs of the Falklands Battle Group Commander*, xvii.

38. Secretary of State for Defence, *The Falklands Campaign: The Lessons*, Command Paper 8758, (London: HMSO, 1983), 25–28.

39. Department of Army, Army Doctrine Publication 4-0, *Sustainment* (Washington DC: July 2012), 11.

40. Privratsky, *Logistics in the Falklands War*, 97–98.

41. Adams, "Logistics Support for the Falklands Campaign." 47; Secretary of State for Defence *The Falklands Campaign*, 25–28.

42. “SITREP 26/01,” 25–26 May, ADM 202/866; Privratsky, *Logistics in the Falklands War*, 39.

43. Stuart Croft ed., *British Security Policy: The Thatcher Years and the End of the Cold War* (Hammersmith: Harper Collins Academic, 1991), 53

44. Hellberg, *Falklands Conflict*, 117.

45. Hellberg, “Falklands Logistics,” 65.

Chapter 8
VII Corps Logistics in Desert Storm

James B. Martin

Logistics constitute an operation within the operation.[1]
—Lieutenant General (Retired) L. Don Holder

This volume is focused on the sustainment of forces in large-scale combat operations. The largest example of this in modern American military history is that of the US VII Corps during Operation Desert Shield/Storm. The VII Corps was an immense organization, built to conduct large-scale combat operations against what was then believed to be the fourth largest army in the world. This chapter will provide a case study on the logistics organization and operations at the corps level that supported VII Corps and will end with a discussion of lessons learned in the planning and execution of such large-scale operations.

Creation of the Logistics Corps Organization

The organizations that became part of VII Corps were from a combination of geographical locations. Much of the corps, including its command headquarters and its senior corps level logistics command, came from Germany and had worked together for decades. Other portions of the corps arrived from stateside units in the Active and Reserve force structure. The corps eventually added the United Kingdom's 1st Armoured Division, which brought its own logistics support and needed little from the corps beyond fuel resupply. Most of the Active force units that joined VII Corps were combat formations that had habitual training relationships and were very cohesive organizations.

On the other hand, most of the Reserve force units that came to VII Corps were logistics organizations that had no habitual relationship to each other or the command headquarters they operated under during the war—the 2nd Corps Support Command (COSCOM). While one of the brigade level organizations, the 7th Corps Support Group (CSG), was part of the COSCOM in Germany, the other—the 16th CSG—was reassigned from a sister corps in Germany and lacked any habitual relationship with the COSCOM headquarters or its subordinate logistics management organizations. Units from Germany made up the base elements of both CSGs, but they were filled out with Reserve force units from the continental United States (CONUS) in the normal "plug and play" method of organizing echelons-above-division logistics units in the US Army. These Reserve

units ranged in size from brigade-level medical organizations to individual truck companies, each bringing unique capabilities to the 2nd COSCOM that had been identified in the corps planning sessions.

The determination of the types and number of units required to support the large combat formations that made up the VII Corps was the result of analysis done once the corps was notified that it would deploy to Saudi Arabia in support of the allied operations against Saddam Hussein. Working in concert with the corps planning staff in Stuttgart, Germany, a logistics planning cell was created from elements of the corps G4 staff and the COSCOM headquarters element. This small group of logisticians used the pertinent planning documents available in 1990 to match support capabilities to the type and number of combat systems that would be brought to bear in theater. Initially utilizing US Army Field Manual (FM) 101-10-1, Staff Officers' Field Manual, *Organization, Technical and Logistical Data,* it quickly became apparent that this 3-inch-thick document was too unwieldy to be of much assistance. Turning to the more concise *G1/G4 Battle Book* produced by the Command and General Staff College's Department of Sustainment and Resource Operations and the available automated systems, the cell received input from the G3 cell on what formations would be added to the corps structure; additionally, they would identify how many and what type of logistics units were needed to support the number of tanks, armored personnel carriers, aircraft, etc.[2] Once the type and number of units were identified through this analysis, the requirement would be conveyed to the appropriate Army channels and units identified to fill the requirements.

Because the VII Corps in Germany was a forward-deployed but stable unit, it was supported by a minimal number of uniformed logistics organizations—with the majority of its higher-level supply and maintenance needs being met by a civilian workforce made up largely of German civilians. As these civilians were not deployable, this meant that a majority of the logistics units required to meet the transportation, ammunition, and fuel requirements had to come from outside of VII Corps. As stated above, a large number of the Army logistics units resided in the Army Reserve, so they were called upon in large numbers to meet the requirements of the corps.

To provide some context as to the size of the organization that VII Corps logistics planners had to support, it is helpful to look at the initial planning factors used. The initial planning assumptions made by the team were that the corps would encompass approximately 125,000 Soldiers and require approximately 3.5 million gallons of diesel fuel per day; that theater logistics could support 90 miles into Iraq; that the war would last be-

tween 7 and 10 days; and that the 1st Cavalry Division and 1st Armoured Division (UK) would eventually be part of the corps footprint.[3]

Deployment to Saudi Arabia from Germany

The majority of VII Corps forces flowed from their locations in Germany to ports in Germany, Belgium, and the Netherlands. Moving by road, barge, and rail, the nearly 38,000 vehicles inundated already-busy ports and created challenges for all involved. Dividing the vehicles and approximately 7,000 containers between 109 ships required creative loading that did not always prove to most effective, though it would have to be considered efficient.[4] An example of this challenge can be found in the shipping of the vehicles belonging to the 2nd COSCOM's 800th Material Management Center, the organization that accounted for and issued the corps's supply and maintenance stocks. The organization was small—only having 16 vehicles in total—but had this fleet divided across five different ships. A particular problem was created by the large towed vans that housed the Standard Army Intermediate Level Supply System (SAILS). SAILS, which accounted for materiel and was needed to order and issue to corps units. The system had two vans which ended up on two different ships—creating a challenge in supporting the corps when one van arrived and the other did not. The lag time in getting the second van in-country delayed the Materiel Management Center's (MMC's) ability to accomplish its mission even though the vans were sent into country ahead of the divisions that they were to support. Though there were gaps in the effectiveness of the loadout in Germany, the personnel who executed the mission must still be congratulated. Uprooting a corps that had spent a half-century focused on the Iron Curtain, reorganizing it, and then completing its loading en route to a new theater of operations in approximately 60 days was a remarkable feat.[5] Upon arrival in Saudi Arabia, the COSCOM units moved from their port of debarkation into the desert toward Hafir al Batin—screened by the 2nd Armored Cavalry Regiment and began to prepare to support the corps movement into Iraq.

Movement into the desert was a complex operation—requiring fuel support and traffic management on the single main supply route, Tapline Road, which moved from the ports to the east and into the interior of Saudi Arabia paralleling the border with Iraq. The road was a simple two-lane blacktop route and would be covered with vehicle convoys, Heavy Equipment Transporters (HET), and tractor trailers from mid-December 1990 to mid-January 1991. In all, the movement along this single main supply route (MSR) from the ports to the Tactical Assembly Areas (TAAs) encompassed approximately 7,400 tractor trailer/tanker loads; 5,000 containers; and 30,000 vehicles between 10 December 1990 and 20 January 1991.[6]

Planning for Offensive Operations

Planning for the offensive phase of Desert Storm began shortly after the announcement of VII Corps involvement in early November 1990. By 5 December, the logistics planning cell was in place and made up a major portion of the overall planning effort. Initially working out of the basement of corps headquarters in Stuttgart, the planning cell worked through the analysis identified above and then transitioned to the plan to support the corps's maneuver.

To support offensive operations, the corps built Log Base Echo near Tapline Road northwest of Hafir al Batin. This sprawling logistics complex provided command and control for most classes of supply and a trailer transfer point for containers that had been shipped to theater from the unit's home station. The 16th Corps Support Group (CSG) had responsibility for this mission as well as supplying fuel and ammunition going forward above the Line of Departure (LD). To provide some context for the scale of the 16th CSG's mission at Echo, it "stocked 10.8 million gallons of fuel; three tactical petroleum terminals; 800,000 gallons of bulk water; 960 tons of meals ready-to-eat (MREs); and mountains of other supplies. Although 95 tons of munitions were planned for stockage, totals never exceeded 67,000 at one time."[7] In addition, the Log Base became a massive storage facility for containers, many of which were never claimed by units and lay unopened at the end of the war.

Initially the corps's plan called for all units to cross the Line of Departure through a single breach to be made in the Iraqi lines. While this breach was not a single crossing point, it was a restricted path through the obstacle belt believed to lie between Allied lines and the Iraqi forces. Largely because of this restriction—and mobility issues with many of the corps level logistics vehicles, which were designed for the highways in Germany—plans called for the divisions to carry significant portions of their logistics requirements uploaded with them on their organic support vehicles and the corps level vehicles which had adequate mobility in the desert environment. In order to support continued offensive movement forward, the COSCOM was given the mission to create Log Base Nellingen (named for the German city which hosted the unit headquarters for decades) by H+54 (the scheduled attack time plus a designated number of hours) at a location approximately 90 miles north of the breach. This placement was driven not by terrain but time and distance that would allow theater trucks to be able to push fuel and other supplies to the Log Base—allowing the corps trucks to focus on moving farther forward to support the continuous momentum of the combat units. With the combat units carrying their unit

basic loads and the next tier of support uploaded on corps trucks, the plan was for combat units to empty the corps trucks thus preserving their organic logistics assets. Then the corps trucks would return and be used as needed to continue to support the offensive fight. The corps logistics support of these units north of LD was the mission of the 7th CSG, the brigade-sized unit that was part of 2nd COSCOM in Germany, as well as two CSGs that joined the COSCOM from the United States—the 30th CSG and the 159th CSG. The CSGs had to examine its mission and determine whether the doctrinal support it had provided to units in Germany and the United States would work in the current operating environment with a larger combat force, significant distances, and poor mobility. The analysis indicated it would not and the unit began to examine non-doctrinal possibilities to meet its mission. The unit created Logistics Task Forces (LTFs), largely taken from draft doctrine manuals, which would provide multifunctional support to division and regimental units. These LTFs were multifunctional entities that did not already exist and were created either by modifying existing functional units or establishing provisional battalion-level organizations to handle the command and control. The plan called for 16th CSG to push support to Log Base Nellingen. Then 7th CSG, 30th CSG, and 159th CSG would carry that forward to the division and regimental rear areas.

The final concept that emerged from the planning effort broadened the points of entry across the LD and allowed logistics units to move through on two separate routes to support combat units in their zone. The new plan was for Log Base Nellingen to be established by H+36 and a second trailer transfer point and petroleum supply point referred to as PSC#1 to be established near the left side route through the LD. This array was designed to provide for more rapid movement of logistics units through the breach lanes and the establishment of corps logistics support bases closer to the offensive effort at a more rapid pace.

Challenges to this plan began to emerge as an accounting of planned logistics assets and actual in-theater assets showed shortages in transportation vehicles of all types. While the analysis of requirements indicated that the corps plan would require 14 medium truck companies and 11 fuel transportation companies, the actual number of trucks available to support the corps was far less. Where the original programmed number of medium truck companies would have provided 1,680 stake and platform (S&P) trailers, the actual number on hand was only about 1,200. For 5,000-gallon fuel tankers, the required 660 was not reached; the shortage in this area was 84 tankers.[8] In all, the corps began offensive operations with 71 percent of the required medium truck capacity and 87 percent of its required

fuel tankers. With a plan already focused on significant challenges in the time-and-distance components of supporting a large combat force, these shortages made the plan that much more difficult to execute.

The plan to support VII Corps offensive operations was complex and relied on many factors to ensure success. The pace at which CSG elements were able to follow the division and regimental forces was critical and depended on their timing through the breach and their ability to match the cross-desert mobility of the units they were supporting. The timing of getting combat units through the breach in order to clear time/space for logistics units to get through and create Log Base Nellingen was another critical requirement to ensure continuous logistics support to the corps. Based on this intricate timing, the COSCOM and the corps were betting their ability to support the combat units past Day 3 on the return of the corps trucks traveling with the major formations and their supporting LTFs.

Execution of Offensive Operations: Logistics

Neither of the plans composed by the logistics planning cell was exactly what was executed in real life. This should not come as a surprise to anyone with a background in military planning or history. Trafficability issues which were not apparent during the planning phases in Germany or before departure from the ports of debarkation precluded 2nd COSCOM from being able to create petroleum supply company (PSC) #1 and provide more direct lines of support along the left side of the corps area of operation. The truck types available to 16th CSG were not able to operate in the area planned for PSC#1 and the mobility requirements for the forward CSGs took priority, meaning the trucks with greater mobility had to remain with them. Even then, some M915 tractors were still deployed forward of the LD, and mobility became a problem. This issue required a modification of the plan for all of the corps's Combat Service Support (CSS) resupply and had to be executed through the breach. The plan to use LTFs moving with the combat units proved to be the best approach. While Log Base Nellingen was slowed in opening from the final plan, it was operational by H+40. With the restrictions in the area of PSC#1, the importance of Log Base Nellingen became more apparent in supporting the corps. Members of the corps G4 section wrote in an article after the war that the creation of Log Base Nellingen "shortened the supply routes to the 1st and 3rd Armored Divisions (ADs) by almost one day."[9]

While the Log Base opened only a few hours later than planned, it was still not fast enough to meet the needs of the combat units. When the initial convoy arrived at the site, it was dark and units were already

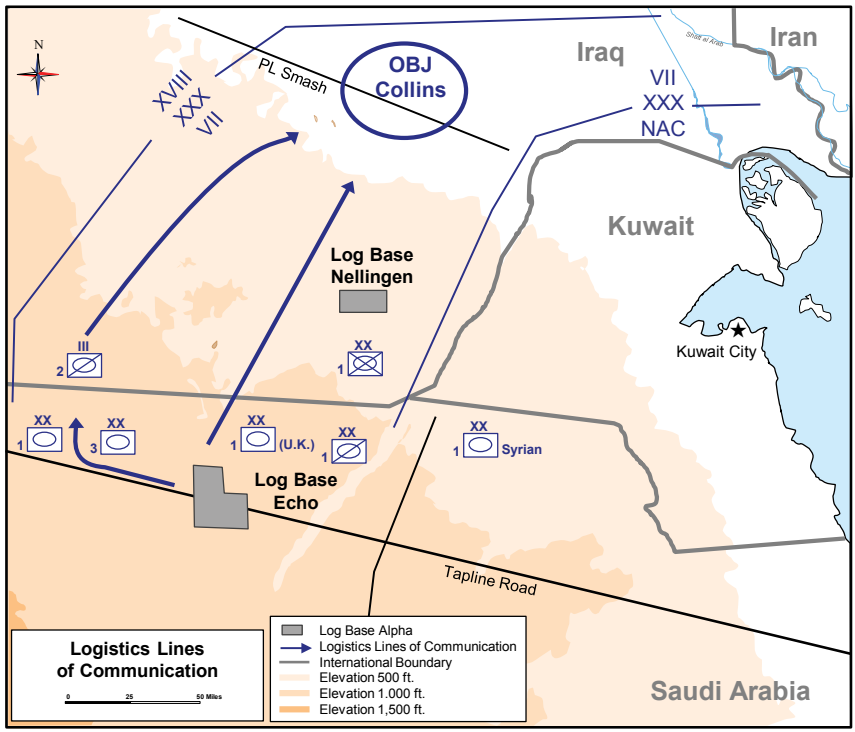

Figure 8.1. VII Corps logistics lines of communication. Map created by Army University Press.

arriving to receive resupply. While the ground should have been cleared by Explosive Ordnance Disposal experts before the fuel bags were filled, time did not allow for the luxury and the fuel resupply point was set up without the required safety features. Individual bags were not secured behind a berm; a single berm was set up enclosing all of the bags. The initial convoy contained approximately 400,000 gallons of diesel and a follow-on convoy with another 400,000 gallons was already en route to the Log Base. While the Log Base was capable of storing 1.5 million gallons of fuel in its bag farm, most of that fuel stock moved through the system very quickly—with a constant stream of trucks either returning from the division rear or COSCOM trucks moving forward to predesignated points and providing a service station-type transfer to divisional trucks. [10] The lack of mobility of the COSCOM trucks required continuous support from engineer units in maintaining supply routes that were passable by the M915 trucks available for the mission.

The COSCOM Deputy Commander was in charge of Log Base Nellingen and was forced to make critical decisions based upon the corps commander's intent. This was partly because of the rapid pace of the operation, which flowed much faster than anticipated in the planning phase, and because of lack of communications assets at the Log Base. The operating environments in Germany and in Saudi Arabia were far different, and the Modified Table of Organization and Equipment (MTOE) of the organization provided a reduced communications capability to the forward Log Base and the convoys that searched out the combat units. While Task Force Allen, which manned the command and control of Log Base Nellingen deployed with mobile subscriber equipment (MSE), the system was not established quickly enough to be useful. The only means of communication with the COSCOM HQ was a Marine Satellite Telephone Terminal, which did not interface with the Tactical Satellite being used on the corps net. The convoys that moved daily to follow the divisions and regiment had severely restricted communications capacity, normally restricted to the single High-Mobility Multipurpose Wheeled Vehicle (HMMWV) that led the convoy.[11] While the Log Base's largest mission was pushing fuel forward to the divisions and the regiment, it also contained a very busy trailer transfer point, a Forward Area Refueling Point (FARP) to support aircraft, a bulk water distribution point, a graves registration element, and eventually an Enemy Prisoner of War (EPW) holding area.

The active combat portion of the offensive operations during Desert Storm was initially expected to take 7 to 10 days but was completed in just 100 hours. The pace at which the combat units moved and the success they achieved saved many lives. It also stretched the logistics assets with the mission to provide support by its sheer speed of movement. While various after-action reports and historical accounts have identified elements that needed improvement, the fuel and ammunition needed to continue the fight were always available during the period of combat. An extension of combat might well have changed that story related to fuel, as the 2nd ACR and others were beginning to run short as the 100 hours came to a close.[12]

Execution of Offensive Operations: Services

VII Corps deployed with its assigned personnel services organizations—the 7th Personnel Group and the 7th Finance Group, which supported the corps as it grew from approximately 42,000 in Germany to more than 125,000 in theater. These units had to keep pace with a rapid inflow of personnel and the movement of units throughout the theater on very short timeframes. The fact that any unit in VII Corps actually received mail is

a credit to the leadership and Soldiers of these unsung units. An example of the issues that these two organizations had to cope with is the pace of incoming personnel to build the 2nd COSCOM to its needed structure. The COSCOM deployed from Germany with roughly 10,040 organic personnel. Between 15 December 1990 and 26 January 1991, the COSCOM grew from its original 10,040 to nearly 15,000 soldiers. This growth of 50-percent strength would be impressive from a personnel standpoint if it had not been followed by a leap in the next four weeks to 26,422 soldiers.[13] This organization—which came from Germany with just over 10,000 soldiers—would go into combat just over two months later 150 percent larger than it began. Stated another way, the COSCOM grew from 38 organic units when it was notified to deploy to 226 CSS units by the time Task Force Allen crossed en route to Log Base Nellingen.[14] With the bulk of these reinforcements arriving late—within the last 30 days before combat commencing—the time for the unit to incorporate these Soldiers and train them in unit standard operating procedures was almost non-existent. A specific example of such a massive influx is in the 800th MMC mentioned earlier. The 800th was an authorized level of organization (ALO) 6 unit in Germany, because local nationals or government civilian employees accomplished much of its mission. Without their support in Saudi Arabia, the unit was grossly understrength for the mission it was assigned. The Executive Officer of the unit noted on 7 February 1991 that while VII Corps had the bulk of the forces in theater, its sister corps was supported by two different corps materiel management centers, both of which were manned at a higher ALO rating than the 800th. This misalignment was simple to understand, as the XVIII Airborne Corps was the Army's expeditionary force and VII Corps was intended to fight on its home turf in Germany. The personnel system finally identified the issue in this case and the flow of personnel turned to the 800th; this unit of just over 100 personnel received 36 replacements between 9 and 11 February, including six chief warrant officer 4s. While this was a significant improvement, the fact that the unit grew by more than 30 percent just 11 days before the Log Base Nellingen convoy crossed the LD creates a question of just how much help this was to the corps.[15]

The planning for the VII Corps portion of Desert Storm included casualty estimates far in excess of what was actually experienced. Because of this, the medical infrastructure that was deployed to support the corps was significant. Under the command and control of the 2nd COSCOM, the 1st Medical Brigade was constructed with four mobile army surgical hospitals (MASH), five combat support hospitals (CSH), and five evacuation hospitals (EVAC) with a bed capacity of 3,300. The much more mobile MASH

units were deployed forwarded, though they had deployable medical systems (DEPMEDS) components that had to be hauled on HETs because their dolly systems would not work offroad. The four MASH units were planned near the vicinity of Phase Line Smash and a single CSH planned near Log Base Nellingen; most of the beds were in the hospitals located south of the LD. Because of the low level of casualties, much of this capacity was never utilized; there were only 1,768 admissions to VII Corps hospitals for both combat and non-combat reasons.[16]

Logistics Lessons Learned in VII Corps

A principal lesson to be learned from the VII Corps story is the risk that sometimes must be assumed and how it can shape an operation. The corps logistics planners were presented with an assumption that theater trucks would be able to support 90 miles into Iraq, but this proved to be untrue. Theater trucks focused their support on Log Base Echo; the COSCOM was forced to handle all of the transportation going forward from there to Log Base Nellingen, effectively reducing the number of trucks the plan relied upon. When the combat units crossed the LD, they were carrying their Tier 1 and 2 loads of ammunition on a combination of their combat vehicles and trucks. Tier 3 ammunition moved on corps trucks with the LTFs. The plan called for the corps trucks to be emptied first and returned to Log Base Echo to be loaded with logistics packages (LOGPACs) made up of other critical classes of supply. These were items that were not as important initially as fuel and ammunition but would be needed later such as repair parts and resupply. Because of the success of the combat units and how accurate the M1A1 tank system was at targeting and killing enemy tanks, far fewer rounds were expended than planned. The trucks loaded with Tier 3 ammunition were never unloaded and thus never returned to pick up LOGPACs needed by the combat units. Because of the short duration of ground combat, the corps was able to weather this storm; no mission-critical problems that occurred were insurmountable, though some units reported running low on water.[17] If the war had been prolonged for some reason, units would have had to make choices between not receiving their follow-on support or grounding some of the ammunition that occupied these trucks.

Part of this challenge was based on how VII Corps was resourced for combat in Germany versus Saudi Arabia. The M915 tractor trailers most valuable to drive the highways in Germany were out of place in the deserts of Saudi Arabia and Iraq and needed to be replaced by either the more-mobile 30-foot trailer rigs or the even-more-mobile but relatively new heavy expanded mobility tactical truck (HEMTT) tankers just coming into the inventory. To aid in the mobility issue, the corps underwent a modernization

effort in theater—with the divisions trading a single 5,000-gallon tanker for two 2,500-gallon HEMTTs; then the larger tankers were pushed to the COSCOM units to improve their capacity.[18] While it increased the COSCOM's capacity, it did nothing to improve mobility. A logistics force that is not as mobile as the combat force it supports is a substandard approach to sustainment and fraught with dangers. As Lieutenant General Charles Mahan, former Army Deputy Chief of Staff for Logistics (DSCLOG), wrote in his after-action report as the 7th CSG Commander, logistics "equipment must be capable of moving at the same speed and over the same terrain as the support MSCs (major subordinate commands)."[19]

Historians and logisticians who have studied the support of large-scale combat will attest to the fact that the two most important supply classes are fuel and ammunition. Units can survive on reduced rations or water and these items can be brought in by air in an emergency if needed, but the Big Two for heavy armored forces will always be Class III and V. This rule means that the biggest issue for the sustainment forces that support these heavy units will always be transportation. Whether the issue with transportation is number of trucks, the ability to move these trucks based on road space and time/distance factors, or a lack of qualified drivers, having the right amount of transportation assets to meet the unit needs will always be the biggest challenge for logisticians. VII Corps survived a serious transportation problem created by a number of intertwined factors, but it was the most dangerous shortfall that occurred in the VII Corps logistics story during Desert Storm. With a longer combat phase, this is the problem that could have endangered the corps's mission accomplishment.

The most positive logistics lesson to be learned from the experience of VII Corps in Desert Storm is that with the right leaders and well-trained Soldiers, logisticians can accomplish support well beyond what their unit characteristics should allow. The 2nd COSCOM started with fewer transportation assets than they required and then fell even further short when combat units did not expend ammunition as expected. Vehicle mobility and a change in the expected support from theater further reduced the assets to support north of the LD. Emerging doctrine and operational needs created new requirements that caused logistics units to use techniques not common in other theaters of operation. While ammunition was commonly shipped with separate components on separate trucks for safety reasons in Germany and elsewhere, the needs of the force in Saudi Arabia required the creation of more effective and less restrictive combat configured loads (CCL) that provided all the ammunition system components to the end user on a single truck. This required immense labor investment at the am-

munition supply points to convert the bulk single-type shipments in the CCLs that were more effective for the combat units. When the sand had settled, the 2nd COSCOM and its assigned units had provided enough support to the multiple combat organizations that made up VII Corps for them to be successful in their mission. No unit ran out of fuel or ammunition or was restricted by a lack of these critical components. It was not pretty, but in the end it was effective. The story of logistics support to VII Corps in Desert Storm was referred to as "Brute Force Logistics" by previous authors, and it remains the best description of this massive operation.[20]

Historical Context: Sustaining Large-Scale Combat Operations

The 2nd COSCOM supported a massive organization that required far more sustainment than its predecessor during World War II. The VII Corps pushed through German forces in 1944, chewing up whatever the enemy put in their path. A comparison of what was required to support the version of VII Corps that fought in Desert Storm is instructive in identifying the sheer mass of materiel needed to support heavy forces in large-scale combat operations. The statistics in the summary provide the context needed to compare VII Corps operations in the two conflicts and how sustainment requirements have changed over the course of US military history. These statistics come from the VII Corps G4's after-action presentation.[21]

Field Manual (FM) 3-0, *Operations*, maintains that "the endurance of Army forces is primarily a function of their sustainment. Sustainment determines the depth and duration of Army operations. It is essential for retaining and exploiting the initiative. Sustainment provides the support necessary to maintain operations until mission accomplishment."[22] The case study of VII Corps logistics during Desert Storm is a prime example of where the sustainment organization of an Army corps was able to meet its mission in accordance with this explicit statement. The commander's intent from the VII Corps Commander was that sustainment had to match the speed of combat operations, as there would be no operational pauses for sustainment to catch up. He depended on his logistics leaders and Soldiers "to provide the support necessary to maintain operations until mission accomplishment," and they did.[23] General Frederick M. Franks summarized it this way: "Colonel Bill Rutherford Corps G-4 and COSCOM CG (Commanding General) Brigadier General Bob McFarlin figure[d] out on their own initiative that to sustain the attack against the RGFC (Republican Guard Forces Command), they needed to push a logistics base with fuel forward of the breach. They called it Log Base Nellingen and placed 1.2 million gallons of fuel there in over 400 tankers. That initiative with the no pause allowed us to 'strike hard and continually, and finish rapidly.'"[24]

	VII Corps World War II	VII Corps Desert Storm
Tanks/Armored Vehicles Destroyed	1,164	4,652
Trucks/Other Vehicles Destroyed	4,697	3,551
Casualties (approximate)	90,000	47
Rations Issued	40 Million	21.1 Million
Fuel Used gallons)	40 Million	25.4 Million
Ammunition Expended (tons)	100,000	65,000
Time (days in combat)	331	4

Figure 8.2. VII Corps comparison: World War II versus Desert Storm. Created by Army University Press.

Notes

1. L.D. Holder, "2nd ACR in Desert Storm," Presentation, Art of War Scholars seminar, Fort Leavenworth, KS, 14 August 2018.

2. VII Corps Operation Desert Shield/Storm After-Action Report, Tab L (Logistics), undated.

3. "2nd COSCOM Desert Storm," Presentation, undated, Slide 1.

4. W.R. Rutherford and W.L. Brame, "Brute Force Logistics," *Logistics: Desert Storm and Into the 21st Century*, Command and General Staff College, Fort Leavenworth, KS, August 1996.

5. Rutherford and Brame.

6. W.L. Brame, "VII Corps," Presentation, Operation Desert Storm, undated.

7. Rutherford and Brame, "Brute Force Logistics," 29.

8. Rutherford and Brame, 29.

9. Rutherford and Brame, 30.

10. "2nd COSCOM Desert Storm."

11. C.S. Mahan, "Lessons Learned Desert Shield/Storm," Memorandum, 3 March 1991, 4.

12. Author's interview with Lieutenant General L. Don Holder, former 2nd ACR Commander, Fort Leavenworth, KS, 14 May 2018.

13. Brame, "VII Corps."

14. VII Corps Operation DESERT SHIELD/STORM After-Action Report.

15. Author's Wartime Diary, 9–11 February 1991.

16. Brame, "VII Corps."

17. Gregory Fontenot, "First Infantry Division and Desert Storm," CSPAN programming at the Kansas City Public Library, 12 May 2018.

18. Rutherford and Brame, "Brute Force Logistics," 31.

19. Mahan, "Lessons Learned Desert Shield/Storm," 3.

20. Rutherford and Brame, "Brute Force Logistics," 27

21. Brame, "VII Corps."

22. Department of the Army, Field Manual (FM) 3-0, *Operations* (Washington, DC: 6 October 2017), 2-47.

23. FM 3-0.

24. Frederick M. Franks, "Desert Jayhawk: Forming Teams and Getting in Place to Fight" in *Essential to Success: Historical Case Studies in the Art of Command at Echelons Above Brigade*, eds. Kelvin Crow and Joe R. Bailey (Fort Leavenworth, KS: Army University Press, 2017), 218.

Chapter 9
Creatively Deploying the Heavy Division: Getting the 4th Infantry Division to Iraq in 2003

Colonel (Retired) Christopher D. Croft and Kelvin D. Crow

The next large-scale combat operation for the US Army will require strategic maneuver of large formations and their major weapons systems from staging locations in the United States to the seat of war. Enemy efforts will complicate an already complex and time-consuming process. Time spent thinking upfront and a shared understanding of the problem enables a more flexible and creative approach to the managed chaos of strategic maneuver. The 2003 deployment of the 4th Infantry Division (Mechanized) (4th ID), Task Force Ironhorse—to Iraq through Turkey, then through the Suez Canal and Kuwait—is an excellent historical case study to examine a creative solution to the deployment problem.

The end of the Cold War brought with it a reduction of US forward presence overseas, making power projection the centerpiece of US defense strategy. As its name implies, power projection is the United States' ability to rapidly and effectively deploy forces from multiple dispersed locations and sustain them in a contested theater of operations. The key to the strategy is the US's ability for unconstrained global reach. Projecting power globally provides our national leaders with the options they need to respond to potential crises: anytime, anywhere.

For their 2003 deployment, Task Force Ironhorse consisted of active, reserve, and National Guard forces located on 18 installations in the United States, Germany, and Italy. The Task Force deployed through eight seaports on 33 Ready Reserve Force ships and planned to enter through physically restricted ports. The Task Force had to plan on an unsupported movement through Turkey to attack the northern divisions of the Iraqi forces while the subordinate unit from Italy conducted a strategic airborne insertion. Each ship was loaded with self-sustaining or partially sustaining force packages that would build operational combat power almost immediately upon arrival. Turkey's denial of access forced Task Force Ironhorse to divert through the Suez Canal and download in Kuwait. The new plan, and the restrictions imposed by canal transit, meant the division had to change the order in which the ships departed the holding area and their arrival in Kuwait.

This complex strategic maneuver for the 4th ID was successful because the division commander was actively involved in the entire process. He brought in key talent and oversaw the development of the team. He planned and executed the deployment through a three-step process: thoughtful preparation and team building toward an expeditionary mindset beginning long before the receipt of a warning order; detailed planning built around an early and shared understanding of the operational effects desired and the obstacles to that end; and finally, flexible execution by teams prepared to make dramatic changes to the plan in response to events. Leaders at all levels from the division commander to the smallest unit enabled these three phases through personal engagement. Each of these phases will be examined in sequence and in some detail using the 2003 deployment of Task Force Ironhorse as a historical case study. Then Major Christopher Croft served as the Chief of Plans and subsequently the 4th Infantry Division Transportation Officer for this operation, and this account will rely on his observations for portions of the study.

Preparation

Preparation for moving a unit begins long before the mission is even conceived. Successful expeditionary maneuver is predicated on building a great team both internally and externally to the organization. A key member of the internal team is the Division Transportation Officer (DTO). An incoming graduate of the Command and General Staff College (CGSC) usually fills this position. Students at CGSC must request an assignment as a DTO in order to be considered. Human Resources Command (HRC) reviews the files on each candidate, rank orders them, and then provides that list to the Chief of Transportation (COT). The COT personally reviews each candidate, interviews them as necessary, and then provides recommendations to division commanders on who should fill the DTO position. There are times that DTOs are selected in-house. Individuals selected to fill DTO slots need specific experiences in preparation for that assignment. The DTO must, at a minimum, be familiar with the other organizations in the transportation world, preferably having worked in a few of them and have connections in all of them. If they've identified themselves for assignment as a DTO, they are expected to take the DTO elective in the Command and General Staff Officers' Course. If they do, the instructors attempt to help future DTOs establish connections to ensure success in the position. Commanders should look for this experience and the endorsement of the Chief of Transportation.

The division's transportation office is a small team with a large mission. The size of the team varies based on the type of division but it typ-

ically has a major as the DTO, a sergeant major, a senior NCO (noncommissioned officer), a mobility warrant officer, and one or two civilians. During deployments, the office is augmented with a movement control team (MCT). The MCT usually consists of an officer, a warrant officer, (during the 4th ID deployment, a senior NCO) and five movement specialists. Even augmented, the division team is barely enough to serve as a core element for the deployment that serves as the nucleus of the deployment team internally and externally.

The DTO also serves to synchronize the external team. Deployments (to combat, to the National Training Center, or to humanitarian relief) all require the commander to rely on a team made up of organizations in the larger transportation world. Each of the organizations below assists in the division's deployment, but they are focused on meeting their mission. It is the DTO's responsibility to ensure the division commander's intent is met. Hence the DTO must have a great working relationship with each of these organizations. Below is brief description of the roles of the six members of the external team.

The Installation Transportation Office (ITO) provides transportation services and related functions for all authorized personnel and activities within the installation's area of responsibility, ensuring that power-projection platform meets force readiness and mobilization requirements. The ITO consists of the Transportation Motor Pool, Inbound/Outbound Personal Property, Passenger Travel, Carlson Wagonlit Travel, Unit Movements, and Inbound/Outbound Freight.[1]

The Movement Control Battalion (MCB)/Movement Control Team (MCT) consisting of 21 personnel, (an HQ element plus four teams) is attached or operational control (OPCON) to a division headquarters and placed under the control of the DTO to augment that staff and assist in providing a range of transportation support planning, programming, and operations required to support the spectrum of military operations. The team operates on a 24-hour basis to assist the DTO in planning, scheduling, controlling, and coordinating mode operations.[2]

US Transportation Command (USTRANSCOM) oversees the overall effectiveness, efficiency, and alignment of Department of Defense (DOD)-wide distribution activities, including force projection, sustainment, and redeployment/retrograde operations. USTRANSCOM supports the strategic flow of deploying forces and sustainment to seaports/aerial ports of debarkation in the joint area of operations. These services are provided

through use of common user airlift, sealift, surface transport, and terminal traffic management activities.[3]

Strategic Distribution and Deployment Command (SDDC) "provides expeditionary and sustained end-to-end deployment and distribution support to meet the Nations' objectives."[4] Military Sealift Command (MSC) "provides ocean transportation of equipment, fuel, supplies, and ammunition to sustain US forces worldwide."[4] Air Mobility Command (AMC) "provides common-user air mobility (airlift and aerial refueling) and aeromedical evacuation services to deploy, employ, sustain, and redeploy US forces on a global basis. Additionally, AMC is the single port manager (SPM) of common-user aerial ports of embarkation (APOEs) and aerial ports of debarkation (APODs)."[5]

Building these relationships takes time so it is important that the DTO have a plan to engage key leaders in the unit, in sister units, in the installation, and outside the installation. Division leadership should stop by their DTO shop well before the warning order is issued and check the status of their internal and external teams. This will help set the conditions for success in the planning and execution of the strategic maneuver.

The single most important element of preparation for any operation is cultivating good habits of thought. In October 2001, then-Major General Raymond "Ray" Odierno, after assuming command of the 4th Infantry Division, walked into the plans vault and asked that the planners identify all the avenues of approach into Iraq. He gave the team three days to think through the question and asked the team to look into all aspects from ports, roads, fuel, population, politics, culture, religion, to anything else that might be important to the division's success. Three days later, the plans team presented the information gathered to the senior leaders of the division. Odierno prompted his team of planners and the senior leaders of the division to think through the problem of deployment to this area of operations and thereby improved their ability to provide solutions to situations and to lead units in those situations.

It is difficult to overstate the importance of this component of preparation, but finding the time to think is difficult. Especially while in command, service members spend most of their time putting out fires and solving immediate problems. The apocryphal quote from Albert Einstein about spending the majority of the time available seeking to understand the problem vice looking at solutions has gained credence because service members intuitively understand its value.[6]

- How many pieces of equipment are in the division?
- How many railcars are available (for planning)?
- What railroads service your area? Who are the leaders/key individuals to know in those organizations? Visit their operations centers to get to know the people so that when you call, they have a relationship with you.
- What are the major line-haul companies that service your area? Again visit their operations centers.
- What are the capabilities of the ports? If you have the time, it is important to know all the ports and their capabilities.
- What are the capabilities of the airfield? How many aircraft can be on the ground at the same time?
- What is the condition and capability of the destination port/ports/airports?
- Is local fuel compatible/contaminated/available?
- What cities will present congestion issues?
- What is the installation's deployment process?

Figure 9.1. List of questions specific to deploying. Graphic created by Army University Press.

This is not thinking designed to come to a particular solution. Dr. Julia Slone describes it as a "divergent process;" thinking over a situation with no endstate in mind and aiming only to improve understanding rather than converging on a solution. It is to "suspend problem-solving and engage in a rigorous process of examination, exploration, and challenge of the underlying premise of the strategy." Just as each of us comes to the table with a set of established biases based on experience, religion, race, etc. we must

understand the background and biases of the people we will encounter. We must "slow down and turn off this instant pattern recognition and deliberately challenge the very process that has served us in the past." This is what Odierno was attempting to do with his planning and command team in 2001; he was asking his team to turn off their preconceived notions and open their eyes to other possibilities. After the briefing, Odierno gave the planners some additional information to seek, more specifically about the religious and political components. Again, he was very particular about having the team open their minds to the other possibilities rather than launch right into planning. He was teaching the team to think critically.[7]

One other habit of thought integrates deployment, traditionally thought of as an administrative movement, with the operational and tactical plan. It should be considered a maneuver and designed with the desired tactical end state in mind. This comes from nesting the DTO with the operations shop and begins early in the process. The division must treat a deployment as a strategic maneuver and focus the entirety of the division's resources to make the maneuver successful. Divisions that treat a deployment as a purely "logistics" operation are able to deploy, with lots of outside help, but they often then struggled to meet the commander's intent in theater.

Planning

The planning phase began the "convergent" thinking process of coming up with an innovative, executable course of action. In this operation, the DTO was a part of the 4th ID planning team helping the senior leadership understand and overcome the physics of the deployment phase while integrating the deployment of the unit into the tactical plan.

It is important to formulate and communicate the commander's intent for the operation before planning begins. In 2001 Odierno was intent on building cumulative combat power with the arrival of each ship. He wanted the capability to employ combat power as soon as possible after disembarking the ship. The commander's desire to deploy combat "sets" rather than focus only on maximizing the capacity of the vessel without regard to combat power on the far shore drove the need to sail each ship with a less-than-optimal load.

The 4th ID was called to a corps planning meeting at Scott Air Force Base to discuss the initial deployment plan. The corps plans team presented their concept of operations and the sequence of the divisions and other major subordinate units—e.g. 3rd Armored Cavalry Regiment (ACR)—into the fight. In that initial plan, the 4th Infantry Division was near the end of the order of battle, meaning their movement would be more administra-

- What is the condition of bridges in Turkey and Iraq: How many? Ratings? Are the rivers fordable? What assists are listed in the task organization? Is this enough?
- Roads: What is the road structure? Capabilities of the roads?
- Fuel: Is there fuel available en route? Is the fuel compatible with our vehicles?
- Rest areas—do they exist? How large?
- What ports are available? What ports allow munitions? What are the restrictions at each port? What are the capabilities for download, staging, preparing, arming, etc.?
- What airfields are in the area? How close are they to the seaport of debarkation? Are there busses available to take from airport of debarkation to the seaport of debarkation?
- What air coverage will we have?
- What help can we expect to receive from the Turks? From US Army Europe (European Command)?
- What additional assets are needed?
- What is the enemy's capability to deny access from Turkey?
- Cultural considerations: What are the different cultures? What must we know?
- What is the political situation in Turkey? Will they let the US use their country? If not, what's the alternate plan?
- How many pieces of equipment are we shipping?
- How many people are in this task force (by location/unit)?
- What ships are available?
- How many ships do we need? How long will it take for the ships to arrive once the order is given? What concerns do you have with these ships?
- How long will it take the ships to transit from the seaport of embarkation (SPOE) to the seaport of debarkation (SPOD)?
- How soon can we get the task force together to work through issues?
- How long will it take the National Guard and Army Reserve units to activate?
- What and how many railcars are available?
- What additional resources are needed to ensure the units are 100 percent ready to deploy?
- How far can tanks travel before needing refueling?
- How will we control the movement of the units?
- How many contractors will we take with us? What do we need to know about their status while transiting through Turkey?

Figure 9.2. List of questions specific to planning. Graphic created by Army University Press.

tive since they would be part of the exploitation and sustainment phases instead of the initial invasion and exploitation force.

When the divisions were asked for their input then Colonel J.B. Burton, 4th Infantry Division G3, articulated the capabilities of the "digital division" and pointed out they were capable of simultaneous but separated operations, e.g. coming into Iraq from the north instead of through the south. Burton had a great understanding of the division and of the enemy's defensive structure, and he pointed out the impact of this capability on the enemy. Having had his say, Burton led the Ironhorse team back to Fort Hood to begin planning. But just as the team arrived home, they were recalled to Scott Air Force Base. At Scott for the second time, the 4th Infantry Division team was informed of a new concept of operations that retained the main effort of attack from Kuwait but added a supporting effort by the 4th Infantry through Turkey into northern Iraq. This supporting attack would fix 25 Iraqi light infantry divisions in the north enhancing the main effort's chances to overwhelm the enemy in the south and take Baghdad. The 4th ID was provided a multi-component task organization that included National Guard, Army Reserve units, and the Airborne Brigade out of Vicenza, Italy. The division was told to plan to conduct the reception, staging, and onward movement independently—meaning no assistance from forces station in Europe. The team returned to Fort Hood, and the initial planning process was now underway. Each plans team member was asked to think through what they needed to know and began to develop a list of questions to answer.

As the team started answering these questions, it started to get a better feel for the organization. The commanding general received an update from his plans team every other week on developments and spoke with his plans chief every week to keep the chief abreast of his evolving concept. The plans team met twice a day, every day to hash out answers to questions and to think of new questions.

Major General Odierno specifically wanted to conduct integration (the 4th component of the reception, staging, onward movement, and integration program) before, during, and after the strategic maneuver. He wanted no delay in the process. He brought the leaders from the entire task force (active, Reserve and National Guard components) into the planning process early to get their input and seek buy-in. He conducted his operations updates with the goal of keeping the entire leadership team integrated into the situation. He maintained these updates throughout the deployment. When he moved overseas, the forward command post took over production of the updates until the Main Command Post arrived.

Entry ports for the division were a big concern in deployment planning. The deepest ports available in Turkey had a cargo pier depth of 35 feet or less. There was some reference to a dredging operation at the Port of Iskenderun but in talking with the local US team, that operation was delayed. The fastest ships in the strategic maneuver fleet are the Fast Sealift Ships (FSS) that can transit from the US to the area of operations in 12 days. The problem was they needed 37 feet when fully loaded. At the time, there were eight FSSs available but with a requirement to move two other divisions, an ACR, and theater opening/sustainment elements. The team felt that USTRANSCOM would not support the use of the FSSs, especially if the 4th ID could only load them at 50 percent of capacity. So the plans team started looking at the RRF (Ready Reserve Force) ships. These ships are somewhat smaller and have a shallower draft making them perfect for any port in Turkey.

Brigadier General Speakes, 4th ID Deputy Commanding General (Support), then requested a meeting with Military Traffic Management Command (MTMC) Director of Operations, Brigadier General Barbara Doornink. Fortunately, the division had made an effort to include MTMC in the deployment team. After being briefed on the situation, the tactical plan, and the limits of the port, she concurred with the analysis. The division requested 32 of the 35 available RRF ships but Doornink provided all 35 (33 were actually used in the deployment). She said MTMC would start the activation process once the order was given but that the division should anticipate the arrival of ships within five days from notification. The RRF has come a long way since Desert Shield/Desert Storm when they could not activate many of the ships. and the 4th ID did not have an issue with any of the ships.[8]

Shortly after returning to Fort Hood from the corps planning meeting, Colonel Burton took the DTO and a logistics planner to Kuwait to get more information from US Central Command (CENTCOM) forward. In the meeting, then Lieutenant General David D. McKiernan described his intent for the 4th ID's strategic maneuver into northern Iraq. It quickly became clear that fuel was going to be an issue. Overnight, the forward plans team looked at two possible solutions: 1) having the tankers travel with the unit and then have follow-on tankers drive forward and transfer the fuel, and 2) using the divisional tankers to make runs between fuel farms established at bases on the road march route based on refuel distances for the M1s. The team compared the alternatives and determined the first method added too much risk to the mission.

Refining the concept of operations, the division plans team cut up sticky notes to represent each tanker in the task force and established lo-

cations to build fuel bag farms. The team determined the number of tankers needed to keep the fuel farms full by making turns between the bag farms. This analysis revealed the logistics assets in the task force could support the movement and employment of Force Package 1 to just north of Mosul, which was the desired limit of advance, as long as the assets were front-loaded. Force Package 1, as described by Burton, consisted of two mechanized infantry battalions and one heavy armored battalion. The next morning, the team briefed the need to push all the division's logistics assets up front with Force Package 1 in order to meet the limit of advance by the prescribed time. McKiernan then asked how many ships this would take and, when told it would take between 8 and 10 ships, he gave the green light to the 4th ID plan.

The next step was to begin to refine the force packages central to Major General Odierno's concept of the operation. The commander's intent to ship combat ready force packages would inevitably lead to sub-optional ship loading. The ships had not yet been identified, and their sequence of arrival at the port for embarkation was unknown. RRF ships do not have a standard configuration so the generic force packages designed would have to be modified after identification until actual loading of the ships, but this was an essential first step. Division leaders, particularly the brigade executive officers and S3s, together with the direct reporting units came together to identify the necessary capabilities for each force package. As a defensive measure, the division avoided loading all tanks or HMMWVs on any one ship. The 4th ID wanted each package to have an ability to move together and build immediate combat power. The analysis brief to McKiernan also meant the division had to front-load the logistics to conduct and support the reception, staging, and onward movement at the destination.

These types of force packages are discussed in general during classes at CGSC and the School of Advanced Military Studies (SAMS) and in more detail in the division transportation officer elective. However, when it came time to actually design the division force packages, it was much more difficult than the classroom assignments. Some commanders had specific desires to maintain absolute unit integrity down to the platoon level. This would make it easier for the brigades to track equipment and require less manpower to execute. Additionally, the division had port restrictions, weather concerns, and had units arriving from 18 installations to three different loading ports via rail, line-haul, and convoy. The sequencing of equipment arrival at port was critical. The port areas were limited. so the division could not just send large amounts of equipment to the port, store it until it was needed, and then load as the space became available.

The division did have a reserve location at Fort Hood and a small one at each port. If something did not fit on the ship at pier, the division would bump to the next ship. If space was available, the division could send something from the small port lot or line-haul something from Fort Hood. The 4th ID had line-haul trucks standing by, ready to load within an hour of the request. This is another reason why eventually placing the brigade executive officer at the port was essential; he knew the unit's equipment and knew what specific pieces to call forward to meet the commander's intent, nested within the division concept.

Odierno had the plans team conduct several rehearsals of the strategic maneuver and initial operations. With the assistance of the Battle Command Training Program (BCTP) team (today's Mission Command Training Program or MCTP), the division conducted a senior leader rehearsal to ensure all key leaders had completely absorbed the commander's intent and concept of operation. The Fort Leavenworth group brought up key points of concern, which were incorporated into the plan. Key to the success of the rehearsals was the presence of the supporting organizations and their leadership, e.g. the seaport commander, the airfield commander, Military Traffic Management Command (MTMC—now Surface Deployment and Distribution Command), and Air Mobility Command. They were able to clearly articulate their processes and limitations so all the subordinate leaders could have a clear understanding of the situation. After this last rehearsal, the operations team took over the operation. The plans team then started working branches and sequels.

The division commander's link into the transportation structure is the DTO. Of course, the division commander can engage personally, but if the division has a quality DTO, it will allow others to focus on their attention on leading Soldiers. In conducting a strategic maneuver, the DTO and associated MCT will need to phase their deployment and array across the spectrum of the deployment with the division transportation officer positioned where the most impact is needed.

It is appropriate to briefly describe the DTO's plan for internal operations within the overall strategic maneuver. At Fort Hood, the DTO first requested their designated Movement Control Team (MCT) be assigned immediately. The team came with six personnel, a first lieutenant, sergeant first class, and three specialists. These were integrated with the DTO staff consisting of a major, first lieutenant, chief warrant officer 2, sergeant major, sergeant first class, and a specialist who were organized into two teams working 12-hour shifts. A team (one first lieutenant and one specialist per 12-hour shift) was integrated into the G-3 operations center 24

hours a day. The DTO sergeant major and sergeant first class maintained contact with the plans team. The mobility warrant officer was responsible to ensure the Joint Operations, Planning, and Execution System (JOPES) data was correct and to serve as the subject matter expert for the various meetings, if the division transportation officer was needed elsewhere. At 0900 daily, the DTO would host a conference call with MTMC, USTRANSCOM, MSC, AMC, BNSF Railroad, CSX Railroad, KC Southern railroad, ITO, CTO, and brigade combat team unit movement officers (UMO) to synchronize all elements for the next 24, 48, and 72 hours. To maintain control throughout the strategic maneuver, it was necessary to establish a DTO forward, DTO main, and DTO rear. The plan was for the first lieutenant, sergeant major, and specialist to serve as the DTO forward and deploy on the first aircraft. Their vehicle was on the first ship and loaded with the radios and key material needed to control the movement. DTO main would jump forward at the tail end of Force Package 1. The intent was to replace DTO forward at the SPOD, allowing them to move forward and prepare to assist the movement of the remaining force packages. DTO rear would stay in place until the last aircraft. Major General Odierno was very specific about maximum utilization of assets provided. The DTO stayed at home station to control the synchronization with his movement tied to the chief of staff's movement.

Execution

To improve is to change; so to be perfect is to have changed often.[9]
—Winston Churchill

On 4 January 2003, the deployment order was issued. Assistant Division Commander (Support), Brigadier General Stephen M. Speakes called a meeting and reviewed the order. The order was actually anti-climactic because so much work had been done in preparation that the division knew exactly what to do. The division operations order was issued and things long planned and rehearsed started happening. Synchronizing the movement to port and loading the ships and aircraft were significant undertakings requiring direct leadership involvement from all elements. But in the midst of this well planned operation, a change in the political situation necessitated a radical shift in the plan, highlighting the need for continual situational awareness and improvisation.

The 4th ID had long had its operations center open, but once the order was issued, the installation established their operations center and opened the railhead, the line-haul upload site, and container staging location, all by 14 January 2003. III Corps established their operations center. The divi-

Figure 9.3. Ready Reserve Force ship MV Cape Texas rides out a storm in the Mediterranean Sea in early March 2003. Cape Texas and 30 other Ready Reserve Force (RRF) ships transported cargo for the US Army's 4th Infantry Division during Operation Iraqi Freedom. Photo courtesy of Military Sealift Command.

sion held a daily unit movement officer meeting to gather key information to maintain situational awareness and to set the conditions for the next 48 hours. The task force would discuss what specific equipment was ready to move to the rail, line-haul or convoy staging areas, and as the deployment progressed, the task force added in personnel movement. While the division commander's intent is provided by the DTO, the actual movements are the responsibility of the local installation transportation offices. These daily meetings with the deployment supporters were instrumental in the task force's success. Having a positive working relationship with all the key supporting and enabling organizations is absolutely essential.

As an example, prior to the start of the operation, the division had developed mutual trust that helped work through some very specific requirements. The task force did not want any vehicles loaded on the trains to stop once they left the installation in order to prevent theft and vandalism. The railroads understood the requirement and agreed to this request without hesitation. The task force also requested that they would not move trains unless the task force called them forward in the morning synchronization meeting in order to avoid overloading the small holding areas in the port. This worked well except for one case, which illustrates the need for detailed synchronization.

Concerned that an impending snowstorm would delay a key movement, the division launched a train from Fort Carson to the port of Corpus Christi ahead of the agreed-upon schedule. Despite the efforts to delay the arrival (without stopping along the route), the train ended up arriving out of sequence. As a result, the train was sent to the Northside General Cargo Terminal at the port. Unfortunately, the ship capable of loading that unit's equipment was unable to dock on the Northside due to size of the pier and depth of the north port. As a further complication, the bridges between the north and south terminals were not rated for tanks and other heavy equipment to transit, so the unit had to download the equipment to clear the track space for inbound equipment, and then upload to other railcars to move the heavy vehicles to the Southside General Cargo Terminal. Well-meaning actions can place the entire timeline in jeopardy and may require extensive manpower to rectify the situation. As it turned out, this early movement only slightly delayed the loading, but it created additional work and frustration for the troops. It is important to understand that when someone in the division has a good idea for adjusting while the maneuver is underway, everyone must understand the real impact of the thought. It is easy to brush over the impact and then get upset when things get muddled.

Another key to a successful strategic maneuver is the importance of involving all of the division's field grade leadership at the key nodes, e.g. rail upload, ship upload, airfield, and processing center. It was impossible for the DTO to go to each location to resolve conflicts. The task force specifically placed the brigade and battalion executive officers at the port since it was such a complex aspect of the movement. They would call the DTO directly and provide eyes on information. They all knew each other from attending CGSC together, so there was a level of trust already formed. By doing this, the commanders at all levels could stay focused on the upcoming fight and maintain their level of integration.

In the daily updates, the division commander was concerned about his combat power. The fact that Task Force Ironhorse was deploying as force packages lent itself to articulating this capability to the commanding general. Interpreting combat potential was built from the key details provided by the unit movement officers that was captured by the DTO on a massive excel spreadsheet. Using that information, the plans and operations teams could build "what-if" scenarios if ships were reordered, delayed, or lost. Then as ships were offloading, the operations team could articulate actual available combat potential to the commander who would know immediately what he had available on the ground as well as what remained afloat so he could change his plans.

Personnel movement was keyed to equipment movement. The commander's intent was that all Soldiers would get two weeks off just prior to deploying. Thus commanders had to build a plan where they continued to train and then sequence leaves appropriately; early deployers went on leave while the later deployers worked. In the original division plan, the personnel for a particular force package would start their 10 days of leave as soon as their force package was loaded. Personnel movement would start at the end of the leave period. The division knew it would take more than 10 days to load out the division so there was a need for the executive officer's and S3's involvement, along with the UMOs, to control transport and loading without wasting any available space on the ships or the aircraft. As the early deployers came back from leave, they prepared themselves for aerial deployment. While this might seem easy, it was not. Since Turkey had not approved the landing yet, there was no arrival date. The plans team provided planning considerations for Soldiers to download equipment and provided a coordinated plan to the commanding general, which he approved. The plan was adjusted as the dates started slipping. The status of the task force personnel was tracked at the daily operations update. This enabled the commanding general to maintain situational awareness of his combat potential.

The major change to the plan was the refusal of Turkey to allow the United States to transit their country to attack Iraq. This development seemed to happen in slow motion, and in hindsight, it was revealed that General Franks kept up the hopeless effort to change their minds as a way to maintain the threat of a northern attack and force the Iraqi high command to maintain their forces in the north. At the division level, this had several effects.[10]

One effect was the delay allowed the division to complete shipborne equipment load out prior to the start of the passenger movement, but that did not seem to slow down the operations tempo. As ships were en route to Turkey and the division started to get word that Turkey might not allow the division to come through their country, the commander needed information at hand should he have to make a decision on another course of action. To provide this, the status of the movement was updated and briefed twice each day. The ships loitered in the Mediterranean Sea so long many had to dock in Cyprus to refuel and refit. This of course changed the sequencing so maintaining an understanding of the status of each ship, and hence the force packages, was critical. USTRANSCOM was great at providing the information needed to keep the division commander and subordinate commanders aware of the situation.

Long before the final determination was made, the division operations staff and logisticians began to plan for the contingency of landing at another, as yet undetermined, port. Odierno's thought experiment for his staff back at the beginning of his time in command paid dividends here. The plans team had worked through a scenario using Kuwait as an entrance to the theater; now it was time to dust off that plan and make adjustments based on the actual loading of the equipment and the situation of the fleet. The capability of each force package was reviewed and considered in terms of a potential new mission to enter theater from the south.

When the order was given to move the destination to Kuwait, the main considerations for revising the draft plan are listed in the call out box. The division needed to sequence the fleet through the Suez Canal. Based on USTRANSCOM data on the locations and speeds of the ships and the data collected during load out on the force package contents of each ship, the division staff needed to launch the ships to sequence a continuous flow through the Suez Canal that would provide the forces and equipment necessary to give the commander options. The task force did not just launch the #1 ship first. As an example, ship #8 was slower and closer to the canal. So, the task force launched ship #8 to get it through the canal without slowing the movement of the rest of the ships. Right behind #8 was #4 then #1 and #2, followed by #7, #5, #6, and then #3. In hindsight, because of the administrative nature of the landings, it would not have mattered, but the task force did this so the division commander could launch combat power if the ground component commander needed something fast. The task force's job was to give our division commander options, and the plans and operations teams worked together to do that.

Now that the division had the ships beginning their final movement to Kuwait, it was time to focus on the air movement and getting a leadership presence in theater to gain a greater understanding and to oversee the building of combat power. The division commander's intent for the air movement was to leave no less than one percent of the seats empty on each aircraft. Filling every seat would have required having people on standby to deploy, many of whom would have had to say goodbye to their family multiple times, which was unacceptable.

The division commander left the DTO back to ensure his intent was met on each aircraft. In fact, that was part of the briefing during the updates. The DTO managed the movement using a similar process as the equipment movement. Every night, there was a movements meeting where unit movement officers, executive officer, and first sergeants would attend to update the personnel they planned to deploy over the next 72 hours

- Revised mission and concept of the operation?
- Force package composition?
- Which ships combined brought the tactical capabilities needed?
- Order in which capabilities were needed?
- Speed of the ships (capable of making a different speed)?
- Detailed location of the ships?
- Status of fuel onboard?
- Weather?

NOTE: Ports were not really an issue since they could easily handle the relatively shallow draft Ready Reserve Force ships.

Figure 9.4. Considerations for shifting port of debarkation. Graphic created by Army University Press.

based on the airflow schedule provided by USTRANSCOM. It was a difficult balance and the UMOs, executive officers, and S3s were instrumental in making this happen again. It cannot overemphasized how important it was for all of the team taking an active role in this maneuver. The typical movement process had the UMOs loading unit line numbers (ULNs) for each unit but the task force found that was too cumbersome. So the task force used one ULN for the entire division and then used an internal tracking mechanism to ensure everyone and every ULN was accounted for. This was a time consuming but necessary step. In the end, the division met the commanding general's intent.

One of Odierno's key concepts in the operation was early and continuous integration of all elements of the task force, and this concept helped overcome confusion as the situation evolved. Each subordinate leader and his staff were aware of the changes to the mission, administration, and concept. So when the ships full of equipment arrived in theater to a different port and in a different order, the download teams were already on

hand to receive the equipment. Each unit's advanced parties moved the equipment from the ports of debarkation to their staging bases and, as the unit personnel arrived by air, they married up with their equipment at those staging bases. Because they were already familiar with the situation, all they need was a quick update and they were ready to move forward. However, that simple sounding "move forward" contained yet another significant element to the strategic maneuver—transporting the division 684 kilometers from Kuwait to Baghdad.

Unlike so many other aspects of the deployment, this was a new aspect to the plan. The commander decided that the division would use heavy equipment transporters (HETs) to move the tanks and other heavy vehicles to Baghdad to reduce the stress on the equipment and ensure greater effectiveness for the tactical operations. After his staff calculated that the division needed more than 1,200 HETs movements to accomplish this—far beyond the division's capacity—Odierno acquired five HET companies to accomplish the mission. He assigned the command and control of the five companies to the 180th Transportation Headquarters element from Fort Hood, Texas, under the command of Lieutenant Colonel David Cotter. At Fort Hood, the 180th Headquarters commanded the HETs companies, so it made sense to use them. Responsibility for uploading the heavy equipment on the HETS in Kuwait, and their download just south of Baghdad, was given to the Division's Chemical Company under the command of Lieutenant Colonel Vance Vasser. The DTO sent one of his MCTs forward to the download site to provide incoming and return vehicle information. It was critical to get each HET downloaded and back to Kuwait as fast as possible to ensure the most efficient movement of the division north. In the middle of the movement, the Army Central (ARCENT) commander directed a halt to the Task Force Ironhorse movement to allow 3rd ACR to utilize the HETs and move into position to protect the flank of the operation west of Baghdad. Task Force Ironhorse provided the support to the movement of 3ACR as if it was a Task Force Ironhorse element. Realizing the right flank was unsecured, two elements, an infantry battalion and a field artillery battalion (multiple launch rocket system), were ordered to conduct a tactical road march to cover this flank. Both commanders provided a detailed movement plan, which was approved by the ARCENT commander, and conducted the movement flawlessly, providing information at all checkpoints. The information helped the division conduct the remaining movement forward. As the heavy equipment moved forward Class IV re-supply was placed in the available spaces on the HETs, thus reducing total transportation requirements. In this efficient and effective use of space the MCT was essential.

Finally, this deployment was similar to an operation the division had begun to plan earlier, which illustrates the use of non-combat deployments for training in complex strategic movements. The 1st Brigade Combat Team, then commanded by Colonel Donald Campbell, was headed out to the National Training Center for a training rotation. One force package for the brigade combat team would move to NTC via rail as usual. Another would go to Seattle by rail, then upload on an Army LMSR (Large, Medium speed, Roll-on/Roll-off ship). It would then download the equipment at Port Hueneme, California, and complete the move to the National Training Center by line-haul and convoy. The division was working some additional options for the brigade to sail out of Corpus Christi but didn't get to execute either plan because the combat deployment began to become a reality. But the planning effort to make deployment training more realistic can be seen reflected in the actual movement of the division.

Conclusion

The strategic maneuver of Task Force Ironhorse in 2003 provides a good case study to begin to prepare for the contested deployment of a heavy division in the future. Given the current stationing posture of US forces, projecting land combat power globally will be an ongoing requirement. It can be practiced and prepared for in deployment to the National Training Center or humanitarian relief. Rather than approach the deployment of the division as an administrative movement, commanders are well advised to begin selecting, training, and building their teams with an expeditionary mindset well before the mission appears. This expeditionary mindset sees the movement to theater as a part of the strategic maneuver. They approach the deployment as a part of the tactical concept, making sure their staff understands how the deployment itself fits into the next phase of the operation and that they incorporate this into their planning. Relationships and coordination with external team members are critical for success, and periodic updates for all team members is a time-tested and approved way to synchronize internal and external members of the division team. In the 2003 deployment of the 4th ID force, packaging proved itself as a planning concept that gives the commander combat relevant options in the face of a changing situation. Detailed plans will not survive contact with reality, much less the enemy, but they form the basis for rapid adjustments as circumstances evolve. A vigorous and imaginative execution of the plan helps achieve the desired end state. Finally, the commanders at all levels must actively participate in the entire process. While the 4th ID's experience is 2003 is not a blueprint for every situation, it does provide a historical example that will reward thoughtful consideration.

Notes

1. Logistics Readiness Center "Transportation Division," accessed 14 May 2018, http://gordon.army.mil/garrison_old/dol/Transportation/Transportation.htm.

2. Department of the Army, Army Training Publication (ATP) 4-16, *Movement Control* (Washington, DC: April 2013), Chapter 4.

3. ATP 4-16, 2-1.

4. ATP 4-16, 2-3.

5. ATP 4-16, 2-2.

6. The quote is sometimes given, "If I had one hour to save the world, I would spend 55 minutes defining the problem and only five minutes finding the solution." According to Quote Investigator (accessed 2 May 2018, https://quoteinvestigator.com/2014/05/22/solve/), it is not found in Einstein's collected papers and was first attributed to him in 1973. It has, nevertheless, since gained wide acceptance.

7. Julia Sloan, *Learning to Think Strategically* (New York: Routledge, 2014), 157.

8. Military Sealift Command "*MSC 2003 in Review*" (accessed 11 May 2018, http://www.msc.navy.mil/annualreport/2003/pm5.htm) states the problem and solution as follows, "Since Operation Desert Storm in the early 1990s, older RRF break-bulk ships have been replaced with newer and more efficient roll-on/roll-off ships. Significant improvements were made in RRF ship readiness, training, and management oversight as well. Where only 20 of 72 RRF ships were activated on time in Desert Storm, all but two were on time for Operation Iraqi Freedom. The RRF delivered 3.4 million square feet of cargo for Operation Iraqi Freedom."

9. Robert James, *Winston Churchill: His Complete Speeches, 1897–1963* 4 (New York: Chelsea House, 1974), 3706.

10. Anthony H. Cordesman, *The Iraq War: Strategy, Tactics, and Military Lessons* (Westport, CT: Prager Publishers Inc., 2003), 58; Williamson Murray and Major General Robert H. Scales Jr., *The Iraq War* (Cambridge, MA: Belknap Press, 2005) 62. Additional difference and detail was provided in Leopold Scholtz, "Iraq 2003 (Part 2): The Road to Baghdad," *Scientia Militaria, South African Journal of Military Studies* 32, No. 1, 2004, 6: "Donald Rumsfeld told Central Command military personnel at the coalition HQ in Qatar that General Franks deliberately waited before diverting the division's equipment from the sea off Turkey to the Gulf, to fool the Iraqis into believing that the offensive was not imminent. It also transpired that Saddam was being fed deliberate disinformation, that the Turkish hard-headedness was only a sham and that the main offensive would come from the north after all."

Chapter 10
For the Want of a Bottle of Water

Richard E. Killblane

General Tommy Franks, Commander of US Central Command, knew that Saddam Hussein would not underestimate the American resolve and consequently not allow the Third Army to build up sufficient combat power to go on the offensive. Therefore, Franks did not intend to wait until he had built up the appropriate three-to-one advantage to attack, but instead would attack significantly outnumbered. The coalition force would attack with one corps, and not even wait until all the divisions were on the ground in Kuwait. After a very short bombing campaign, the coalition would launch the attack with the 3rd Infantry Division (Mechanized), I Marine Expeditionary Force, and British 1st Armoured Division. He expected the 4th Infantry Division (Mechanized) to attack out of Turkey while the 101st Airborne Division (Air Assault) and 1st Armoured Division would catch up later. The US Army units would fall under V Corps supported by the 3rd Corps Support Command (COSCOM). The key to this success depended upon speed of maneuver.

As the ground offensive would prove, the coalition forces had all the skill and audacity to overwhelm the Iraqi Army and drive deep into Iraq before the latter could appropriately react. There was only one flaw to the plan—logistics. V Corps would run out of bottled water and fuel before it reached Baghdad, but not for the lack of bottled water or fuel in theater. Armies historically have run out of supplies not because there was a shortage of supplies but due to a shortage of transportation. The advance of V Corps to Baghdad would grind to a halt due to a shortage of trucks to deliver the bottled water and fuel.

Operation Iraqi Freedom would be the first large-scale combat operation that would test the revolutionary new logistics concept of on-time delivery. During Operation Desert Shield/Desert Storm in 1990–1991, the Army had built mountains of containers at the seaport and airport of debarkation in Saudi Arabia. Many of the containers remained unopened in the container yards throughout the duration of the war.

After Desert Shield/Storm, logistics planners wanted to reduce the logistical footprint. This coincided with the downsizing in the commercial world that led to the idea of doing more with less. Efficiency was the bottom line. On-time delivery eliminated warehousing. In military terms, this translated to a reduction in days of supply stockpiled at logistical bases

on the ground. The Army also planned to augment military transportation with contract companies, specifically Kellogg, Brown and Root (KBR) who held the Logistics Civil Augmentation Program (LOGCAP) contract for large scale operations. This would allow the Army to focus more on combat operations and turn Phase IV nation building over to contractors. The key to on-time delivery, however, required automation.

Automation was designed to resolve the problems of tracking cargo that occurred during Operation Desert Storm. The bar-code system and radio frequency identification (RFID) tags, borrowed from commercial industry, attached to the containers tracked the cargo by computer from the port to the customer by eliminating the confusion that occurred where the logistics officers had to open each container to learn what was in it. In concept, a unit supply officer could order supplies on a laptop computer and have them delivered within 18 to 24 hours. With scanners strategically placed along the line of communication, a movement control specialist could track cargo from its point of origin to its destination, providing almost instant in-transit visibility making the US Army like Federal Express. Since the deployment of the 1st Armored Division to Bosnia during Operation Joint Endeavor in 1995, movement control specialists in Europe had been using this system. The US Army had the tools necessary to conduct on-time delivery for the next large-scale combat operation.

For Operation Iraqi Freedom, General Franks wanted to attack from multiple directions. The 3rd Infantry Division, I Marine Expeditionary Force and British Army would attack from Kuwait in the south. When it arrived, the 101st Airborne Division would leapfrog up from the west in a series of air assaults. The 173rd Airborne Brigade would parachute into the northern provinces while the 4th Infantry Division (Mechanized) would invade from Turkey to link up with Special Operations Forces inserted ahead of them. Franks wanted to start the ground campaign as soon as he had sufficient forces on the ground. The offensive campaign would begin with a very short bombing campaign as opposed to the 21-day bombing campaign during Operation Desert Storm.[1]

The Secretary of Defense, Donald Rumsfeld, warned Franks to be prepared to attack on 1 January 2003. Weather was also a key planning factor. Franks warned they could not attack any later than the 15 March, since the weather rose above 90 degrees. If hit with chemicals, the Soldiers would have difficulty functioning fully dressed in their gas masks and chemical suits in the oppressive heat. This required the coalition forces to attack before the end of winter. All these factors contributed to Frank's "Rolling Start."[2]

The first part of the buildup of forces was accomplished very slowly and deliberately. As part of Exercise Intrinsic Action, Central Command (CENTCOM) had been rotating a brigade into Kuwait every six months for training while also serving as a deterrent to an Iraqi invasion. The 3rd Infantry Division had just replaced a brigade of the 1st Cavalry Division in April 2002 and was scheduled to swap out brigades in October. Instead of replacing one brigade with another, Franks secretly wanted to leave both on the ground, but would announce this was an exercise to swap out equipment from the Army Preposition Stocks at Diego Garcia under the pretense that the equipment on the ground was worn out. This deployment also put the Iraqi Army on alert in the desert, which would hopefully tire out the Iraqi soldiers.[3]

Meanwhile, Third Army headquarters formed the Combined Forces Land Component Command (CFLCC). The 377th Theater Support Command (US Army Reserve-Louisiana) had responsibility for theater logistics in the CENTCOM Area of Operations. It deployed its planners forward to Kuwait in October along with planners from the subordinate headquarters, 143rd Transportation Command and 3rd Theater Army Movement Center (TAMC), both in the Army Reserves. The Distribution Management Center (DMC) of the 377th Theater Support Command (TSC) developed the theater distribution plan based upon the concept of on-time delivery. The concept made maximum use of limited resources to achieve greater efficiency. Supplies would arrive on the ships and not sit on the ground as echelon above corps trucks would then deliver them straight to the corps rear. After Lieutenant Colonel Sam Pearson, Deputy DMC Chief, briefed the distribution plan to Major General Claude Christianson, Combined Forces Land Component Command (CFLCC) C-4, the general told him to pad the plan with more trucks.[4]

Brigadier General Charles Fletcher Jr., Commander of 3rd Corps Support Command (COSCOM), correctly considered logistics the center of gravity during V Corps's drive to Baghdad. The concept of on-time delivery spread logistics too thin. The war would begin without an adequate stockpiling of days of supply. Since he did not know when the war would start, Fletcher expected the war to start without the mountain of supplies on the ground as they had during Operation Desert Storm. He anticipated that V Corps would launch with only five days' supply. Fletcher knew that additional supplies awaited off shore, and they would go straight from the ships to trucks to the front line units without spending any time on the ground. In the commercial world, UPS and FEDEX delivered to fixed installations. V Corps would be on the move. If there was any disruption

in the line of communication or distribution plan, the offensive could grind to a halt. Army transportation had an extremely critical role to play in the success of this logistic operation.[5]

While CENTCOM finished Operations Plan (OPLAN) 1003V, it also refined the Time Phased Force Deployment Data (TPFDD) in a series of conferences from March through November 2002. The planners had wargamed the list of units to where they had the right balance of support-to-supported. In November, however, Franks decided to scrap the TPFDD in lieu of Request for Forces (RFF). He did not need entire units, but preferred to build eight force packages. He felt the RFF process was more flexible since he did not need entire units. RFF allowed him to deploy parts of them. Scrapping the TPFDD for an RFF required the planners to rebuild the force packages in haste, though. Coupled with the idea of reducing the logistical footprint, critical logistics units fell out. Some merely because no one in the room knew what the unit abbreviation stood for. Selecting what units stayed on the RFF and what fell out resulted in a dog fight.[6]

A significant consequence of going to the RFF was the reduction of transportation assets. The original plan called for five movement control battalions, but the RFF only allocated for three: the 27th, 53rd and 450th Movement Control Battalions (MCBs). Fewer battalion headquarters might have simplified mission command but the reduction also meant a decrease in movement control detachments which would provide in-transit visibility. Fletcher also considered in-transit visibility the Achilles' heel of the logistics operation. More being asked of less would not always lead to efficiency but to the lesson of every war, "movement control is broken." Theater logistics would initially have only two truck battalions—the 6th and 106th—to conduct the Reception, Staging, and Onward Movement (RSO) and then support the drive to Baghdad. The distribution plan suddenly came up short trucks.[7]

The 7th Transportation Group arrived in Kuwait with four battalions to conduct reception, staging and onward movement (RSO) while the 141st Area Support Group built and managed the state camps for the integration piece. These camps were named after the states attacked by the terrorist on 911: New York, Pennsylvania, and Virginia. The 7th Transportation Group brought two terminal service battalions. The 11th Transportation Battalion joined the 831st Transportation Battalion to offload ships at the port of Ash Shuaybah. The 831st belonged to the Military Traffic Management Command (MTMC) (later designated Surface Deployment and Dis-

tribution Command) and had responsibility for discharging ships with host nation contract stevedores. The 11th Battalion brought military stevedores to receive and stage equipment at the seaport. The 24th Transportation Battalion conducted Joint Logistics Over the Shore (JLOTS) at the beach ramp at the Kuwaiti Naval Base, which took pressure off of depending on a single seaport of debarkation. The 6th and 106th Transportation Battalions (Motor) would move the equipment from the staging yards at the ports and deliver them to the state camps.

The remainder of the 3rd Infantry Division arrived in January 2003. When Lieutenant Colonel Pearson watched the stevedores unload the equipment at the seaport, he noticed that the 3rd Infantry Division had left all its water buffalos behind. The "Marne Men" expected to drink bottled water. When he informed Major General Christianson of this, the general told him if they wanted to drink bottled water, then he had to deliver bottled water. When other units learned the 3rd Infantry Division did not bring its water buffalos, they left theirs in the staging yard at the port. Pearson's plan did not account for this, and his recalculations revealed the 7th Group did not have enough trucks to haul the water.[8]

Another planning figure was an operational readiness rate of 75 percent in truck fleet. Lieutenant Colonel Pearson noticed that the two truck battalions were not putting as many trucks on the road as he had planned. The operational readiness rate of the trucks was less than anticipated, and he ended up with a 20-percent shortfall in truck availability. The active duty truck units also deployed with 80 percent of their authorized strength. This threw off the distribution plan even further. So he needed more trucks.[9]

The CFLCC plan called for commercial trucks to assume a greater burden. Kellogg, Brown and Root (KBR) and host nation trucking companies were awarded contracts for picking up a significant portion of the line haul mission. KBR management personnel had arrived in Kuwait in January 2003, so Pearson checked to see if they could have their contract trucks available earlier. The plan called for contract trucks to be available by 1 May, but Pearson initially needed them by 15 April. After further calculations, he realized he needed the 1,500 contract trucks ready to go north by 1 April, only a week after V Corps would breach the berm. KBR could not meet the new requirements. Pearson realized that the 3rd Infantry Division was going to run out of water. The worst-case scenario was that just two truck battalions would have to simultaneously conduct RSO and sustain V Corps on the move. This created a great demand for the limited number of truck assets.[10]

With trucks in short supply, the 377th Theater Support Command DMC began hosting a meeting of representatives from the 7th Transportation Group and 53rd Movement Control Battalion to allocate resources to requirements. During the first two weeks, Major General Christianson personally chaired the daily meetings to plan each truck load based upon the predicted availability of trucks the next day. The 7th Group representative estimated how many trucks it expected to have available based upon categories of definite, probably and not likely available; and at the end of the day when convoys returned, it refined the numbers. Christianson's participation established the ground rules for the meeting and prevented any conflict over priorities since every unit wanted its containers and equipment moved first. Food and water had become the top priorities. Because of the increasing water requirements, there would not be enough echelon above corps trucks to move the containers forward. After a week, Christianson turned the daily meetings over to the DMC. A couple weeks later, they crossed the berm, but the shortage of cargo trucks was not the only problem.

Colonel Mark Scheid, CENTCOM Chief of Mobility and logistics planner, knew they could keep the ground forces supplied with food, however, the entire theater only had seven petroleum, oils, and lubricants

Figure 10.1. Command Sergeant Major Paul Nelson leads the 7th Transportation Group ADDER convoy crossing of the berm enroute to Tallil. Photo courtesy of Command Sergeant Major Paul Nelson.

(POL) medium truck companies. For that reason, he anticipated the ground assault would come to a halt for want of fuel. Prior to the start of the war, the engineers had laid the inland petroleum distribution system (IPDS), a system of rigid aluminum pipe, all the way to the state camps and the Iraqi border. (See Chapter 11, "The Lifeblood of War.") Once the ground forces crossed the berm, the fuel trucks would drive back to Breach Point West and refuel from the bladders. Meanwhile, the engineers expected to lay two to three miles per day.[11]

The CENTCOM and Third Army logistics planners informed General Franks that if he attacked without a sufficient logistical tail, V Corps could only penetrate a short distance into Iraq. Franks directed that V Corps would drive as far as it could and then wait for logistics to catch up. During this operational pause, CENTCOM would start bombing again. When V Corps had enough days of supply on hand, it would renew the advance.[12]

Because of the success of the "shock and awe" bombing campaign, General Franks recommended that they start the ground offensive 24 hours earlier. On 20 March, combat units rolled through the breaches cut in the berm. The ground assault of V Corps, under Lieutenant General William S. Wallace, began with the I Marine Expeditionary Force (MEF) and the British 7th Armoured Brigade on the right, the 3rd Infantry Division (Mechanized) on the left, and the 3rd Squadron, 7th Cavalry screening out

Figure 10.2. 7th Transportation Group ADDER convoy halt. Photo courtesy of Command Sergeant Major Paul Nelson.

front. The 101st Airborne Division would conduct air assaults along the 3rd Infantry Division's left flank. Franks realized that Turkey would not allow the 4th Infantry Division (Mechanized) to attack through its country, so he ordered its equipment sitting in the Mediterranean to steam through the Suez Canal for Kuwait. It and the 1st Armored Division were scheduled to arrive along with a myriad of support units after the ground war started.

As feared, neither the Kuwaiti contractors nor KBR were ready at the start of the war. The US Army Reserve transportation group with its three additional truck battalions was still en route. The two truck battalions of the 7th Transportation Group would have to carry the burden of conducting both sustainment operations during an offensive and reception, staging and onward movement (RSO) of arriving units.

The critical supplies during the drive to Baghdad were Class I food and water, Class III fuel, and Class V ammunition. Even a change of one day would upset the distribution plan. The upload plan was based upon the original G-Day (the ordered day to begin an action) of 21 March. When G-Day was bumped up a day, the units lost one day of uploading and consumed one day of supply while waiting in their tactical assembly areas. Brigadier General Fletcher believed that V Corps only had five days of supply on hand when the ground war started. The 7th Group, who delivered the supplies, believed that the 3rd Infantry Division had an estimated seven days' of supply when it left Camp Virginia. The rest had piled up at the Public Warehouse Center (PWC) and Theater Distribution Center (TDC). The entire distribution plan depended upon the limited transportation assets delivering the supplies to the customer on time.[13]

Based upon the plan of carrying five days of supply, the 7th Group was not scheduled to have its Convoy Support Center (CSC) Cedar and the line haul operation up and running until G+5 (G-Day plus five days). Even though the 6th and 106th Battalions had a couple convoys chase after the 3rd Infantry Division with an extra issue of food and water, Fletcher stumbled across 13 empty trucks in the 6th Transportation Battalion's convoy. He asked why they were running forward with empty trucks when the 3rd Infantry Division was short of food and water. He did not want any empty truck to cross the border. The trucks hauled so many pallets of water that they were falling off of the trailers.[14]

By 23 March, V Corps was four days into the ground war when some trucks of the 3rd Infantry Division returned to Cedar looking for the pallets of food and water that the 6th Battalion had fortunately policed up before

they left. No trucks with supplies from either the PWC or Theater Distribution Center had started forward to open up the supply line from Kuwait. The 3rd Infantry Division still had plenty of ammunition and fuel. The growing shortage of food and water was not the only problem.

On 23 March, the 507th Maintenance Company missed its turn and drove into An Nasariyah, where it was attacked by Fedayeen paramilitary resulting in the capture of eight Soldiers. The original plan was to bypass enemy resistance on the way to Baghdad. It soon became evident that the enemy lay astride a very thin and vulnerable line of communication. The US Marines and British had to turn around and clear out the resistance. This forced the 3rd Infantry Division to halt until the units on their right flank caught up all the while consuming food and water. Fortunately, the halt conserved fuel.

By G+4 (G-Day plus four days), the 3rd Infantry Division was running short on bottled water. There was plenty of food and water available but it was in Kuwait. Division's Reverse Osmosis Water Production Units

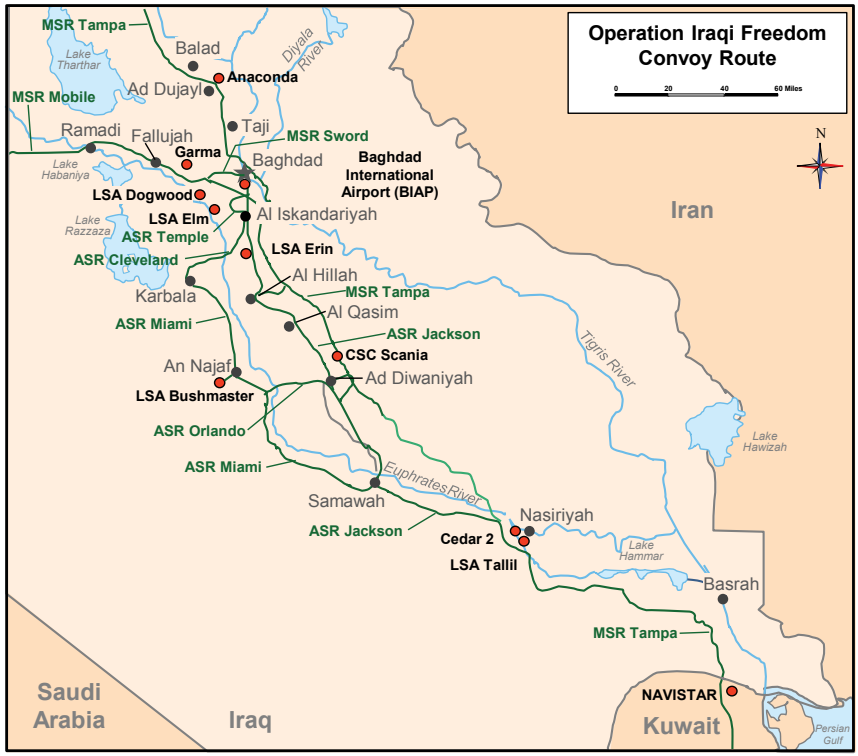

Figure 10.3. Operation Iraqi Freedom Convoy Route. Map created by Army University Press.

(ROWPU) were operational but they did not have the water buffalos to distribute the ROWPU water. The situation was becoming critical with little room for error. Murphy's Law stated that "anything that can go wrong, will—and at the worst possible time." A precise distribution plan with little room for error would prove Murphy's Law true once again.[15]

On 24 March, a convoy of the 89th Transportation Company (Medium Truck) hauled an immediate resupply of MREs and bottled water up to CSC Peterbilt in the 3rd Infantry Division rear. The surprised truck drivers learned the camp already had a couple hundred pallets of MREs and bottled water sitting on the ground—the very same thing the trucks were hauling forward. The convoy's mission was to push forward to Forward Logistical Support Area (LSA) Bushmaster; and if enough things had not gone wrong already, the war was about to be delayed by the weather.

On 25 March, G+5, the full force of the *shamal* hit. The *shamal* was the mother of all dust storms. The early part of the dust storm had turned the day sky red. Lieutenant Colonel Andrew Bowes, Commander of the 87th Corps Support Battalion, described this storm as "Biblical in nature." The hurricane winds and dust turned the sky dark as "a sack cloth." The *shamal* brought the 3rd Infantry Division advance to a halt near Karbala about 50 miles outside of Baghdad. While halted, elements of the Medina Division attacked the division. The *shamal* also grounded the helicopters of the 101st Airborne Division, which were moving the division to An Najaf, about 100 miles south of Baghdad. The Marines meanwhile prepared to secure An Nasiriyah as the British planned to clear Basra of 2,000 Iraqi soldiers and 1,000 militia. This halt did provide some Soldiers a chance to rest and mechanics a chance to work on their Abrams tanks and Bradley fighting vehicles, but it brought everything to a halt, especially transportation. The 7th Transportation Group was supposed to open the line of communication on G+5. Although the trailer transfer point at Cedar was ready, nothing could roll until after the storm. While halted, the units still consumed food and water. Consequently, the 3rd Infantry Division began running critically low on fuel, food, and water and not having brought water buffalos caused second and third order effects. The division lacked an efficient distribution plan for bottled water.

Early on the morning of 26 March, after the *shamal* passed, the convoy of the 89th Medium Truck continued on to Bushmaster. When it arrived, the 703rd Main Support Battalion did not have any trucks available to transfer the loads. After more delays, the convoy proceeded that evening to Tactical Assembly Area Raider within a few miles from the front line leaving the truck drivers to wonder how desperately the 3rd Infantry

Division needed the water if they did not have the trucks and forklifts waiting for them. The convoy waited throughout the night for a forklift, but it broke down after it arrived. The Soldiers realized the longer they waited, the more it delayed their turnaround time and reduced loads going forward. So the convoy commander ordered his truck drivers to bust the bands and push the bottles of water into the desert. The major escorting the convoy tried to prevent the convoy from leaving, but the lieutenant in charge of the convoy managed to get in contact with Brigadier General Fletcher by radio who instructed the major to let the convoy return. This problem was more common than rare.[16]

The 3rd Infantry Division seemed to have failed to account for the fact that bottled water was delivered on pallets. The division needed forklifts to unload the pallets and trucks to further deliver them to the units at the front. Instead units tried to commandeer echelon above corps trucks and deliver the water straight to the consumer. This resulted in further delays in supplies going to the front and longer turnaround times for convoys. So Lieutenant Colonel Pearson and his staff had to explain to the division logisticians that if they did not return the trucks, the 377th Theater Support Command could not send any more supplies forward.

As the line of communication stretched closer to Baghdad, the limited number of POL truck companies became an issue. On the morning of 27 March, Fletcher called the 181st Transportation Battalion to establish a convoy support center at Logistics Support Area (LSA) Bushmaster in order to facilitate the rapid turnaround of theater trucks. The commander, Lieutenant Colonel Charles Maskell, built a bag farm in order for the fuel trucks to drop their fuel, turn around and head back to Breach Point West to pick up more fuel. If the enemy cooperated, that bag farm could also support the 101st Airborne Division's various Forward Arm and Refuel Points (FARP), and push food, water and ammunition to the 3rd Infantry Division.[17]

By Friday, 28 March, the situation had become so critical, the 3rd Infantry Division cut food rations to two meals, ready to eat (MREs) per day. The unexpected resistance in the rear put a strain on the overextended supply line. Front line units also began to run low on batteries, as well as water, fuel and spare parts. In order to go back on the offensive, the 3rd Infantry Division would have to build up 10 days of supply while waiting for the Marines to finish their fight at An Nasariyah. The 3rd Infantry Division waited until 29 March and then went back on the offensive. It reached Baghdad International Airport on 3 April and entered the city two days later. By 7 April, the capitol was in US hands and the Third Army declared victory on 14 April. After a little over a month of advancing, coalition

forces began to settle into static positions in late April. This would change the nature of the war and logistical support. Up until this time, the war had been one of maneuver but the occupation would shift to a "hub and spoke" sustainment operation.

During the drive up to Baghdad, Fletcher's biggest concern had been the delivery of fuel, food and water. A shortage of any of these would have and did stop the war. The units were very much self-sufficient in ammunition and general support maintenance was almost non-existent. If the units could not repair a vehicle on the spot or tow it, then it was abandoned for later recovery.

The well-planned drive came to a halt due to weather and insufficient transportation to deliver the required food and water, a consequence of the reduction of the logistical footprint. The concept of on-time delivery maximized efficiency but left little room for error, and theater transportation assets ended up taxed beyond their limit. The planners had done the best they could with the limited resources. They did not even have enough transportation assets to pull off the mission with the best case scenario and in war, one had to plan for the worst case scenario. Fortunately, they did and planned a bombing campaign during the operational pause.

The idea of on-time delivery as used in the corporate world was entirely impractical in combat. While it would later take time to build up the required days of supply at each logistical node, this would prepare the Army for the worst-case scenario. Without fuel, the Army comes to a halt. Without food, Soldiers go hungry. Without water in the desert, Soldiers can die. As seen during the operational pause, just-in-time logistics was not in time. Fletcher, along with other logisticians, believed that the line of communication was so vulnerable that had the Fedayeen militia attacked the logistic bases instead of combat units, they would have shut down the war for quite a long time.

Another key factor relevant to the success of on-time delivery was in-transit visibility. In spite of people's best efforts, movement control was also broken. The dependency on new technology had caused movement controllers to abandon the previous methods of in-transit visibility, the stubby pencil and stencil. The loss of RFID tags, dead batteries due to the heat, and incompatible systems caused the loss of in-transit visibility. Neither did the movement control teams talk with the truck battalions they were collocated with. Conversely, the truck battalions initially disregarded the taskings from movement control. For this reason, Major General Christianson had to chair what would later become the asset allocation

board meeting to determine taskings. The fluid battle situation took convoys extra days to track down their customers, exceeding the turnaround time further reducing the available theater truck assets. However, with all the griping between the movers and controllers on what to deliver, there was not too much to argue about. There were only enough theater trucks to deliver food and water, nothing else.

The failure of the on-time delivery was largely due to the shortage of trucks complicated by the fact they had to haul bottled water instead of other classes of supply. The Host Nation and KBR contract trucks had become operational before President George Bush's declaration of victory on 1 May. In concept, the war was over and the commercial trucking companies could assume the role of delivering the goods north. This was the inspiration behind reducing the logistical footprint. The military transportation would support the Army during the fluid battle then turn over the line-haul mission once the situation became stabilized. Again, this was based upon the best-case scenario. Convoy ambushes would force military transportation units to remain and escort the contract convoys. LOGCAP did not reduce the logistical footprint but allowed the logisticians to send even more equipment forward.

A masterful concept in efficiency, on-time delivery definitely did not work in combat, because there was no room for error. After the theater matured into a hub-and-spoke sustainment operation, the enemy had a vote and—as wasteful and inefficient as it may seem—building mountains of supplies provided a cushion when the enemy severed the main supply route and ambushed convoys.

The weak link in the distribution system, however, was the shortage of trucks, a problem inherent at the beginning of every war. LOGCAP worked if the contract trucks and drivers are already in-country as they were during Operation Desert Shield. Otherwise, the contractors usually cannot stand up the contract as fast as needed. The trend since the Vietnam War has been rapid deployment and an equally rapid ground offensive. Speed has been the key tenet of American military success in global response instead of mass. In the race to embrace multifunctional logistics and find bill-payers for the brigade combat teams, the current US Army, however, has no more truck battalions or groups. It only has two POL truck companies on active duty. Seven POL truck companies were not even enough to sustain one corps's drive to Baghdad. The US Army went into Operation Iraqi Freedom short of trucks, and it does not even have that many trucks on active duty. So logisticians will have to develop even

more innovative solutions in the future. That means maximizing other means of transportation.

One possibility is aerial resupply. Besides fixed wing and rotary wing aviation, the Army is about to field aerial drones for aerial resupply. The Joint Tactical Aerial Resupply Vehicle (JTARV) can deliver up to 300 pounds 50 miles away. If there is a functioning railroad or deep river in the theater, the Army should use it. Rail and boats can still haul more tonnage than trucks. To more realistically meet the needs of the combatant commands, the Transportation Corps has created the expeditionary railway center with the advisor and management capability to take advantage of host nation rail. The Transportation Corps is also designing the Maneuver Support Vessel-Light (MSV-L) as a replacement to the LCM-8s. These vessels will travel faster and retain the capability to push more tonnage up rivers. While rail and rivers can transport more tonnage, they significantly restrict the lines of communication.

With the availability of good roads, trucks can provide the greatest flexibility in establishing lines of communication. With the majority of the truck units in the Army Reserves and National Guard, the mobilization requirements can delay the buildup of a sufficient logistical tail required to start a large-scale ground combat operation. The Transportation Corps, however, is fielding self-driving trucks and will begin with the leader-follower concept where a certain number of fully automated trucks will follow a vehicle driven by a human. In this respect, a smaller number of active duty truck drivers can field more trucks. All this technology provides the logistician multiple solutions for transportation. Another way to reduce the logistical footprint is to find imaginative ways to reduce the need for trucks, such as taking water buffalos and drinking ROWPU water. To be successful in the next war, logisticians need to truly think multi-modal.

Notes

1. Brigadier General Mark Scheid interview by Richard Killblane, 15 September 2006.

2. Scheid interview.

3. Scheid interview.

4. Colonel (Retired) Sam Pearson and Colonel (Retired) Mike Ford interview by Richard Killblane at Birmingham. Alabama, 11 September 2017.

5. Brigadier General Charles Fletcher interview by Major Robert G. Smith in Balad, Iraq, 19 May 2003; Colonel Stephen A Hicks interview by Major William Shane Story at Camp Victory, Baghdad, Iraq, 5 October 2003.

6. Hicks interview.

7. Fletcher interview.

8. Pearson and Ford interview.

9. Pearson and Ford interview.

10. Pearson and Ford interview.

11. Scheid interview.

12. Scheid interview.

13. Fletcher interview; Sergeant First Class Michael Aguilar interview by Richard Killblane at Fort Eustis, VA, 30 July 2003.

14. Captain Jeffrey Wagstaff interview by Richard Killblane at Fort Eustis, VA, 20 February 2004.

15. Colonel James Hodge and Lieutenant Colonel Joseph Corleto interview with Richard Killblane, 30 January 2006.

16. Wagstaff interview; First Lieutenant Bradley May interview by Richard Killblane at Fort Eustis, VA, 19 February 2004.

17. Major Cliff M. Serwe, “181 Transportation Operation Iraqi Freedom Historical Summary of Operations,” 31 December 2003; Lieutenant Colonel Charles Maskell email to Killblane, 19August 2004.

Chapter 11
"The Lifeblood of War": The Inland Pipeline Distribution System in Operation Iraqi Freedom I

Kenneth Finlayson

Operation Iraqi Freedom I (OIF I), the US-led Coalition effort to oust Saddam Hussein and topple his Baathist regime resulted in the swift destruction of the Iraqi Army. Post-conflict analysis reveals that the victory was achieved in the face of considerable challenges in the area of sustainment. One function that was generally recognized as a success was the delivery of bulk petroleum using the Inland Pipeline Distribution System (IPDS).

Class III (Bulk) petroleum represents the single largest commodity by volume in the conduct of large-scale combat operations. During OIF I, US forces installed, maintained, and operated 220 miles of tactical pipeline that snaked across the Kuwaiti desert and ran for more than 120 miles into Iraq.[1] The delivery and distribution of more than 60 million gallons of fuel utilizing the IPDS was a key component in the successful Coalition assault on Baghdad.[2] The deployment of the IPDS in OIF represented the culmination in the evolution of the Army's tactical pipeline system, a process that began more than 60 years ago.

The fielding of a tactical pipeline system in the US Army began in World War II. In 1942, the Army adopted an "invasion-weight pipeline" system developed by Shell Oil engineers. In World War II, Class III operations were split between two branches. The Army Quartermaster Corps was responsible for the distribution of petroleum in 5-gallon containers transported by rail and truck and the Corps of Engineers was in charge of the installation and operation of petroleum pipelines. Extensive use of pipelines to support the US armored and mechanized forces began in the North Africa campaign in late 1942, where more than 1,000 miles of pipeline were laid in Algeria and Tunisia. After the landings at Normandy, wartime planners anticipated installing six pipelines out of the port of Cherbourg, sufficient to move 90 percent of the fuel needed by the Allied forces advancing into Germany. Fuel was delivered from vessels offshore or through the PLUTO (Pipe Line under the Ocean) system that traversed the English Channel. Ultimately, a Military Pipeline Service was organized to handle the pipeline requirements of the European Theater.[3]

The other WWII theaters also made extensive use of pipelines to distribute fuel, most notably in the Southwest Pacific. Extensive pipelines were constructed in New Guinea and the Philippines and on Okinawa. In

the China-Burma-India Theater, a pipeline followed the Burma Road into China.[4] In the post-war years, the Army did little to develop a lighter, more efficient tactical pipeline system—relying instead in the 1950s on the huge stocks of pipeline components left over from the war.

During the Korean War (1950–1953), pipeline operations in the mountainous Korean peninsula were not nearly as widespread. The most significant pipeline constructed during the war ran from Incheon to Kimp'o Airfield and was built using WWII-era 4-inch line. What was identified in this conflict was the necessity to protect the line from sabotage, a requirement that took on even more significance in Vietnam.

During the Vietnam War, more than 50 percent of the supply tonnage was petroleum. Using lightweight steel 6-inch pipe with "Victualic" couplings, several pipelines were constructed to meet the needs of the forces. The longest was one of 109 miles laid from Qui Nhon to Pleiku,[5] The vulnerability of the pipeline system was a matter of significance and it was noted that: "The important lesson to be learned here is that if assets are not available to protect and secure the pipeline, it is more efficient to resupply fuel by truck, rail, and barge."[6] Post-Vietnam, the Army addressed the necessity of fielding a lightweight tactical pipeline system to replace the obsolete Vietnam-era steel model.

In April 1983, the Department of Defense directed that the Army and Navy develop the capability to procure, transport, and preposition bulk fuels. The Navy was responsible for maritime petroleum operations, which included the ability to pump fuel onshore. This resulted in the Offshore Petroleum Discharge System (OPDS) and was designed to operate in conjunction with a land-based system developed by the Army. Thus, the Inland Petroleum Distribution System was born.

Between 1984 and 1990, the Army developed, tested, and fielded the IPDS. The new system featured numerous differences from the previous Light Weight Steel Tubing (LWST) system. The new pipeline was a significant improvement in terms of efficiency and deployability.

The old LWST system was composed of 20-foot lengths of 6-inch steel pipe weighing 170 pounds per section. Fuel was moved through the LWST by a system of pump stations that featured four pumps designed to have three running with one pump as backup. The Maximum Allowable Operating Pressure (MAOPS) in the LWST was 600 pounds per square inch (psi). In contrast, the new IPDS featured 19-foot sections of 6-inch aluminum pipe. Each pipe section weighed 107 pounds—a 40-percent weight reduction—and could fit into the standard 20-foot International

Figure 11.1. The World War II pipeline system consisted of steel pipe that required welding to connect the individual sections. The Army depended heavily on pipelines to move bulk fuel during the war. Photo courtesy of Army Signal Corps.

Standards Organization (ISO) container—a great improvement in deployability. IPDS pump stations required only two pumps, one working as the primary and one as backup. The improved pumps generated a MAOPS of 740 psi.[7] Pipe couplings in the IPDS featured a simple single-pin design vice the multiple nuts and bolts of the LWTS, and each pipe section had an internal gasket to prevent leakage. The IPDS was first deployed in 1990, during Operation Desert Shield/Desert Storm (ODS/S).

Between 10 August 1990 and 31 May 1991, US forces used 1.88 billion gallons of fuel to sustain operations within the Central Command (CENTCOM) Theater.[8] The bulk fuel was obtained from Host Nation (HN) resources—primarily Saudi Arabia and the United Arab Emirates—as well as through Defense Logistics Agency (DLA) contracts with other Gulf States. As the proponent for Class III operations, Army Central Command (ARCENT) was responsible for the mission command of the construction, installation, operation, and expansion of the petroleum distribution system in the theater, as well as inland distribution of bulk fuel to supported service components. The sequence of unit deployment during the Desert Shield pre-combat buildup precluded the full deployment of the IPDS in Desert Storm.

The decision to call forward the IPDS system and the units needed to construct and operate it was not made until late October 1990. The necessary troops and equipment to build the IPDS did not arrive until early December 1990. The 475th Petroleum Group was the unit tasked with the mission command of petroleum operations. The majority of the Class III requirements were met with US tactical fuel vehicles and a contract fleet of 1,400 HN tanker trucks. During combat operations in the brief l00-hour war, the Army very nearly ran out of gas as the swiftly moving combat formations outran their fuel trucks over the rough off-road terrain. Due to the late arrival of the 475th and the IPDS, only 127 miles of pipeline were installed. Subsequently, it would be more than a decade before the IPDS would again be deployed in a major combat operation—this time in 2003 when the Army returned to Iraq. OIF I turned out to be a full test of the system.

As mentioned previously, Operation Iraqi Freedom is noteworthy for the successful installation and operation of the longest tactical pipeline system in the Army's history. The doctrinal methodology for managing a petroleum pipeline system has not fundamentally changed since World War II in that it requires the joint efforts of two separate Army branches.[9] The design and construction of the IPDS is a function of the Corps of Engineers, and the operation of the pipeline and fuel distribution upon installation is a mission of the Quartermaster. In OIF I, the 416th Engineer Command (ENCOM) was assigned the mission of pipeline construction and the 49th Quartermaster Group (QM GP) from Fort Lee, Virginia, was tasked with operating the IPDS when installed.[10] Working in close coordination, these two units designed, built, and operated the IPDS in a highly successful manner while overcoming numerous challenges that threatened the viability of the system. The IPDS was an integral part of the Combined Forces Land Component Command (CFLCC—"See-flick") Class III theater sustainment plan.

Initially, the CFLCC planning team had to determine Class III requirements, locate a fuel source, and develop a plan to distribute the fuel throughout the theater. The initial estimated requirement for fuel up to Deployment plus 10 days (D+10) was 1 million gallons per day.[11] A multinational planning group composed of US personnel from the US Embassy staff, CFLCC C4, the 377th Theater Support Command, and the 49th QM GP met weekly with Kuwaiti government officials and refinery personnel to develop a plan that used Kuwaiti refineries as the fuel source. Ultimately two Kuwaiti facilities, the Mina Abdullah refinery and the Al Ahmadi refinery, provided the fuel for the Coalition war effort. When constructed, the IPDS would be connected to the Al Ahmadi refinery's commercial

steel pipeline at its terminus at Camp Virginia. The IPDS would be the primary bulk fuel source to support the Coalition forces when combat operations commenced.

The function of the IPDS is to distribute large volumes of fuel between storage and distribution points. Tactical Petroleum Terminals (TPTs) are the facilities where this reception, storage, and dispensing takes place.[12] Well before hostilities commenced, the establishment of the TPTs was underway.

A TPT is built around 18 collapsible fuel bags known as Bulk Fuel Tank Assemblies (BFTA), each with a capacity of 210,000 gallons. When 100 percent filled, a TPT can store 4.3 million gallons of fuel.[13] These are emplaced in excavations that are lined and surrounded by earthen berms to prevent spillage. The TPT also includes a Fuel Dispensing Assembly, Tanker-Truck Receipt Manifold, and a Fuel Additive Injection point and features an internal road network that accommodates large fuel tankers. The Camp Virginia TPT was built around 24 fuel bags and with a perimeter of roughly 600 x 580 meters.[14] This would be the entry point for

Figure 11.2. Bulk Fuel Tank Assemblies form the storage component of the Tactical Petroleum Terminals that connected the pipeline segments. When combat operations commenced, US forces had more than 4 million gallons of fuel in the TPTs. Photo courtesy of US Army Quartermaster Center and School.

fuel flowing through the IPDS via a 12-inch commercial pipeline from the Mina Abdullah refinery.

The 240th Quartermaster Battalion (Petroleum Pipeline Terminal Operating), a subordinate unit of the 49th Group, deployed to the theater beginning in March 2002. Construction commenced in late 2002 on a TPT with a capacity of 1.8 million gallons at Camp Virginia northwest of Kuwait City. This TPT was completed in January 2003.[15]

A second TPT was constructed in early February 2003 near the Al Ahmadi refinery located south of Kuwait City. This TPT was known as the Truck Fill Stand (TFS), and it supported the increasing requirements of US aircraft refueling at Kuwait City International Airport and the Class III needs of the US facilities at Camp Doha and Camp Arifjan. The TFS serviced the 7,500-gallon tankers delivering fuel to the airport and the nearby camps and—prior to the commencement of combat operations—supplied the fuel to fill the TPTs until the completion of the IPDS.[16] As the buildup continued, two additional TPTs were constructed supported by the expanding IPDS.

Two other TPTs were built as the IPDS moved north toward the Iraqi border. Fifty-one miles northwest of Camp Virginia, a TPT was constructed at a site known as Breach Point West (BPW). On the Kuwaiti side of the border, BPW was roughly 5 miles from the planned crossing point into Iraq. At nearly 1,000 meters square and containing 30 BFTAs, this TPT was the largest ever constructed under combat conditions. The TPT at BPW had a holding capacity of 4.2 million gallons. An intermediate TPT between Camp Virginia and BPW was emplaced at Camp Udairi in mid-February and held 1.9 million gallons of fuel.[17] The total capacity of these four TPTs was 11 million gallons.[18] Constructed concurrently with the laying of the pipeline, the filling of the two new TPTs commenced using tanker trucks from the TFS while the IPDS was under construction.

The construction of the pipeline was tasked to the 416th ENCOM (US Army Reserve) headquartered in Darien, Illinois. The 416th assigned the construction mission to the 62nd Engineer Battalion (Combat Heavy), a general construction unit from Fort Hood, Texas. The technical expertise in pipeline construction was provided by the 808th Engineer Pipeline Company (US Army Reserve) from Houston, Texas. Additional construction assistance came from the 226th Engineer Company (Combat Heavy), Kansas Army National Guard, and C Company, 46th Engineer Battalion, Tennessee Army National Guard. Civilian personnel from Radian Corpo-

ration, the supplier of the IPDS, were also on hand in an advisory capacity during the installation and operation of the IPDS.

The construction of the IPDS required preparation of the ground along the route of the pipeline, construction and installation of pump stations at pre-determined intervals, and establishment of connections at the source and at the TPTs. Prior to operation, the system had to be flushed with clean water and pressure-tested. A modular system, the IPDS arrived in six section-sized kits that contained all the components necessary for construction.[19]

Each aluminum pipe section was 19-feet long and weighed 107 pounds. The pipe sections had an internal gasket and connected by snap-joint coupling collars that featured a single brass retaining pin. After 50 pipe sections were connected, an expansion joint was built into the pipeline to allow for thermal expansion and contraction. Screw-type anchors were installed between expansion joints to prevent shifting of the pipeline and, at regular intervals, gate valves were installed to allow for the isolation of a segment of the pipeline for maintenance and repair. A five-mile pipeline set contained all the pipe sections and components needed to build a segment of that length, and came packaged in 13 20-foot ISO containers.[20]

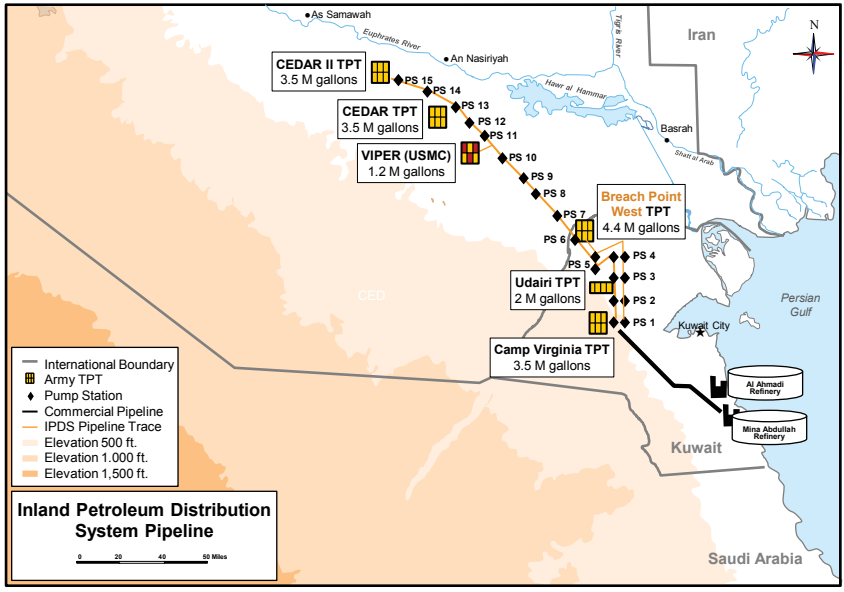

Figure 11.3. Tactical Petroleum Terminal (TPT) map. Map created by Army University Press.

As was the case in World War II, using a pipeline for bulk fuel delivery dictates that the construction and operation of the pipeline each belong to a different Army branch. This is standard Army doctrine. Design and construction of the IPDS is the responsibility of the Corps of Engineers. The physical operation of the pipeline pumping stations and the mission of distributing the fuel belongs to the Quartermaster Branch. In OIF, it was the close coordination of these two elements that resulted in an efficient, effective bulk Class III operation.

The 416th designed the pipeline to meet the requirements specified by the CFLCC C4, who was responsible for fuel and water distribution during OIF. Based on the operations plan that determined how much fuel would be needed at each of the TPTs, the engineers designed the route of the pipeline and identified the location of the pump stations. Based on map and route reconnaissance, the optimal trace of the pipeline was designated. The initial construction installed one system, known as IPDS I from Camp Virginia through Camp Udairi to BPW.

Installation required running the pipe along a smooth aboveground track. The engineers did such grading as was necessary to keep the pipeline as level as possible. The generally flat, sandy desert terrain posed few problems emplacing the IPDS. The exception was a 5-mile long-section north of Camp Udairi known as the "moonscape." This rough, rocky area of sand dunes required the employment of seven bulldozers and took nine days to prepare before the pipe could be laid.[21] The engineers were able to install IPDS I from Camp Virginia to BPW in 21 days, 5 days ahead of schedule.[22] This first system had the capacity of delivering fuel at a rate of 800 gallons per minute (gpm) to the TPTs at the three camps. As the initial OPLAN did not envision the IPDS being extended into Iraq, CFLCC decided to install a second IPDS parallel to the first.[23]

The installation of the second IPDS (IPDS II) made the maximum use of the existing pump stations and provided an enhanced flow rate for the fuel. With both lines in operation, the Army was able to establish the largest TPT ever built at Breach Point West. Fed by 102 miles of pipeline, BPW had a holding capacity of 4.4 million gallons. This insured that all the units preparing for combat were fully fueled prior to the commencement of hostilities.

Once the engineers had constructed the IPDS, the 49th Group took over the operation of the system. The initial flushing and pressure testing of the pipeline took 21 days.[24] The collection and delivery of 600,000 gallons of potable water was required to accomplish this, a process that was

delayed on occasion by lack of water. This flushing and pressure testing of the IPDS was a critical mission, and once accomplished, signaled the beginning of the flow of fuel. Getting fuel into the system required constant liaison with the Kuwaitis.

The 49th personnel worked closely with the local nationals manning the Kuwaiti Al Ahmadi Refinery, the primary source of fuel. The Kuwaiti commercial pipeline from the refinery to Camp Virginia—the start point for the introduction of fuel into IPDS—had not been used in a number of years and required significant testing to verify the integrity of the pipeline. Pumping fuel from the refinery required close, constant communication between the 49th personnel and the refinery staff to make sure that the fuel flowing through the pipeline was of the proper grade and delivered at the proper pressure. The training given by the refinery personnel to the 49th Soldiers on refinery pump operations and the delivery of fuel to the pipeline was a critical part of making the IPDS function efficiently. The job of the 49th began at the refinery, which did not produce the proper fuel needed by the Coalition.

Figure 11.4. The installation of the IPDS into Iraq slowed the rate of construction as the troops worked in the debilitating heat wearing full combat equipment. Despite this, throughout OIF I, the rate of construction exceeded the doctrinal standard. Photo courtesy of 416th Engineer Command.

The Al Ahmadi and Mina Abdullah refineries produced Jet A1 fuel, (aviation fuel) for commercial use. The American military uses JP-8 as the single fuel for US ground and air forces. To convert JA-1 to JP-8 requires the injection of three additives. Special "Hammonds" injectors were placed on the refinery pump manifolds, and the three compounds—Corrosion Inhibitor, Fuel System Icing Inhibitor, and Static Dissipating Additive—were mixed with the JA-1 fuel to make the JP-8.[25] This was done throughout the campaign by 49th personnel at the refineries. Once the proper mixture was attained, the fuel was sent into the pipeline. The two IPDS did not remain as the only pipelines built to support operations once the war commenced.

With the pipelines established in Kuwait, CFLCC made the decision to extend the pipeline into Iraq to follow the Coalition advance. On 20 March 2003, a few hours after the start of combat operations, personnel from the 808th Engineer Company began the process of establishing a route for the new pipeline (IPDS III) and preparing crossing points in the border berm.

IPDS III was a 58-mile-long pipeline running from Breach Point West to Logistics Support Activity (LSA) Viper in Iraq. To construct this new pipeline, additional pump stations had to be airlifted into theater. Construction of IPDS III also consumed the remaining IPDS stock on hand. A section of the pipeline was tied into a TPT operated by the US Marine Corps at Jalibah Airbase. The Marines used their own low-pressure assault hose reel system to supply their forces. Running the IPDS to Viper provided a greater capacity to bring fuel to the TPT and allowed the Marines to roll up their hose reel and deploy it forward to support their advance. Soon, another IPDS was built that extended farther into Iraq.

IPDS IV ran for 24 miles from LSA Viper to LSA Cedar I. Using two pump stations, this pipeline was completed in five days by the now-seasoned engineer pipeline companies. A 1.2 million gallon Fuel System Supply Point (FSSP) was established at Cedar I and manned by the 110th Quartermaster Company. The company later replaced the FSSP with a 3.5 million gallon TPT.[26] With the establishment of the IPDS to Cedar I, 184 miles of pipeline supporting a storage capacity of roughly 15 million gallons was in place. The emplacement of IPDS IV and a subsequent extension required a dismantling of systems already in use and the leapfrogging of pipeline equipment forward.

The running of the IPDS IV to Cedar I exhausted the supply of IPDS components in theater. To help meet the demand for an extension of the line, the Kuwaiti Oil Company was contracted to extend their commercial line

from Camp Virginia to Camp Udairi, which allowed for the disassembly of the IPDS between the two camps. Once disassembled, the former IPDS II sections were relocated forward. The recovered systems were used to run IPDS V, a 34-mile extension from LSA Cedar I to LSA Cedar II in the vicinity of Tallil Airbase.[27] With the construction of IPDS V finishing on 6 June 2003, the pipeline network was complete. The installation and operation of the IPDS system was a monumental achievement and was not accomplished without an incredible effort on the part of the engineers and quartermasters.

Engineer support to the pipeline construction continued after the installation was complete. One of the most vexing issues was caused by vehicles driving over the pipeline. When operating at close to maximum pressure, a rupture in the pipeline resulted in a serious loss of fuel and extensive ground contamination. The aluminum pipe sections, tan in color, blended in perfectly with the desert terrain, and were vulnerable to crushing by vehicles of all types. Protecting the pipeline from friendly assault was a major mission of the engineers.

In areas where the pipeline was laid in the vicinity of or intersected established roads, the engineers buried the pipeline in specially constructed crossing points. Using protective culverts, the engineers ran the pipe underground. However, outside of the designated crossing points, the

Figure 11.5. To prevent the damage to the pipeline caused by vehicles, engineers constructed 6-foot-high berms on both sides of the line. Ultimately, more than 130 miles of berms were erected. Photo courtesy of 416th Engineer Command.

pipeline was laid at ground level and exposed to being run over as vehicles maneuvered off-road across the desert. Initially, the engineers countered this with a three-foot-high berm marked with pickets and engineer tape on the friendly side of the pipeline. When this proved inadequate to prevent tactical vehicles from running over the pipe, the engineers raised the height of the berm to six feet, built up on both sides of the pipeline. With additional crossing points installed, this largely eliminated the problem of the pipeline being run over, but required the building of 130 miles of berms.[28] Throughout the operation, the engineers battled with the terrain and climatic conditions.

With the commencement of the ground war, the Soldiers forward in Iraq worked in Mission-Oriented Protective Posture 1 (MOPP 1) gear with body armor. This caused a considerable slowing of the rate in which the pipeline could be laid, as the troops needed frequent rest and water breaks when the temperature climbed to near 120 degrees. Installation dropped to one mile of pipeline constructed per day, a reduction in productivity of 50 percent.[29] Frequent sandstorms also impinged on the installation as visibility was severely curtailed, and it was difficult to emplace the pipeline in a straight line. The engineers did yeoman service to keep the pipeline operational, as did the quartermasters who were operating the pump stations.

When fully operational, the pipeline network extended 250 miles from the base TPT near Kuwait City to the TPT at LSA Cedar II in Iraq. Each of the numerous pump stations along the route was manned by personnel from the 240th Quartermaster Battalion, some of whom were more than 70 miles from the nearest base camp. These isolated, exposed outposts were some of the most spartan of any occupied by US Soldiers. Living conditions were extremely austere, with the troops billeted in tents with no running water or dining facilities; burn-out latrines; and the necessity of maintaining around-the-clock security and the operation of the site.[30]

Each pump station was roughly an acre in size, surrounded by a 6-foot earthen berm and featuring a controlled entry point. Triple-strand concertina wire and an observation tower, continuously manned, were the primary security for the station. Troops on site were responsible for their own security, the continuous maintenance and operation of the pump systems in the harsh desert conditions, general housekeeping of the site, and the security of the 10 or more miles of pipeline in the vicinity of their pump station. Those pump stations in Iraq required double the forces on site to provide 24-hour security and operations. As the pipeline was pushed into Iraq, security of the system became an increasingly important mission.

The vulnerability of the pipeline to sabotage and theft was a constant challenge. Theft of fuel by the local inhabitants was a common occurrence and, on more than one occasion, Iraqi saboteurs ruptured the pipeline and ignited the fuel. In one instance, more than 600 meters of pipe were stolen from the system, presumably for resale as scrap aluminum.[31] This required continuous patrolling of the pipeline by the 240th Quartermaster Battalion Soldiers, who were not well-equipped for the mission, in most cases suffering a lack of vehicle-mounted crew-served weapons, a paucity of night vision goggles, and inefficient communications equipment.[32] Despite these handicaps, the troops persevered and kept the pipeline open and running with negligible effect on operations. While the pipeline was the system to move bulk fuel, the CFLCC plan would not have succeeded without the ability to move the fuel out of the TPTs to the combat forces, or vehicles to move the component parts of the IPDS as needed. This proved to be the most challenging part of the Class III operation.

A key component of the CFLCC theater distribution plan involved using US and British military vehicles and HN contract tankers to move fuel as the TPTs were being filled and after the completion of the IPDS. The 240th Quartermaster Battalion employed seven Reserve Component Transportation Companies (Medium Truck, POL). Each company had 60 5,000- and 7,500-gallon tanker-truck combinations in three platoons. Once combat operations commenced, these companies were reassigned as theater and corps assets.

Two companies went to 3rd Corps Support Command and supported 3rd Infantry Division as it attacked into Iraq. One was attached to the Marine Expeditionary Force and the other four were retained as theater assets, moving fuel throughout the various division and corps areas.[33] The key component of the POL distribution mission, all the companies supported the warfighting effort while travelling the dangerous roads behind the front lines. The shortage of POL trucks did cause issues on the drive to Baghdad, as did the lack of vehicles needed to move the IPDS equipment plagued the engineers during the construction of the IPDS.

The movement of the IPDS components for construction of the pipeline was handled largely by the engineers using their internal transportation capability. Over the course of OIF I, the 416th ENCOM personnel transported more than 1,300 ISO containers of IPDS components; 1,500 engineer Soldiers hand-coupled more than 66,000 pipe sections and installed 20 pump stations in support of the 220 miles of pipeline. Overall, the IPDS transported more than 60 million gallons of fuel.[34]

The scarcity of external transportation assets hampered the 62nd Engineers' ability to stage the ISO containers in the required locations along the route of the pipelines. The unit relayed the containers using its own M916/M920 tractors and M870 lowboy trailers, a process that slowed the placement of the materials between Camps Virginia and Udairi. Once on site, the construction went rapidly. The unit was able, through strenuous effort, to keep one day ahead of the construction schedule.[35] Similar difficulties were encountered when the pipeline sections had to be recovered and moved forward to support the construction of the new line from Cedar I to Cedar II. All these obstacles were overcome through the ingenuity and effort of the Soldiers, and the IPDS proved to be one of the most successful sustainment efforts of OIF I.

In retrospect, the Inland Petroleum Distribution System performed sufficiently well to sustain Coalition forces throughout the period of combat operations. More than 220 miles of pipeline were constructed and carried more than 60 million gallons of fuel in OIF I. As estimated by the 49th Quartermaster Group, this volume represents the equivalent of five 5,000-gallon or three 7,500-gallon truck companies with a proportional reduction in manpower, maintenance, and road space usage.[36] The fact that POL operations were under a single unit in the theater was a significant part of the success of the effort.

Major General Claude V. Christianson was the CFLCC C4 in OIF I. His view of the necessity of having a single commodity manager for fuel was expressed in an interview after OIF I:

The lesson we took away from our failure in Desert Storm to provide POL, when some Army units ran out of fuel after 80 miles of movement, the lesson we learned was we needed to have a single belly button [to push] to be able to watch over the entire battlespace. The way we decided to do that was to allocate all that capability to that one guy, in this case the petroleum brigade. He was watching over the bag farm, the pipeline, and the tanker trucks, and it was his job to manage all that stuff against the customer requirements. And the reason it was successful, I'm not sure managing as a commodity was the right term but I wanted that colonel to be in charge. I did not want to have him responsible for something that either he did not have the authority or tools to execute. And that fundamentally was the reason why.[37]

Both the 49th Group and the 416th ENCOM were able to incorporate a mix of active and reserve units to successfully fulfill their mission responsibilities. With the cessation of hostilities, the pipeline was disman-

tled and the IPDS returned to war reserve in preparation for the next conflict. In the years following OIF I, the Army changed its force structure regarding POL operations.

The 49th Quartermaster Group was inactivated on 14 September 2012. It was preceded by the 240th Quartermaster Battalion, which was inactivated on 24 June 2011. Currently there is no Quartermaster Petroleum Group in the Active Army and 90 percent of the Echelon above Brigade units whose mission is petroleum and water logistics reside in the United States Army Reserve. Consequently, the emphasis for the Army going forward is in addressing the early entry capability and the ability to set the theater prior to the arrival of Reserve sustainment units.

IPDS is still the system that the Army depends on for ground pipeline POL operations. In early 2000, a proposed replacement, the Rapidly Installed Fuel Transfer System (RIFTS), was under development. This was a system designed for the speedy emplacement and recovery of a conduit-based design that could support the installation of up to 20 miles of pipeline per day.[38] RIFTS was subsequently cancelled, and the current future of POL pipeline operations lies with the Early Entry Fluid Distribution System (E2FDS). The E2FDS is in the development and design stage and represents one aspect of the Army sustainment community's effort to be able to support early entry into theater in response to the threat of large-scale combat operations. As it was during Operation Iraqi Freedom, fuel is the lifeblood of the Army and the ability to deliver enormous quantities of POL is essential to success in combat.

Notes

1. Shawn P. Walsh, "240th Quartermaster Battalion After Action Report, May 2003," Combined Arms Support Command Quartermaster School Historical Records Repository, Fort Lee, VA, 1.

2. Kevin Born, "History of Tactical U.S. Military Pipelines," report prepared for Radian Corporation under FORSCOM contract, 2003, Combined Arms Support Command Quartermaster School Historical Records Repository, Fort Lee, VA, 12.

3. Born, 1–4.

4. Born, 1.

5. Victualic pipelines featured couplings that connected the pipe sections with a special clamp and gasket system. This eliminated the necessity of welding the pipe sections as was the case in previous wars. Born, 1.

6. Born, 4.

7. The higher MAOPS results in the petroleum moving faster and being less effected due to undulations in the pipeline. Also, within the pipeline are "pigs," internal devices placed at intervals along the line that move between stations and clean the interior of the pipe. Higher pressure results in more effective cleaning.

8. Department of the Army, Deputy Chief of Staff for Logistics, "Operation Desert Storm – Sustainment," December 1990, 38–39. Gallons-consumed estimates are based on Defense Logistics Agency, Defense Fuel Center figures, date unknown.

9. Department of the Army, Field Manual (FM) 3-34, *Engineer Operations* (Washington DC: April 2014), 2-42, 2-7; Department of the Army, Field Manual (FM) 4-40, *Quartermaster Operations* (Washington DC: October 2013), 2-19, 2-3.

10. Gregory Fontenot, E.J. Degen, and David Tohn, *On Point: The United States Army in Operation Iraqi Freedom*, (Fort Leavenworth, KS: Combat Studies Institute Press, 2004), 65.

11. Colonel Donna L. Shaw, "Theater Fuel Support during Operation Iraqi Freedom," Personal Experience Monograph, US Army War College, Carlisle Barracks, PA, 2004, Combined Arms Support Command Quartermaster School Historical Records Repository, Fort Lee, VA, 6.

12. Department of the Army, Forces Command, "IPDS Student Handout 'Guide,'" FORSCOM Training Module, April 2014, CASCOM Petroleum and Water Training Division, Fort Lee, VA, 4-2.

13. BFTAs can be configured in groups of 6, 12, or 18. A single 6 BFTA set is call a fuel unit. Leakage issues with the BFTAs resulted in an Army-generated directive to restrict the filling of the bags to 70 percent of capacity. This restriction remained in effect throughout OIF I.

14. Shaw,"Theater Fuel Support," 7.

15. Born, "History of Tactical U.S. Military Pipelines," 7.

16. Born, 7.

17. Born, 8.

18. Leakage issues with the BFTAs resulted in an Army-generated directive to restrict the filling of the bags to 70 percent of capacity. This restriction remained in effect throughout OIF I.

19. The sub-component kits of the IPDS were the Fuel Units, Pipeline connection Assemblies, 5-mile pipeline sections, Pump Stations, Pipeline support Equipment, and Special Purpose Equipment.

20. Robert A. Kirkpatrick and Robert B. Knowles, "416th ENCOM After Action Report (AAR), Enclosure 4 to OPORD 12-001," 2012, Combined Arms Support Command Quartermaster School Historical Records Repository, Fort Lee VA, 2.

21. Department of the Army, "62nd Engineer Combat Battalion (Heavy) After Action Report," undated, Combined Arms Support Command Quartermaster School Historical Records Repository, Fort Lee, VA, 6.

22. Kirkpatrick and Knowles, "416th ENCOM After Action Report," 4.

23. Kirkpatrick and Knowles, 5.

24. There are four options for flushing the pipeline after construction: potable water, salt water, nonpotable water, and fuel. The 49th chose potable water as the most effective and environmentally sound. Shaw, 6.

25. Born, "History of Tactical U.S. Military Pipelines," 7; Shaw, "Theater Fuel Support," 5.

26. Born, "History of Tactical U.S. Military Pipelines," 9.

27. Born, 10.

28. Kirkpatrick and Knowles, "416th ENCOM After Action Report," 6.

29. Department of the Army, "62nd Engineer Combat Battalion (Heavy) After Action Report," 10.

30. Walsh, "240th Quartermaster Battalion After Action Report," 3.

31. Walsh, 2.

32. Walsh, 2.

33. Walsh, 2.

34. Kirkpatrick and Knowles, "416th ENCOM After Action Report," 6.

35. Department of the Army, "62nd Engineer Combat Battalion (Heavy) After Action Report," 12.

36. Born, "History of Tactical U.S. Military Pipelines," 6.

37. Lieutenant General (Retired) Claude V. Christianson, CFLCC C4, interview with Mr. Richard Killblane, USA Transportation School, Fort McNair, DC, 3 April 2014, Combined Arms Support Command Transportation School Historical Records Repository, Fort Lee, VA, 6.

38. Lieutenant Colonel Kimberly A. Weaver, "The Inland Petroleum Distribution System (IPDS): Can It Fuel the Force?" Strategy Research Project, US Army War College, Carlisle Barracks, PA, 10 April 2001, Combined Arms Support Command Quartermaster School Historical Records Repository, Fort Lee, VA, 6.

Conclusion

The Future of Sustainment: A Vision of What's Possible and How to Get There

Major General Paul C. Hurley, Major General Rodney D. Fogg, and Ronald R. Jaeckle

Colonel Phillips receives a BUB (Battlefield Update Brief) less than an hour before departing the assault command post. All conditions are "Go." But when echeloned movement begins, his brigade meets enemy contact. On his command vehicle heads-up display, alarms and notifications are indicating that the brigade has already become critically short on small arms ammunition, Sabot, and HEAT M1A1 Abrams tank rounds. Additionally, two tanks have been disabled from enemy contact, and sensors indicate maintenance problems on tanks B16 and A11. The main effort fuel and ammunition trucks have been destroyed—things are not going as planned.

Over his headset, Colonel Phillips directs the brigade XO, Lieutenant Colonel Smith, to "work logistics" as he continues to focus on his electronic map display—watching the brigade's icons advance toward Objective Eagle down 4-0 east-west gridline. Enemy resistance along the 75-mile attack zone has been intense. The push forward continues, but maintaining momentum requires logistics and medical replenishment.

Lieutenant Colonel Smith clicks on his digital assistant—a voice-activated mission command system synched with sustainment information—and says, "Logistics update." The artificial intelligence system quickly starts providing a thorough update on ammo, fuel, maintenance, and medical statuses across the brigade to include estimates for the next 48 hours. The XO interrupts with, "Abbreviated update." The system gives him a quick review of ammunition, fuel, and maintenance statuses and confirms that a resupply mission has already departed from the brigade's supporting unit and will arrive within approximately 50 minutes.

Lieutenant Colonel Smith knows that the ground resupply will provide the volume of resupply needed—the dramatically improved lift capability enabled through Leader/Follower technology allows logisticians to move more supplies over extended distances to reach dispersed units in contact. However, that ground movement still takes time, and the time until resupply may be the difference between victory and defeat for the brigade. The XO knows he has to provide some help to sustain the tempo of immediate

combat operations until the ground convoy can get to the Soldiers in combat. He activates his mission command system again to initiate autonomous aerial resupply of crucial ammunition to buy more time. The autonomous resupply drones sent from the brigade support battalion will arrive within the next 30 minutes with a relatively small but critically important resupply of small arms ammunition.

Meanwhile, the casualties are beginning to mount. The commander's dashboard indicates that the brigade has 12 killed in action (KIA) and 26 wounded in action (WIA)—many critical and requiring evacuation. Unfortunately, the battlefield is so fluid and the combat so intense that evacuation aircraft cannot reach the casualties. Fortunately, the brigade had echeloned an advanced resuscitative medical capability forward to address such a contingency. The surgeon on site has an adequate supply of freeze-dried plasma, liquid bandages, and skin glue to address the less severe injuries, and his team can stabilize the most seriously injured with the lightweight advanced medical life support equipment located at the casualty collection point. Once stabilized, many of the casualties can be evacuated using a Leader/Follower mixture of autonomous and manned ambulances to the combat support hospital for further treatment.

Confident that the casualty situation has been stabilized for the time being, Colonel Phillips returns his attention to the brigade combat power. "Chief, what's the status of B16 and A11?" The brigade maintenance tech responds to the bark of his brigade commander's voice: "Sir, B16 is down for an actuator valve, but the maintenance support team used the 3-D printer to produce a temporary replacement. It will be up within the hour. We are still assessing A11."

"Well, that's at least one more tank in the fight," Colonel Phillips thinks to himself, "but the battle is growing more intense. We cannot afford to lose any more combat power." Again, he checks his mission command display. The sensors indicate significant consumption of fuel and ammunition but no additional maintenance issues. As if on cue, the radio bursts to life with the report that leading elements of the brigade have reached Objective Eagle and are beginning to clear the objective. The brigade has survived to fight another day.

What if we could anticipate sustainment shortfalls and combat system failures before they happen, or nearly simultaneously, and intervene immediately to replenish or prevent the loss of combat power? The type of sustainment support depicted in the scenario above is made possible by two sets of enablers: a series of functional technology advances being worked

across the sustainment research and development community and an artificial intelligence system that relies on a collection of communications systems and sensors, an integrated secure cyber-protected network, and enterprise resource planning (ERP) software that integrates information across all the sustainment functions and with mission command systems.

Functional Technologies

Efforts are well under way on a number of science and technology priorities to resolve critical sustainment capabilities gaps. The above scenario highlights just a few of them.

Leader/Follower. In the highly lethal and dispersed operations envisioned for the future, Leader/Follower technology can greatly reduce risk to Soldiers on the battlefield by providing an autonomous enhancement for tactical wheeled vehicles. It can enable two Soldiers to run a convoy of 10 trucks through a high-threat area. Sensors allow as many as nine unmanned vehicles to follow a single manned vehicle across all tactical mobility levels, greatly reducing the number of vehicle crews put at risk.

Autonomous Aerial Resupply. This capability can augment the Leader/Follower technology as represented in the above scenario. The Joint Tactical Autonomous Aerial Resupply System (JTAARS) under development can be used in situations where time, threat, terrain, weather, or priorities make other resupply methods infeasible or unresponsive. Sustainers can load preconfigured supply packages (water, meals ready to eat, ammunition, medical supplies, batteries, etc.) on the JTAARS platform, which self-navigates to the supported Soldiers' position, unloads, and returns autonomously with any materiel to be retrograded.

Freeze-dried plasma. A number of developments related to blood components and blood component substitutes are being worked to save lives by providing blood products far forward and close to the point of injury. Freeze-dried plasma (FDP) can be used to treat acute trauma as far forward as a Role 2 medical facility with a forward surgical team since it can be shipped in a ruggedized container without requiring dry ice. Other medical products such as liquid bandages and skin glue are already far into development.

Additive manufacturing. Additive manufacturing (AM) is the process of joining materials to make objects from 3D-model data, usually layer upon layer, as opposed to subtractive manufacturing methodologies. AM will become a critical enabler for maintaining combat power and providing responsive sustainment to widely dispersed units by providing parts

that can be quickly and efficiently manufactured at the place of need. It can help reduce Class IX storage and distribution times and also be used to manufacture parts for obsolete equipment. In the future it will also have great utility for the Army in design and prototyping of equipment.

Condition-Based Maintenance Plus (CBM+). CBM+ tracks the health condition of equipment to enable maintenance to be done at the most opportune times and only when needed. It optimizes the tradeoff between maintenance costs and performance costs. CBM+ sensors embedded on individual major weapons systems record fault codes at the source of the problem and transmit the data to the consolidated database so maintainers know what to fix and managers can predict the real-time status of their equipment and schedule maintenance before catastrophic failures occur. This process increases availability and reliability while eliminating unnecessary maintenance.

Sustainment Analytics and Decision-making

All the functional technology discussed above and much more can only be employed effectively if sustainers understand what is and will be needed as well as where and when that need will be. The key to gaining that understanding is a networked cyber-protected integrated mission command and sustainment information system. This system relies on an integrated database constantly (and automatically whenever possible) updated with reliable and current data and on a set of ERP systems.

The Army is already on its way to establishing the ERPs with the Global Combat Support System-Army (GCSS-A), Logistics Modernization Program (LMP), General Fund Enterprise Business System (GFEBS), and Integrated Personnel and Pay System-Army (IPPS-A). These systems can have nearly immediate impacts on support to the force. For instance, properly leveraging the GCSS-A tactical capability can greatly reduce logistics demand on the battlefield due to the increased visibility and understanding it can provide. It enables both maneuver commanders and sustainers to see the battlefield more clearly and reduces the overestimation of requirements. That helps to shrink the large stockpiles of supplies kept on the battlefield due to lack of confidence in our ability to predict requirements. The reduced logistics footprint resulting from this approach will enhance force protection.

Ultimately, what transforms the data associated with our ERPs to a decision-making tool for commanders is business intelligence (BI). The initial operational capability for the Army Readiness Common Operat-

ing Picture (AR-COP) —the first true decision-making tool pulling data from our ERPs—is already fielded. It provides more up-to-date and rapid visibility of the sustainment status in an easy-to-understand visualization. Better and more tools are on the way. ERPs with associated BI employ algorithms to predict such events as when a piece of equipment or part will fail or when fuel will be required. The final goal is to get to prescriptive analysis where the tool not only predicts requirements but also recommends actions to take to avoid or ways to rectify problems.

However, despite initial progress on these systems, we will not realize the full potential of our ERPs or the vision in our opening scenario without changes to the Army's processes and mindset. Too often, ERPs and associated BI are viewed as business systems only—esoteric enterprise-level systems that warfighters don't need to be concerned with. In actuality, they are the pacing item for sustaining the battle at the tactical level. Without them, we are left with inadequate and untrusted visibility, iron mountains, and reactive sustainment.

Wisely implementing these sustainment warfighting systems will require the Army to be embedded in software development so we can leverage commercial R&D resources to get the capabilities we require rapidly and not have to react to and tailor whatever the commercial world provides us. Unlike a tank, software never goes into "a sustainment phase" when it is considered complete; it constantly evolves. Understanding this difference will require different funding and development processes to allow continuous improvements. Unfortunately, current Army acquisition procedures do not accommodate updating and improving software at the speed of war. The Army needs to leverage new software acquisition policies whenever possible and also establish a new, quicker way of making information system updates that will support new functions and improved battlefield capabilities.

The Future of Supporting Large-Scale Combat Operations

Back to the original question: What if we could anticipate readiness challenges and combat system failures before they happen and intervene to prevent the loss of combat power? We can and are progressing toward the kind of support Colonel Phillips receives in the beginning scenario. We can answer questions like where and when to refuel a tank and when to repack a parachute. We can automatically receive alerts before an engine fails and track the inventory of a tool room or arms room using sensors.

Implementing the initiatives discussed above will enable us to deliver increased readiness at lower cost and with a smaller sustainment footprint. Using big data visualizations and embedded BI, we can forecast demand precisely, provide real-time views of combat power and readiness, and give commanders the predictive and prescriptive capacity to employ advanced functional technology to surge readiness at decisive points during large-scale combat operations.

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