Influences of Coalition Construction

A Monograph

by

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The US military uses construction to build relationships with multi-national partners. United States-led coalitions develop infrastructure that enables strategy, extends influence, shapes operations, and facilitates tactical actions. Providing access, basing, and lines of communication, through infrastructure, Engineers enable the movement and maneuver of forces in a theater of operations. The Ledo Road of World War II and Operation Desert Shield are two examples of construction shaping military operations. Through comparison and considering the future, this monograph explores the role of construction and coalitions in operational art as the US Army transitions to large-scale ground combat operations.

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Abstract

Influences of Coalition Construction, by Major Kenneth M. Porter, 47 pages.

The US military uses construction as a means to build relationships with multi-national partners. United States-led coalitions execute massive construction projects that enable strategy, extend influence, shape operations, and facilitate tactical actions. Infrastructure development builds host nation capacity, meet political objectives, and enable military operations. Infrastructure provides access, basing, and lines of communication, essential factors in planning operations. Construction supports operational design by enabling the movement and maneuver of forces in a theater of operations. Contingency construction, military engineering, and contracted construction play a vital role in warfare by enabling the commander to execute the desired course of action by shaping the physical environment and setting conditions. This monograph uses a case study analysis focusing on the influence of construction in large-scale ground combat operations on creating coalitions, building partners, and military operations. The case studies are the construction of the Ledo Road in the China-Burma-India (CBI) Theater of World War II and the construction efforts during Operation Desert Shield of the 1990-1991 Gulf Conflict. Each case study discusses the theater strategy, construction challenges, and operational level impacts. Built into the discussion is how construction addresses challenges of geography and helps create a cooperative environment leading to coalition building. As the US Army transitions to large-scale ground combat operations, by comparing the case studies and considering the future, this monograph explores the role of construction and coalitions in enabling operational art.

Contents

Abbreviations

ARCENT	United States Army Central Command
BG	Brigadier General
CBI	China-Burma-India
C3IC	Coalition, Coordination, Communications, and Integration Cell
COL	Colonel
USCENTCOM	United States Central Command
DoD	Department of Defense
EAB	Echelons Above Brigade
FM	Field Manual
JP	Joint Publication
KKMC	King Khalid Military City
LOGBASE	Logistics Base
LTG	Lieutenant General
MEAPO	Middle East/Africa Projects Office
MG	Major General
MSR	Main Supply Route
SOS	Service of Supply
SWA	Southwest Asia
SUPCOM	Support Command
TAA	Tactical Assembly Area
TEC	Theater Engineer Command
USACE	United States Army Corps of Engineers

Figures

Chapter One: Introduction

Roads? Where we are going, we do not need roads.

—Dr. Emmett Brown, *Back to the Future*

Starting at the dingy bazaar of Ledo, into the jungles of Burma, the Chinese, British, Indian, Burmese, and Americans blasted a highway through the wilderness toward China. The Ledo Road traversed through the dense jungle, steep mountains, low swamplands, monsoon rains, and disease. The road transformed from a rough combat trace with hairpin curves and narrow wooden bridges to a road of crushed rock and steel Bailey Bridges.[1]

American and Chinese engineers worked together, pushing through northern Burma. Demolition crews blasted a path through the jungle for the bulldozers and road graders, following the survey teams. Chinese engineers installed culverts to help drainage and built corduroy roads of hand-hewn timbers. The corduroy roads made it possible for trucks to carry supplies and equipment to the men working ahead of the passable portion of the new road.[2]

The road created a yellow scar through the green jungle. Leading the Ledo Road project was US Army Engineer Colonel (COL) Lewis Pick. He told the men to keep working on the new line of communications into China by stating, “damn the rain, the jungle, the mud, the mosquitoes, the mountains, and the consequences.” The Allies pushed the road ahead at a pace once thought impossible. One officer got an order from COL Pick to build five miles in 24 hours. The soldiers said it is impossible, then they got their bulldozers and built the five miles. They said it was luck and cannot be done again. However, it would be done again, and again, regardless of circumstances, until trucks with Chinese and American drivers drive from Ledo to China.[3]

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[1] John McDowell, “Along the Ledo Road,” *CBI Roundup* (Delhi), November 23, 1944, http://www.cbi-theater.com/roundup/roundup112344.html.

[2] Ibid.

[3] “Hell, High Water Fail to Halt Big Job,” *CBI Roundup* (Delhi), February 24, 1944, http://www.cbi-theater.com/roundup/roundup022444.html.

Thesis

The United States relies on its international partners and Allies to support global force projection. This projection requires facilities and bases connected by a road network. Military construction has been, and continues to be, one of the ways to enable force projection through infrastructure improvement. United States-led coalitions execute massive construction projects that enable strategy, extend influence, shape operations, and facilitate tactical actions.

In addition to building infrastructure, the US military uses construction as a means to build relationships with multi-national partners. While operating outside our borders, it is essential for the United States to partner with other nations to meet political and military objectives. Infrastructure development is a means to build partner capacity and to enable military operations. Engineering projects provide both an immediate result in enabling military operations and a long-term result addressing host nation security, economic, and political concerns.

Access, basing, and lines of communication are essential factors in operational planning. Engineering construction efforts also support operational design by enabling the movement and maneuver of forces in a theater of operations. Contingency construction, Military Engineering, and contracted construction play a vital role in warfare, allowing the commander to execute the desired course of action by shaping the environment and setting conditions.

Monograph Structure

This monograph uses a case study analysis focusing on the influence of construction in creating coalitions, building partners, and military operations. The monograph introduces critical ideas and looks at construction effects in two different regions, in two different wars. A comparison of the two case studies demonstrates the similarities, their role in enabling operational art, and then consider future applications. The case studies are the Ledo Road in the China-Burma-India (CBI) Theater of World War II and infrastructure development in Operation Desert Shield in the 1990-1991 Gulf Conflict. Built into the discussion of these case studies is how

construction addresses challenges of geography and helps create a cooperative environment leading to coalition building.

These case studies focus on construction projects of military significance. Using case studies demonstrates or proves the thesis, requiring a strategic context. After addressing the context, the focus then transitions to discuss the geography of the construction projects and the importance of each project related to the strategic problem. Furthermore, this study requires a review of the actors involved and their interests. In closing, each study illustrates how those projects facilitated coalition operations.

Case Study Approach

In 1942, the US Army, with its Allies, constructed the Ledo Road through India and Burma to reopen ground lines of communication to China. This project linked the CBI theater, along 1,100 miles of road, and was believed critical to the US strategy against the Japanese. The Ledo Road traversed through difficult terrain in mountains and jungles of northern Burma. At the operational level, the construction also forced the Japanese Army to split their forces in the CBI theater.

In 1990, Operation Desert Shield saw the massive deployment of Coalition Soldiers to the Saudi Arabian Desert along the Kuwaiti and Iraqi borders. This build-up required an equal, if not greater, construction effort to support the force closure and enable movement into the Saudi Arabian desert. The construction effort during Operation Desert Shield led to the success of Operation Desert Storm by enabling VII Corps to stage in the Arabian Desert and later execute its fatal left hook against the Iraqi Army.

Both case studies begin by introducing the theater and the conditions that brought the US military to those regions. The examination provides insights into the military and political objectives of key actors and how those objectives aligned with US interests. An appreciation of the political environment offers an understanding of the strategic approach each nation had in the

theater. After the political environment, the focus transitions to the physical environment, the geography of each region. The terrain, climate, human geography, and existing infrastructure influenced both theaters in similar and different ways. Through visionary leaders, these projects overcome the physical environment to create opportunities in building the coalition and planning operations.

The case studies focus on construction projects that influenced large-scale ground combat operations. Discussing the challenges of both projects in terms of resources, access, and existing infrastructure provides a better understanding of how leaders overcame those challenges and some of the critical construction decisions. Some of those challenges were due to the multi-national environment. The next section focuses on the coalition environment and the unity of effort that enabled success. Gaining an understanding of the different actors' interests provides a framework to discuss the role of the coalition in the construction.

Lastly, the case studies focus on the operational level of war and how strategy links to tactics. The monograph utilizes the elements of operational art to describe the influences of the construction in both the CBI theater and Operation Desert Shield. The elements of operational art discussed are: operational reach, basing, and lines of operation, as well as the effect on tempo. The construction progress in both cases shaped the US operational approach and enabled strategic success.

In both cases, the coalition addressed considerations of the multi-national partners to strengthen the relationship. This monograph is an examination of United States-led coalition construction efforts that demonstrates how construction has shaped operations and supported strategic goals. The case studies discussed have a significant amount of declassified material available for research. Each case study also represents the US Army in large-scale ground combat operations. Given the current national security strategy focusing on great power competition, it is important to understand past operations provide context for future operations. Furthermore, both studies involve considerable engineering construction effort that shaped subsequent operations.

The combat operations that followed or paralleled the construction effort demonstrates the relationship between basing, operational reach, and tempo.

Another consideration in choosing these case studies is that they represent different eras in the way that the US military utilized Engineers. World War II construction focused on troop construction to provide much of the labor. The Gulf Conflict represented a shift away from troop construction to contracted construction, as the primary construction workforce. This shift is representative of the eras of each project. The globalization and interconnectedness that occurred after World War II gave rise to international construction companies that enable the United States to contract construction. In this new era, the military increasingly employs the private sector to execute traditional military projects. This shift is prevalent in today's environment and will likely operate in the future.

The Ledo Road and Operation Desert Shield are vital to understanding the options available for the US military against future adversaries in large scale ground combat operations. Both engineering efforts enabled successful operations and strategic victory by working with our multi-national partners and supporting maneuver commanders. The US military will continue to work with its partners and Allies in global operations. During operational planning, the required engineer effort cannot be underestimated, or come as an afterthought, as critical infrastructure is necessary to extend operational reach. Engineers will continue to provide access, enabling commanders to execute their plans by shaping and securing terrain while providing the foundation for global force projection. From this standpoint, what would the US military need to accomplish such a mission akin to the Ledo Road and Operation Desert Shield? Historian John Lewis Gaddis reminds us that we "interpret the past for the purposes of the present with a view to managing the future."[4]

[4] John Lewis Gaddis, *The Landscape of History: How Historians Map the Past* (New York, NY: Oxford University Press, 2004), 10.

Chapter Two: Construction and Coalitions: A Theoretical and Doctrinal Approach

> The principles of War are not, in the final analysis, limited to any one type of warfare, or even limited exclusively to war itself… but principles as such can rarely be studied in a vacuum; military operations are drastically affected by many considerations, one of the most important of which is the geography of the region.
>
> —President Eisenhower, *addressed the Corps of Cadets at West Point on April 22, 1959*

Construction and Theory

Military construction improves existing infrastructure enabling access to remote areas and regions. Military commanders throughout time have studied and influenced the effects of geography on military operations. From the ancient Romans who understood the importance of roads to unify their empire, military construction remains vital to the projection of military forces. Napoleon's use of multiple roads to converge in overland campaigns to the rapid ground movement through the integration of railways in the Franco-Prussian War, followed by the modern-day methods of force projection, has continuously evolved with technology. Time, distance, and modes of transportation determine how rapidly armed forces can respond to remotely located contingencies.[5] Construction and infrastructure enabled these Armies to put their plans into action. Armed forces then construct new roads and facilities when existing networks are inadequate.[6]

Military geography includes the study of the environmental influences on military operations.[7] This holistic approach includes the range of influences at work in any geographic location and the blending of physical factors. The factors incorporate the spatial relationships of

[5] John M. Collins, *Military Geography for Professionals and the Public*, Brassey's Edition. (Washington, DC: National Defense University, 1998), 24.

[6] Ibid., 221.

[7] COL(Retired) John Collins defines military geography as, "the concentrations on the influence of physical and cultural environments over political-military policies, plans, programs, and combat/support operations of all types in global, regional, and local contexts." Collins, *Military Geography*, 3.

physical characteristics of size, location, the shape of the land areas, and the presence and arrangement of intervening waters, the cultural factors of people, natural resources, along with transportation and communication networks.[8] The weather and climate are other significant geographic influencers. Almost every military activity on land, at sea, and in the air is affected by weather and climate.[9] Therefore, an understanding of the military geography of a region and the capabilities of the military forces leads to visualizing the construction requirements needed to improve existing infrastructure.

The ancient Romans invested heavily in the construction of roads to maintain control of their empire. By constructing more than 50,000 miles of roadway, on twenty-nine turnpikes, their road network radiated to every conquered province from Rome.[10] These roads enabled their legions to exercise control over territories and defend from invasions. Many of these roads were so well built modern military campaigns continue to use them. In the 1948 Arab-Israeli War, Israeli forces under Colonel Yigael Allon's Negev Brigade utilized a long-idle, and undefended, Roman road in the northern Sinai desert to outflank Egyptian forces.[11] The study of the local and regional geography was instrumental to the success of the Israeli forces through the identification of trafficable routes.

Military construction also improves existing infrastructure to enable access to remote areas and regions, addresses the military challenges of geography, and enables successful operations. From the ancient Romans to modern times, construction provided the necessary infrastructure to enable the commander's success. Military practitioners who purposefully make geography work for them are winners more often than not. Conversely, those who lack sound

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[8] Collins, *Military Geography*, 3–5.

[9] Ibid., 89.

[10] Ibid., 215.

[11] Trevor N. Dupuy, *Elusive Victory: The Arab-Israeli Wars, 1947-1949* (New York: Harper and Row, 1978), 105–111.

appreciation for the significance of geography succeed only by accident.[12] Modern warfare is so complex that commanders at every level must consistently manipulate geographic influences advantageously to gain a decisive edge.[13] Ultimately, military construction projects enable strategy, shape operations, and facilitate tactical actions.

Construction and Current Doctrine

The US military classifies most construction as General Engineering. General Engineering is the capabilities and activities, other than Combat Engineering, that modify, maintain, or protect the physical environment.[14] The focus is to provide construction support to the commander through planning, design, construction, operations, and maintenance of infrastructure for military use. Military construction occurs throughout the area of operations, at all levels of war, and during every type of military operation.[15] Each project meets a requirement in the operational environment. The measures of success in a construction project are time, cost, and quality. The US Army executes these projects through specialized engineer units, contracted construction, host-nation support, or by partnering with multi-national Military Engineers.

Specialized Engineer units in the US Army reside outside the divisional force structure in echelons above brigade (EAB) Engineer units. These technically oriented units provide specialized capabilities in horizontal and vertical construction support, infrastructure development, prime power, well drilling, and real estate management.[16] The US Army increased contracted construction following World War II. However, Soldiers executing troop construction finish in a faster amount of time, at a lower cost, but at minimally acceptable quality.

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[12] Collins, *Military Geography*, 9.

[13] Ibid., xxiii.

[14] US Department of Defense, Joint Staff, *Joint Publication (JP) 3-34, Joint Engineer Operations* (Washington, DC: Government Printing Office, 2016), I–2.

[15] US Department of Army, *Field Manual (FM) 3-34, Engineer Operations* (Washington, DC: Government Printing Office, 2014), 1–2.

[16] Ibid., 1–9.

There are three echelons of current Engineer headquarters units: the Theater Engineer Command (TEC), the Engineer Brigade, and the Engineer Battalion. The TEC supports a geographic combatant command when assigned to a theater army by providing mission command of assigned Engineer Brigades.[17] A TEC is in the Reserve Component and requires mobilization. It is a military planning and coordinating headquarters with the ability to provide contract and real estate oversight. The Engineer Brigade supports a corps for most operations and controls up to five Engineer Battalions.[18] The Engineer Brigade can provide support for a corps or theater army, but lacks the planning and coordinating ability of a TEC. An Engineer Battalion is the unit of action, executing the General and Combat Engineer tasks for the supported theater army down to the brigade. The current model is a tailored force approach, which brings separate units together for a specific mission and duration.

As the military reduced its troop construction capabilities, it increased its ability to execute contract construction. Contract construction is the award of construction contracts to private companies in support of military operations.[19] Authorities are granted from the Secretary of Defense to Department of Defense (DoD) Construction Agents and standing contingency contracts to execute the design and construction of US military facilities. The US Army Corps of Engineers (USACE) is the designated contract construction agent for the US Army. USACE and its contractors are a force multiplier, allowing Military Engineers to concentrate on missions in high-threat areas.[20] Therefore, contracted construction reduces military demand while providing the highest quality product. However, the higher quality comes with a higher cost, longer time to completion, and execution limited to low-risk areas.

Multi-national Military Engineers integrate with US Army Engineers through political

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[17] US Department of Army, *FM 3-34, Engineer Operations*, 1-9.

[18] Ibid., 1–10.

[19] US Department of Defense, Joint Staff, *JP 3-34, Joint Engineering Operations*, I–10.

[20] Ibid., D-1.

agreements. In addition to multi-national Engineers, host nations also increase engineering capability. The host nation provides a range of support to military forces, which may include access, real estate, materials, and laborers. Contracted construction is different from the practice of using local laborers. Local labor augments the Military Engineer force. Using local labor to assist military units in construction, is historically the most utilized method. Examples include the ancient Roman roads, U.S. Grant's Canal during the Civil War, Operation Desert Shield, and the Ledo Road. Utilizing local labor is a long-established practice, rooted in time and cost savings.

Military Engineers organize to execute construction tasks based on geography, capabilities, and force structure. The physical geography of the location, size, and shape of landmasses and large bodies of water strongly influence military capabilities, limitations, and vulnerabilities.[21] In the current tailored force, commanders must understand the military objectives and the effects of geography in order to design the best plan or program for execution. This understanding leads to military construction that capitalizes on available resources to improve existing infrastructure and enable mission success.

Chapter Three: Case Study: The Ledo Road

> The Ledo Road is one of the most difficult engineering jobs ever undertaken, worse even than the Alcan Highway across Canada and Alaska. Mountains, jungles, humidity, heat, rains, insects - to say nothing of the Japanese - all are pulling against Engineer units working on the road. Nevertheless, I found it progressing exceptionally fast. The Engineers, in fact, practically merge with the combat troops as the bulldozers move right in where the mortars were. And the Japanese do not overlook the Engineers when shooting. The terrible Burma monsoons are about beginning now. Naturally, they will mean knee-deep mud and road washouts, hindering progress temporarily. But as the Chief of Engineers, Maj. Gen. Eugene Rybold, recently said: 'Victory seems to favor the side with the greater ability to move dirt.' I found our side moving plenty of dirt and plenty of Japanese along with it.
>
> —LTC George H. Taylor, "Engineer Praises Ledo Roadsters in US Radio Broadcast"

[21] Collins, *Military Geography*, 24.

In March 1942, the Japanese 15th Army occupied southern Burma, and most importantly, the port city of Rangoon. In April and May, the Japanese advanced their four divisions north up the Sittang and Irrawaddy Valleys, and they overwhelmed the uncoordinated defense established by the British, Indian, and Chinese forces.[22] By the end of May 1942, the Japanese forced the Allies out of Burma into India and China (See Figure 1). The start of the monsoon season and the extended lines of communication of the Japanese 15th Army stopped the advance in Burma. The Japanese closed the Burma Road to the Allies, cutting off ground supplies to China. Military aid to China now relied on the "Hump" flights from northern India into China, drastically reducing the much-needed supplies.[23] The United States convinced that it needed to keep Chiang Kai-shek in the war, required options to increase the build-up of supplies to the Kuomintang Army.

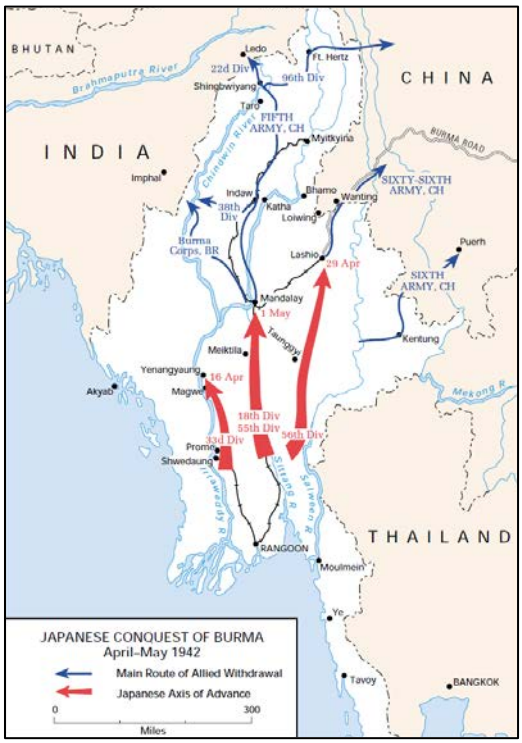

Figure 1. Map of Japanese Conquest of Burma April-May 1942. Taken from: Clayton R. Newell, *Burma, 1942*, CMH 72-21 (Washington, DC: Center of Military History, US Army, 1995), 20.

[22] Charles F. Romanus and Riley Sunderland, *Stilwell's Mission to China*, The China-Burma-India Theater CMH 9-1 (Washington, DC: Center of Military History, US Army, 1953), 105.

[23] "Hump" flights were US military flights from India, over the lower Himalaya mountains foothills in northern Burma, to China. These flights supplied Chiang Kai-shek with US lend-lease equipment. The flights were forced to fly the "hump" to avoid Japanese forces in Burma.

Strategic Context

In the years before the bombing of Pearl Harbor, the United States had steadily increased its involvement in China's fight against Japan. Starting in 1937, the United States loaned money to China for nonmilitary needs.[24] Generalissimo Chiang Kai-Shek used some of the financial aid to fight the invading Japanese forces. So in April 1941, President Franklin D. Roosevelt approved $125 million for lend-lease aid to China.[25] The lend-lease aid increased support by providing military equipment and training to the Chinese military. The President declared the defense of China to be vital to the defense of the United States.[26] The combination of the lend-lease aid and the presidential declaration resulted in the formation of the American Military Mission to China (AMMISCA).

The War Department established the AMMISCA to execute lend-lease support. Upon arrival in China, the military mission needed to improve the methods of transporting materials to China and training on equipment.[27] The team focused on improving the existing road, rail, and airfield infrastructure from the port at Rangoon, Burma to Yunnan, China. The military mission provided engineering expertise to the construction of airfields to support lend-lease transactions. Once the United States formally declared war on Japan, these organizations served as the framework for US Army Forces in China, Burma, and India.

The War Department picked Lieutenant General (LTG) Joseph W. Stilwell to lead the US Army Forces in China, Burma, and India. The establishment of the command came out of the ARCADIA Conference in Washington, D.C., in January 1942. Lieutenant General Stilwell would

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[24] Leslie Anders, *The Ledo Road: General Joseph W. Stilwell's Highway to China* (Norman, OK: University of Oklahoma Press, 1965), 6.

[25] Karl Christian Dod, *The Corps of Engineers: The War Against Japan*, United States Army in World War II. The Technical Services CMH 10-6 (Washington, DC: Center of Military History, US Army, 1966), 389.

[26] Maurice Matloff and Edwin M. Snell, *Strategic Planning for Coalition Warfare 1941-1942*, The War Department CMH 1-3 (Washington, DC: Center of Military History, US Army, 1953), 63.

[27] Anders, *The Ledo Road*, 6.

also serve as chief of staff to Generalissimo Chiang Kai-shek as part of his dual role.[28] As one of his first actions in command, LTG Stilwell established the Services of Supply (SOS) organization. Major General (MG) Raymond Wheeler, an Army Engineer, was selected to lead the SOS and to "initiate required action to push through to General Stilwell all equipment" and to investigate and report requirements, difficulties, and opportunities.[29] Major General Wheeler oversaw all US Army construction in India and Burma.[30] To manage the theater construction efforts, MG Wheeler divided the theater into regional commands (See Figure 2). Until the end of 1942, most projects across the command focused on airfield construction, supply facilities, and port facilities. The priority of the US Army forces was to reopen the ground lines of communication to China.

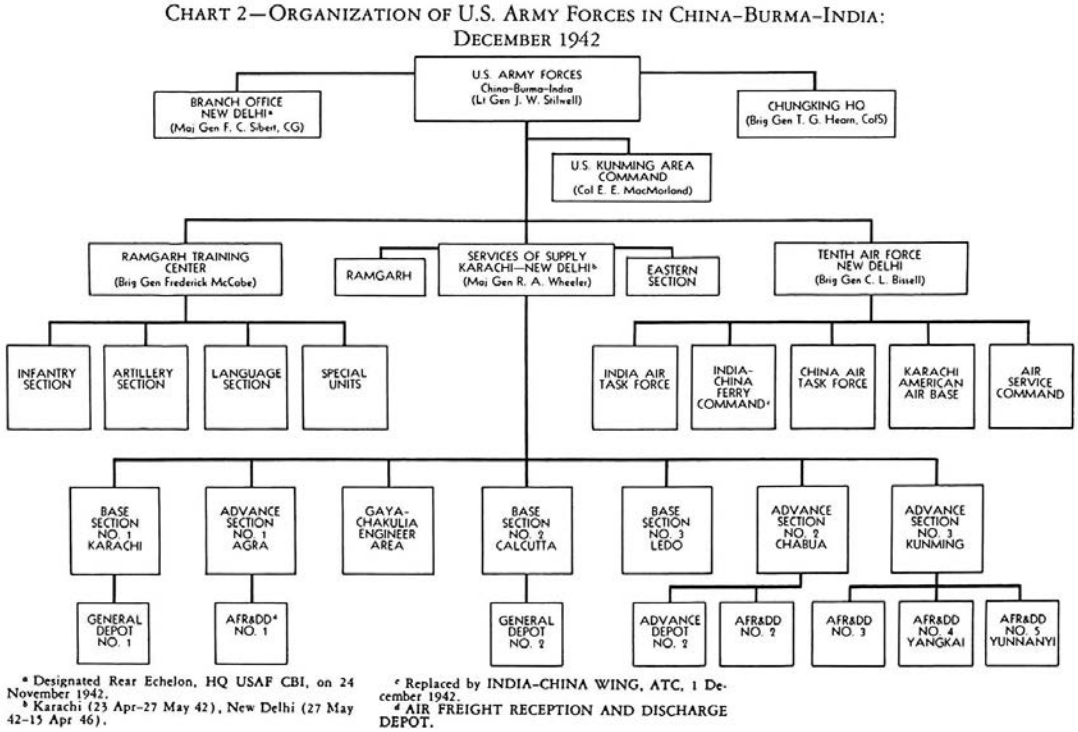

Figure 2. Organization of US Army Forces in CBI, December 1942. Taken from Charles F. Romanus and Riley Sunderland, Stilwell's Mission to China, The China-Burma-India Theater CMH 9-1 (Washington, DC: Center of Military History, US Army, 1953), 195.

[28] Matloff and Snell, *Strategic Planning for Coalition Warfare 1941-1942*, 140.

[29] War Department, "History SOS, China-India-Burma" (World War II Operational Documents, 1942), 4.

[30] Dod, *The Corps of Engineers*, 395.

In August, General George C. Marshall, US Army Chief of Staff, called for an offensive into northern Burma to reopen land communications and keep China in the war effort.[31] Initially, LTG Stilwell considered forcing the Japanese out of Burma by retaking Rangoon and reopening the Burma Road. The British claimed they could not support such an offensive until March 1943.[32] The next option was to retake northern Burma using Stilwell's assigned Chinese Divisions. In October 1942, Lieutenant Colonel (LTC) Frank D. Merrill suggested building the Ledo Road. At that time, LTC Merrill served as LTG Stilwell's Operations Officer. He envisioned the road would serve as a simultaneous supply line for a campaign along the route.[33] The next day LTG Stilwell directed MG Wheeler to start building the road. Starting in Ledo, the road would advance down the Hukawng and Mogaung Valleys to Myitkyina and link with the old Burma Road.[34] The route pushed through some of the most challenging terrain and conditions.

Geography

The geography of the CBI theater presented unique challenges to the Allied Command. The CBI theater is roughly the same size as the United States and has a population of 900,000,000, almost half the human race.[35] Isolating India from China is the Himalayan mountain range, and the 9000-foot-high spurs of that range extend into northern Burma.[36] With the Japanese holding Burma by May 1942, supply over the "Hump" remained the only alternative.

Furthermore, the supplies coming from the United States took roughly two months to arrive in theater.[37] The Irrawaddy is the primary river system in Burma, generally running north-

[31] Dod, *The Corps of Engineers*, 404.

[32] Anders, *The Ledo Road*, 15.

[33] Dod, *The Corps of Engineers*, 405.

[34] Romanus and Sunderland, *Stilwell's Mission to China*, 231.

[35] War Department, "History SOS," 6.

[36] Dod, *The Corps of Engineers*, 393.

[37] War Department, "History SOS," 6.

south as it drains the northern and western parts of the country. The mountainous and jungle frontier between Burma and India was uncharted, not connected by road or rail.[38] The lack of infrastructure further isolated these countries from each other limiting mobility. At the operational level, weather and disease posed additional challenges to the physical environment.

The tropical climate, with excessive rainfall at certain times of the year, made military operations difficult. The monsoon season, spanning from May to October, brings over 100 inches of rain a year in some locations.[39] The world's most torrential rainfall, more than 400 inches a year, fell in the Khasi Hills of Assam.[40] The Assam region is the region of the proposed Ledo Road. The rainfall had a significant impact on road construction, causing the road to wash out with river flooding, destroying bridges. Diseases, such as cholera, plague, typhus, smallpox, and dysentery, were commonplace and affected the local construction force. These diseases spread quickly throughout India and Burma due to unhealthy, unsanitary conditions.[41] From a military perspective, malaria created the worst health issue for the force.[42] The Allied forces needed solutions to work within the environment. Addressing the challenges of geography was only just the start of issues constructing the Ledo Road.

Building the Ledo Road

The construction of the Ledo Road presented several challenges to the Engineers leading the project. The CBI was the 'shoestring theater' and last in the Allied priorities behind the European theater and the Pacific theater. For a short time after the QUADRANT Conference, the theater received shipments of requested supplies and personnel.[43] However, that priority quickly

[38] Dod, *The Corps of Engineers*, 393.

[39] War Department, "History SOS," 6.

[40] Dod, *The Corps of Engineers*, 393.

[41] War Department, "History SOS," 6.

[42] Ibid.

[43] Dod, *The Corps of Engineers*, 389.

shifted to other theaters. Despite these challenges, the road opened in January 1945 and officially completed in April 1945 (See Figure 3). The Ledo Road team overcame not only the environmental and natural obstacle challenges but the project challenges of competing requirements, phasing, and equipment shortages.

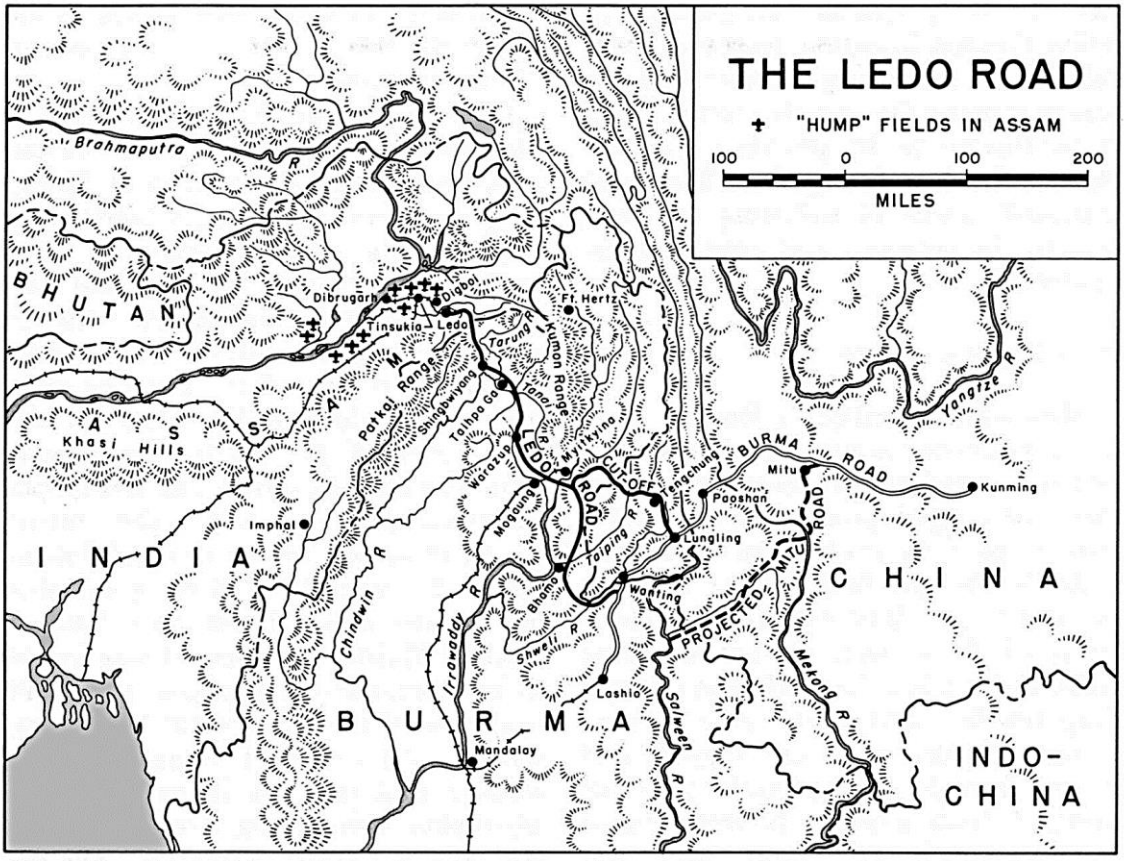

Figure 3. Map of the Ledo Road. Taken from: Karl Christian Dod, *The Corps of Engineers: The War against Japan*, United States Army in World War II. The Technical Services (Washington, DC: Center of Military History, US Army, 1966), 474.

Work on the road was not always smooth or continuous due to competing requirements for Engineers and changes in prioritization of projects. The success of road construction depended on the concurrent construction of facilities and bases along the route. By late 1942, and into early 1943, the 45th Engineer General Service Regiment and the 823d Engineer Aviation Battalion consolidated their units at Ledo from across India. Since the units arrived in July 1942, they

worked on airfield and facility construction across the India theater.[44] The competition for Engineer resources, between road and airfield construction, remained for the duration of the project. CPT Claire L. Chennault, now a Brigadier General, continuously requested to the War Department for the construction of airfields to support the "Hump" flights to China over the construction of the Ledo road.[45] Support for combat troops provided another external competition for resources. Engineers provided support to operations of "Merrill's Marauders" and Brigadier Orde Wingate's "Chindits" to repair runways and conduct river crossing operations.[46] These requirements took Engineers and equipment off the Ledo road and slowed construction progress. Internal to the project, the summer monsoon seasons forced Engineers to stop forward progress on the road to repair sections damaged by heavy rains. As the Engineers repaired road sections, they also constructed forward depots and camps to preposition supplies for the coming dry season.[47] The competing requirements and the weather effects on construction drove the phasing and sequence of actions in building the Ledo Road.

In hindsight, the Ledo Road project had several distinct phases. Each phase took a different approach to the methods of construction. Initially, the project started under British control. During this phase, the British Royal Engineers, with five thousand native laborers, started the construction of two roads from Ledo.[48] In November 1942, following the Joint Planning Committee sessions, the leadership of the project transitioned to Colonel John C. Arrowsmith, commander of the US Army 45th Engineer General Service Regiment.[49] Colonel Arrowsmith approached the project in a linear method. The lead Engineer Element cleared the general path

[44] Dod, *The Corps of Engineers*, 398.

[45] Ibid., 418.

[46] Dod, *The Corps of Engineers*, 444.

[47] Anders, *The Ledo Road*, 143.

[48] Ibid., 15.

[49] Barry W. Fowle, ed., *Builders and Fighters: US Army Engineers in World War II* (Fort Belvoir, VA: Office of History, US Army Corps of Engineers, 1992), 330.

forward, followed by culvert emplacement, road widening, ditching, and ending in the graveling or surfacing element.[50] By February 1943, the road extended thirty-eight miles from Ledo to the Burma border, at Pangsau Pass.[51] This progress was better than the British, but not good enough. The goal was to reach the town of Shingbwiyang, still eighty miles ahead, before the start of the monsoon season in May. By August 1943, the road had still not made it to Shingbwiyang. Due to the lack of aggressive leadership and construction progress, LTG Stilwell replaced Colonel Arrowsmith with Brigadier General (BG) Lewis A. Pick.[52]

In order to increase speed and efficiency on the project, BG Pick moved his headquarters forward along the route, instituted round-the-clock construction, and supplied the forward units with field lighting. When shortages of electric lighting occurred, the road crew ignited wicks in buckets of diesel oil lighting the way.[53] BG Pick also increased the rate of construction by positioning supplies forward and maximizing unit effectiveness. By leapfrogging units on the route, the Engineers could continuously clear areas for the road crews. By January 1944, the road reached Shingbwiyang and transitioned to the next phase (See Figure 4).

[50] Anders, *The Ledo Road*, 33.

[51] Dod, *The Corps of Engineers*, 411.

[52] Fowle, *Builders and Fighters*, 334.

[53] Anders, *The Ledo Road*, 89.

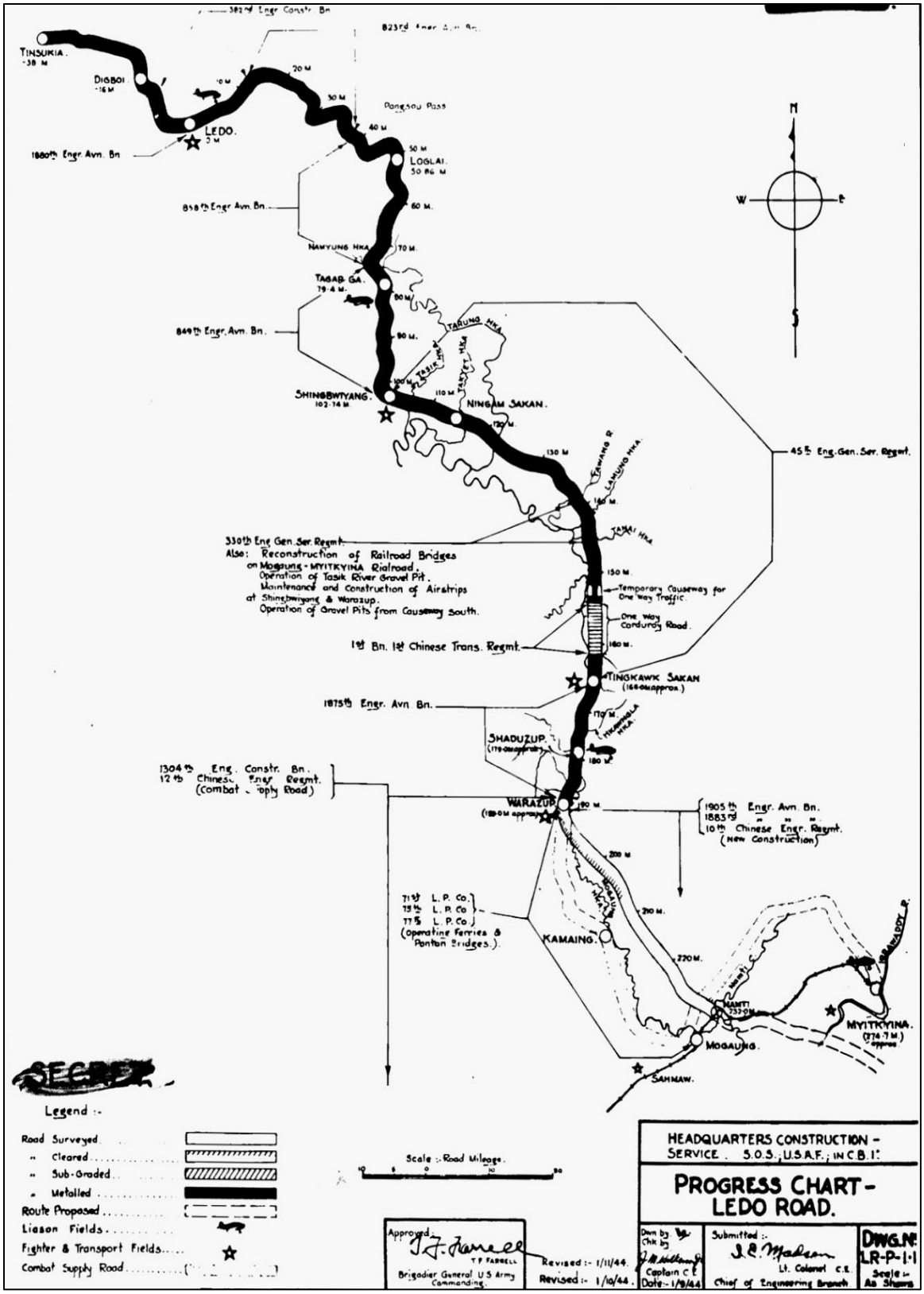

Figure 4. Organization of Engineer Forces 1944. Taken from: War Department, "History SOS, China-India-Burma" (World War II Operational Documents, 1942), 229.

The next phase of construction was to reach Myitkyna and cross the Irrawaddy River. In the drive to Myitkyna, the Engineers provided considerable support to combat forces of "Merrill's Marauders" and the 22nd and 38th Chinese Divisions (See Figure 5).[54] This phase also focused on much-needed equipment maintenance. By January 2, 1944, BG Pick declared that their bulldozers had little life left in them, and there is not enough equipment to keep the road force working around the clock.[55] The shortage of engineering equipment and lack of maintenance finally caught up. Concurrent with this phase was the improvement of the existing Burma Road from Wanting, China, to Myitkyna that focused on improving the road and bridges on the route.

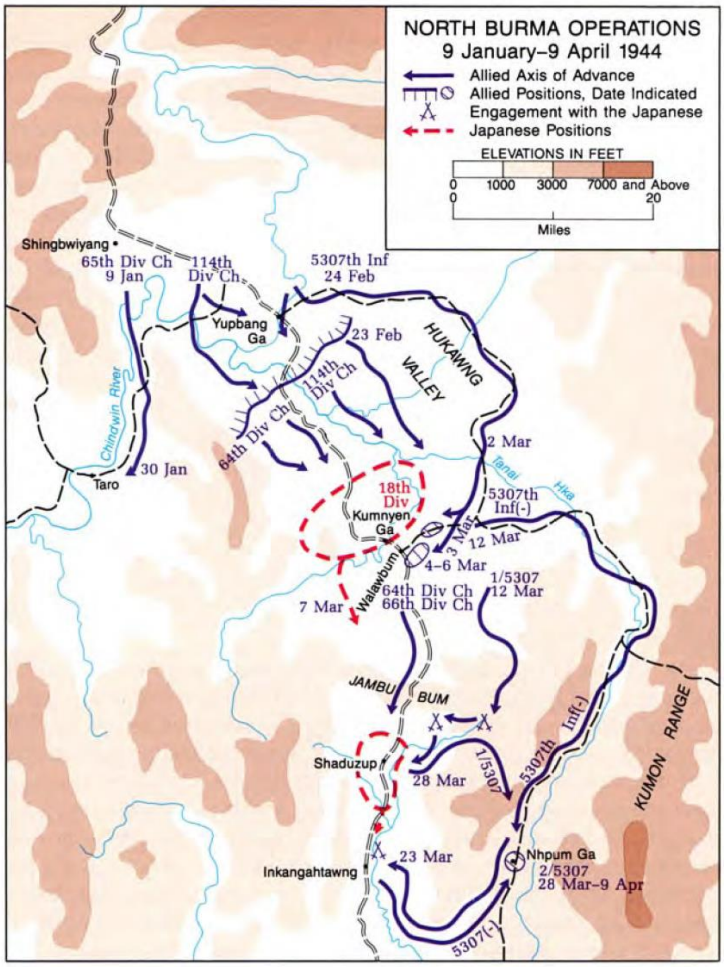

Figure 5. North Burma Operations along Ledo Road 1944. Taken from: David W. Hogan, *India-Burma*, CMH 72-5 (Washington, DC: Center of Military History, US Army, 1992), 15.

[54] Fowle, *Builders and Fighters*, 338.

[55] Anders, *The Ledo Road*, 141.

Building the Alliance

The construction of the Ledo Road is analogous to the overall strategic aim of the United States in the China-Burma-India Theater. The United States was working toward unifying its alliance with both China and the United Kingdom. The United Kingdom still a colonial power in India, valued its relationship with India more than China. The United States valued leveraging China's population and geographic proximity to Japan as a strategic ally to defeat Japan. One of the first challenges for LTG Stilwell was convincing the United Kingdom to support the Ledo Road project and the value of accessing northern Burma.[56] The Chinese backed the Ledo Road project because it promised to increase lend-lease supplies. Overall, the success of the project relied on the support from the United Kingdom, China, India, and local Burmese populations.

Lieutenant General Stilwell, with his multiple command positions and relationships, was key to building and maintaining the unity of effort in the theater. Working in a multinational setting, LTG Stilwell desired to forge cohesive teams.[57] He served as Chief of Staff to Chiang Kai-shek as the US Forces Commander in India and Burma under the Field Marshal Sir Archibald P. Wavell. His positions allowed him to influence both commands. The Ledo Road fell under MG Wheeler, commander of Service of Supply. Major General Wheeler faced challenges in intra-theater transit of supplies, equipment, and lend-lease stocks and providing Engineer forces for road and airfield construction.[58] Working with the British and Indian government, MG Wheeler provided local supplies and local labor to the projects.

A significant challenge facing the Ledo Road was the over-promising and under-delivering of workers for the project by coalition partners. Throughout the project, each coalition partner promised more labor force than they provided. Initially, the native labor force continued

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[56] Anders, *The Ledo Road*, 14.

[57] Barbara W. Tuchman, *Stilwell and the American Experience in China, 1911-45* (New York: Grove Press, 1970), 293–4.

[58] War Department, "History SOS," 5.

work on the road after the British Royal Engineers left the project. The native laborers arrived from across India and organized into various units depending on the contract agreement. The British continued to lead some of the organizations and organized local porters.[59] As the project progressed, Chinese units joined the effort from the Ramgarh training area. When the road reached Burma, local Burmese labor from the different tribal areas along the route joined the team. In China, the provincial governors provided local laborers to improve the Burma Road.[60] Construction of the Ledo Road was as much a coalition effort as the operations to defeat the Japanese in Burma.

Operational Art

The Ledo Road supported operations to defeat the Japanese through the movement and maneuver of Allied forces into northern Burma. By shaping the terrain, the road set the conditions for the Allied forces under LTG Stilwell to increase the operational reach, shape the lines of operation in the theater, and maintain operational tempo. The road concurrently drove toward the endstate of reopening the ground lines of communication to China, linking tactical actions to the US strategy.

Lieutenant Colonel Merrill was the first to identify the value of the road in 1942. He recognized that the completed portion could be a supply line during the campaign.[61] Brigadier General Pick also understood the significance of the road for basing and operational reach. Brigadier General Pick built bases and lines of communication to support the offensive from Ledo to Myitkyina.[62] Shingbwiyang became the first forward base along the route. The base and airfield at Shingbwiyang, established in January 1944, was 103 miles from Ledo. The road

[59] Anders, *The Ledo Road*, 38.

[60] Dod, *The Corps of Engineers*, 415.

[61] Ibid., 404.

[62] Joseph Warren Stilwell and Theodore H. White, *The Stilwell Papers* (New York, NY: W. Sloane Associates, 1948), 97.

provided supplies to British Brigadier Orde Wingate's Chindits, now Brigadier General Frank Merrill's "Marauders," as well as the 22nd and 38th Chinese Divisions during their campaigns in the Hukawng and Mogaung valleys.[63] As the Ledo road reached Myitkyina in May 1944, the "Marauders" with the Chinese attacked and seized the airfield.[64] The Engineers landed on gliders at night to repair the runway for larger aircraft.[65] Myitkyina then became the next major forward supply area extending operational reach.

The lines of operation of the combined Chinese and American forces in Burma followed the progress of the Ledo Road closely (See Figure 6). Initially, Chinese infantry operations focused on clearing the Japanese from the area ahead of the road crew. Simultaneously, Wingate's Chindits cut communications of the Japanese 18th Division's northern front.[66] "Merrill's Marauders" operated in coordination with the Chinese 22nd and 38th Divisions to clear the way for the construction of the Ledo Road.[67] The lines of operation for the northern front supported the construction progress of the Ledo Road.

[63] Charles F. Romanus and Riley Sunderland, *Stilwell's Command Problems*, The China-Burma-India Theater CMH 9-2 (Washington, DC: Center of Military History, US Army, 1956), 42.

[64] Adopting a similar model to Brigadier Wingate, the US Army formed the 5307th Composite Unit (Provisional), called "Merrill's Marauders," to execute long-range penetration missions.

[65] Dod, *The Corps of Engineers*, 454.

[66] William Joseph Slim, *Defeat Into Victory* (London: Macmillan, 1986), 251.

[67] Center of Military History, ed., *Merrill's Marauders, February-May 1944*, CMH 100-4 (Washington, DC: Center of Military History, US Army, 1990), 1.

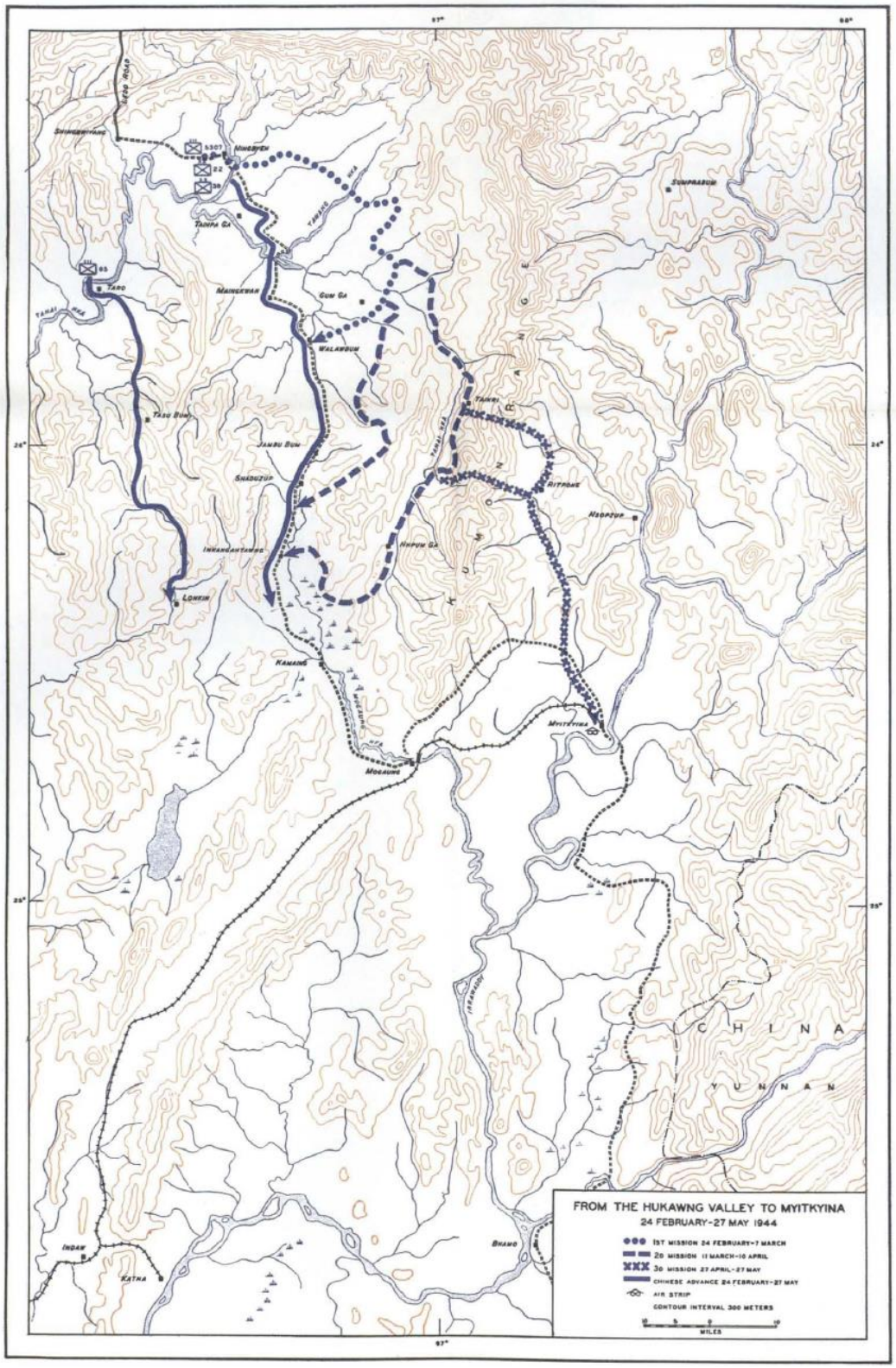

Figure 6. Map of Merrill's Marauders from February to May 1944. Taken from: Center of Military History, ed., *Merrill's Marauders, February-May 1944*, CMH 100-4 (Washington, DC: Center of Military History, US Army, 1990), 118.

As the Ledo Road with the Chinese and US forces approached Myitkyina, the British forces also attacked south through Imphal, in Central Burma. Simultaneously, the Chinese Y-Force also attacked into Burma from Yunnan. The three-front strategy prevented the Japanese 18th Army from massing its forces against the Allies.[68] The Chinese and US forces siege at Myitkyina kept the Japanese from consolidating their forces and shaped British operations at Imphal.[69] The Ledo Road enabled this multi-pronged approach.

The Ledo Road enabled Allied operations in Burma by shaping the physical environment. The construction effort built relationships between coalition partners and met the strategic objective of keeping Chiang Kai-shek in the war against Japan. As the road traversed through the mountains and jungle of northern Burma, it enabled movement and maneuver of allied forces into Burma. Lines of operation developed from the construction progress as the US forces maintained operational tempo against the Japanese. As such, the Ledo Road played a vital role in enabling strategy, shaping operations, facilitating tactical actions, and extending influence with multi-national partners.

Chapter Four: Case Study: Operation Desert Shield

> As Soldiers from the 82nd Airborne Division disembarked the plane onto the King Abdul Aziz Airbase in Dhahran, they were met with a hot wall of humidity and 140-degree heat. The soldiers stood on the tarmac, looking for direction on where to go next with limited shelter from the sun. The transport planes continued to arrive, pouring hundreds of more troops onto the ground, and the busses at the airfield did not know where to take them. The limited space that was secured by the US Military Training Mission of Saudi Arabia (USMTM) and their Saudi military counterparts was filling up too quickly.
>
> —LTG William G. Pagonis, *Moving Mountains*

The date was August 8, 1990, six days after Saddam Hussein invaded Kuwait. Operation Desert Shield was underway, and the coalition needed options. The initial problems of

[68] Dod, *The Corps of Engineers*, 404.

[69] Slim, *Defeat Into Victory*, 273–5.

transportation, security, and available space for housing, supply storage, and work areas only grew as coalition forces flowed into northeast Saudi Arabia. Operation Desert Shield was as much a feat of coalition construction, as it was a feat of logistics and combat execution. Basing became the primary issue. The coalition needed to get the basing strategy correct because these decisions would shape any subsequent operation. As planners developed the campaign, the basing locations would drive the lines of operation, operational tempo and reach, and the operational phasing and transitions decisions in campaign design.[70] The successful transition to Operation Desert Storm on January 17, 1991, and the defeat of Iraqi forces on February 28, 1991, was, in part, a result of the construction effort in the coalition basing strategy.

Strategic Context

> He who eats Kuwait for breakfast is likely to ask for something else for lunch.
>
> —Prince Bandar bin Sultan Al Saud, Saudi Arabia's Ambassador to the United States

The August 2, 1990, Iraqi invasion of the sovereign Kingdom of Kuwait created an unprecedented global response. The Iraq army's swift defeat of the Kuwaiti military surprised the major powers.[71] Saddam Hussein quickly established control of Kuwait and the Iraqi army moved to positions along the Kuwait-Saudi Arabia border. The United Nations immediately condemned Iraq's actions.[72] The North Atlantic Treaty Organization, the League of Arab Nations, and the Gulf Cooperation Council also convened and responded to Iraq's aggression. Everyone agreed that the invasion threatened local, regional, and global security.

The United States and the Kingdom of Saudi Arabia had no formal alliance. However, they shared a history of economic cooperation and military assistance. In 1943 the US

[70] US Department of Army, *Field Manual (FM) 3-0, Operations* (Washington, DC: Government Printing Office, 2017), 1–20.

[71] Lawrence Freedman and Efraim Karsh, *The Gulf Conflict, 1990-1991: Diplomacy and War In the New World Order* (Princeton, NJ: Princeton University Press, 1992), 4.

[72] Freedman and Karsh, *The Gulf Conflict, 1990-1991*, 81.

administration declared that the defense of Saudi Arabia was a vital national interest and dispatched the first US military mission as well at USACE to the region.[73] This relationship was further cemented in the 1951 mutual defense assistance agreement, establishing the permanent United States Military Training Mission in Saudi Arabia.[74] Therefore, it was no surprise that the United States accepted the Saudi Arabian invitation to assist the Arab forces.[75] The sovereignty of Saudi Arabia, the United States' long-standing political, economic, and security partner, was threatened. There was an established trust between the two nations that proved vital when Saddam invaded Kuwait.

United States Army Corps of Engineers started working in Saudi Arabia in 1951, providing construction support to infrastructure development until the late-1980s (See Figure 7).[76] In 1965, Saudi Arabia and USACE signed the Engineer Assistance Agreement. This agreement started the construction of four military cities across Saudi Arabia.[77] One of the military cities was the King Khalid Military City (KKMC) near Iraq/Kuwait border, which became increasingly important during Operation Desert Shield.[78] The Engineer Assistance Agreement helped build relationships between the two nations. It also established relationships between USACE, the Saudi Arabian government officials, and local construction companies. The investment of

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[73] Helen Chapin Metz and Library of Congress, eds., *Saudi Arabia: A Country Study*, Fifth edition., Area Handbook Series 550–51 (Washington, D.C: Library of Congress, 1993), 222.

[74] Ibid., 223.

[75] Khaled bin Sultan and Patrick Seale, *Desert Warrior: A Personal View of the Gulf War by the Joint Forces Commander*, 1st ed. (New York: HarperCollins, 1995), 18.

[76] The first USACE project in Saudi Arabia was the construction of the airfield at Dhahran. This project was followed by the construction of the Dhahran civil air terminal as the airfield became an essential stopover for US military aircraft. Metz and Library of Congress, *Saudi Arabia*, 222-223.; Janet A. McDonnell, *Supporting the Troops: The US Army Corps of Engineers in the Persian Gulf War* (Washington, DC: Office of History, US Army Corps of Engineers, 1996), 33.

[77] Metz and Library of Congress, *Saudi Arabia*, 254.

[78] Other important USACE infrastructure projects during this time were: he Headquarters for the Royal Saudi Air Force, the King Abdulaziz Military Academy, the Port facilities at Ras al Mishab, HQ complex and officer's club for the Ministry of Defense and Aviation, Saudi Naval facilities to include the construction at Al Jubayl. McDonnell, *Supporting the Troops*, 34. Stephen A. Bourque, *Jayhawk! The VII Corps in the Persian Gulf War*, CMH 70-73-1 (Washington, DC: Department of the Army, 2002), 53.

personnel and expertise on the construction of facilities in Saudi Arabia proved invaluable in late 1990 and early 1991.

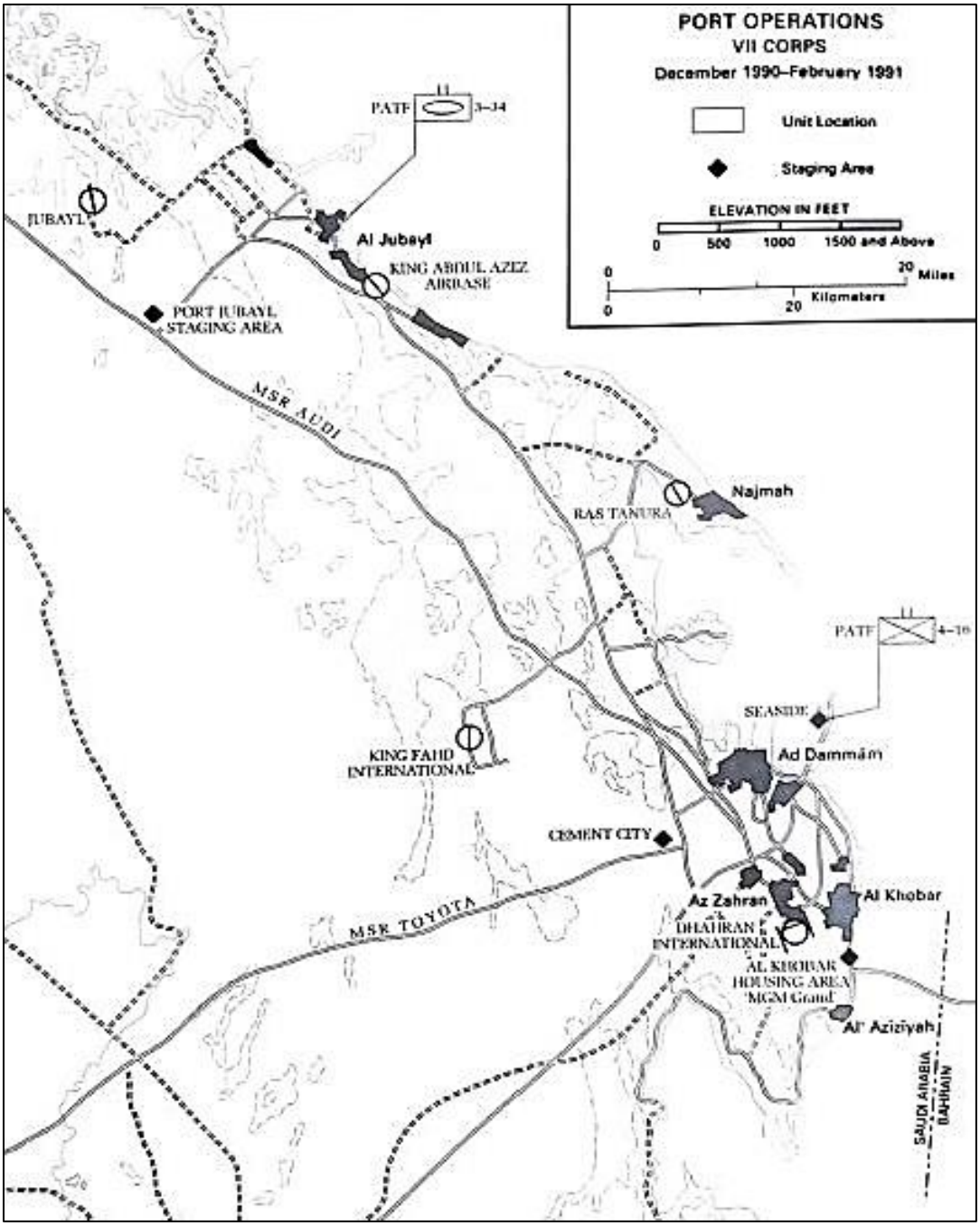

Figure 7. Map of Saudi Arabian Infrastructure. Taken from Stephen A. Bourque, *Jayhawk! The VII Corps in the Persian Gulf War*, CMH 70-73-1 (Washington, DC: Department of the Army, 2002), 50.

The coalition militaries used the Dhahran Airport and the Al Jubayl port as ports of debarkation. In addition to the port of debarkation facilities, the KKMC proved essential to the

coalition. Situated at the "hinge" of the frontiers of Saudi Arabia, Iraq, and Kuwait, KKMC lay astride the natural invasion route into the Kingdom from the north of Wadi al-Batin.[79] The geographic location made it an ideal location to establish the coalition headquarters as well as a sustainment and transportation hub.[80] The Saudi Arabian investment in modern military facilities set conditions for the arrival and sustainment of the coalition for the First Gulf War.[81] Further, these existing facilities made it possible to avoid many initial logistical problems.

The United States Central Command (USCENTCOM) activated Plan 1002-90, focused on the defense of Saudi Arabia from a northern aggressor. The initial estimate to implement Plan 1002-90 required four months and 250,000 service members.[82] In June 1990, USCENTCOM exercised the plan during "Internal Look 90."[83] Planning assumptions from the exercise proved to have significant consequences. The assumptions resulted in a lack of available transportation and real estate to support US forces as they arrived in Saudi Arabia. The focus of force buildup on combat troops over Logistics and Engineers did not help the problem.[84] These issues became the top priority of Engineers and Logisticians, and it took several weeks to match capabilities with requirements.

Starting August 6, 1990, Engineers and Logisticians focused on supporting the rapid buildup of forces starting with the XVIII Airborne Corps. The 3rd US Army (Army Central or

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[79] Khaled bin Sultan and Seale, *Desert Warrior*, 8.

[80] KKMC is a self-contained city of 65,000, providing power plants, seventeen deep wells, underground command bunkers, antiaircraft missile sites. Construction was completed by USACE in 1988. Metz and Library of Congress, *Saudi Arabia*, 255.

[81] Ibid., 224.

[82] Freedman and Karsh, *The Gulf Conflict, 1990-1991*, 88.

[83] Exercise "Internal Look 90 focused on the military actions only along the Persian Gulf coastal region and started with forces already in the theater of operations. The exercise assumed no issues in necessary infrastructure and logistics for the reception, staging, and onward movement tasks. By starting the exercise on D+6, this action assumed away potential logistics and engineering problems when moving large forces into the theater of operations and away from the coast into the desert. McDonnell, *Supporting the Troops*, 4.

[84] Freedman and Karsh, *The Gulf Conflict, 1990-1991*, 94.

ARCENT) commander, LTG John Yeosock, assigned MG William "Gus" Pagonis to the task of building up forces in Saudi Arabia. Major General Pagonis formed the ARCENT Support Command (SUPCOM) to receive, sustain, and support the arriving troops.[85] The ARCENT SUPCOM provided the structure for Engineer support throughout the war. The ARCENT SUPCOM led the engineering effort until the deployment of the 416th Theater Engineer Command in November (See Figure 8).

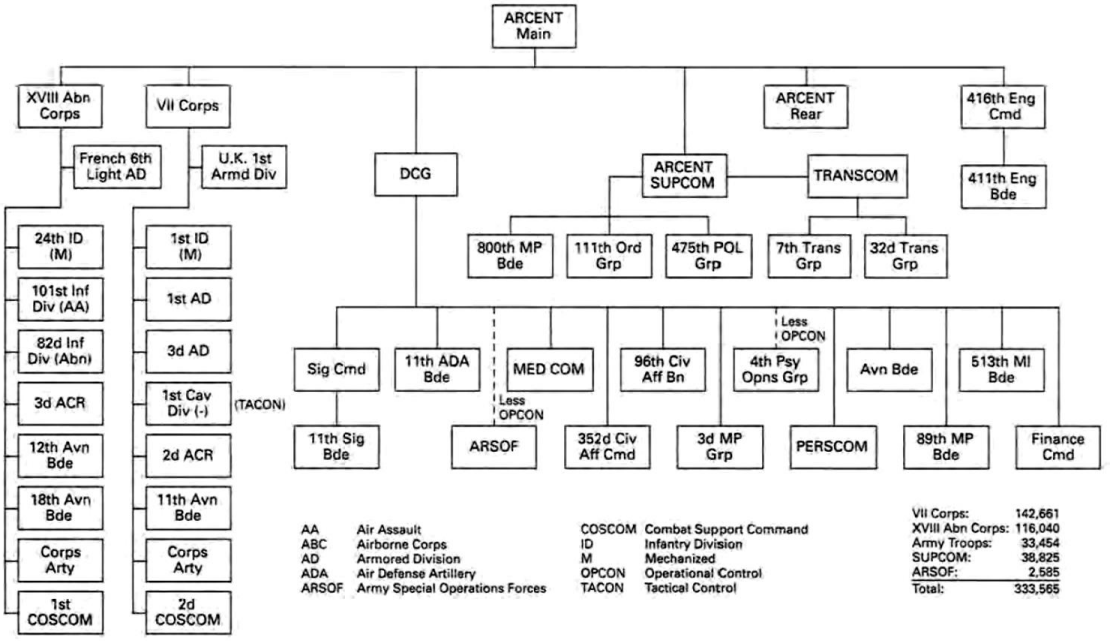

Figure 8. Third Army, January 1991. Taken from Stephen A. Bourque, *Jayhawk! The VII Corps in the Persian Gulf War*, CMH 70-73-1 (Washington, DC: Department of the Army, 2002), 88.

The coalition needed to set the conditions early if escalation occurred. By October, coalition forces established defensive positions and occupied the built-up areas along the Gulf Coast. The initial defense force was inadequate for offensive operations.[86] Transition to the offense needed more forces in the theater, and those forces needed a destination. Early actions by Engineer and Logistics planners enabled this transition to the offense. When President Bush announced on November 8, 1990, the "offensive military option" ARCENT was ready for the

[85] William G. Pagonis and Jeffrey L. Cruikshank, *Moving Mountains: Lessons in Leadership and Logistics From the Gulf War* (Boston, MA: Harvard Business School Press, 1992), 98.

[86] Freedman and Karsh, *The Gulf Conflict, 1990-1991*, 88.

arrival of the US Army VII Corps.[87]

Geography

Northeastern Saudi Arabia is an inhospitable place. The Arabian Peninsula is a dry climate with high temperatures, summer droughts, and winter precipitation with frequent severe dust storms.[88] The operational area is a desert the size of Florida, Georgia, and South Carolina. Weather and terrain posed significant challenges to coalition forces as they arrived in the theater.

Operating in the desert climate requires acclimatization, shade, and water. The deserts of Saudi Arabia produce the hottest temperatures in Southwestern Asia.[89] The coastal region of the Persian Gulf is not any better, adding high humidity to the high temperatures. The daytime heat and rapid nighttime cooling results in windy conditions and wide daily temperature swings. Wide swings in climatology required careful training and equipping of soldiers; conditions experienced during training were often radically different from those of Desert Storm.[90] As forces increased along the Kuwait border, the need for water rapidly increased. To further complicate issues, surface potable water is scarce throughout the region only occurring after rain during the rainy season.[91] Drilling for water wells, utilizing desalinization plants, and bulk water shipment were the three methods used for water supply in Desert Shield. The Engineers needed to find, or build, adequate shelter and water for the troops to protect them from the heat.

The terrain also posed challenges to the coalition forces, mainly in the operational distance. While Saudi Arabia had modern seaports, the road network was not as versatile,

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[87] Khaled bin Sultan and Seale, *Desert Warrior*, 164.

[88] George M. Howe, *Classification of World Desert Areas*, Technical Report (Hartford, CT: Travelers Research Center, Inc, December 1968), 41.

[89] Ibid.

[90] John J. Yeosock, "Army Operations in the Gulf Theater," *Military Review* LXXI, no. 9 (September 1991): 7.

[91] Howe, *Classification of World Desert Areas*, 43.

resulting in transportation bottlenecks.[92] The main supply routes (MSRs) were suitable roads, but few secondary roads existed.[93] The US warfighting equipment, although capable, was not optimized for traversing long distances. The previous exercises failed to address this issue because they remained close to the Persian Gulf coast. The well-developed infrastructure allowed planners to assume away potential Logistics and Engineer problems of moving an entire corps across a desert.[94] The limited number of capable routes within the theater challenged planners to organize, build, and sustain capabilities efficiently. As Operation Desert Shield took shape, the Engineers addressed the challenges posed by distances and the lack of internal transportation infrastructure.

Building the Iron Mountain

The presence of USACE over the previous 50 years mitigated many of the engineering challenges of operating in the Saudi Arabian desert. From the established working relationships, issues that arose in Operation Desert Storm were handled quickly. Despite the years of construction, Saudi Arabia lacked the logistics infrastructure to feed, shelter, and supply a large external force.[95] The austere environment posed challenges, but so did the decision to prioritize combat power over logistics units. The prioritization resulted in unit reliance on organic supply and host nation support initially.[96] The primary engineering issues that needed addressing were reception areas, tactical assembly areas, and logistics bases.

As the XVIII Airborne Corps arrived in Saudi Arabia, the issue of host nation support arose. With no status of forces agreement or contracts to establish essential services, ARCENT needed a way to meet the emerging requirements for contract construction and real estate

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[92] Yeosock, "Army Operations in the Gulf Theater," 7.

[93] McDonnell, *Supporting the Troops*, 120.

[94] Ibid., 4.

[95] Ibid., 7.

[96] Ibid., 10.

support.[97] USACE provides the Department of Defense contract construction and real estate services. To meet the requirements, USACE deployed a team of military officers and civilian professionals on commercial flights to Riyadh to support ARCENT SUPCOM.[98] Upon arrival, USACE negotiated the lease of various facilities to assist in the reception problem.[99] The command needed to move troops into the desert as reception facilities filled up. To move Soldiers out of the ports meant establishing tactical assembly areas (TAA) and logistics bases (LOGBASE).

The USACE civilian professionals and officers set to the task of moving the troops out of the reception areas. The USACE team arrived in mid-August to form the Middle East/Africa Project Office Southwest Asia (MEAPO SWA). This office provided a single point of contact to support both ARCENT and USCENTCOM with contracts, real estate, and construction.[100] The USACE team established real estate agreements and construction contracts to fill the gap until the deployment of Engineer troops arrived in October. The construction contracts ranged from small projects to supply toilet and shower facilities to the construction of six major life support areas.[101] Ultimately, there was more success with smaller contracts.

Troop construction provided another part of the assembly area and logistics base strategy. By the end of October, the 20th Engineer Brigade of the XVIII Airborne Corps, under Colonel Robert B. Flowers, arrived and started to function as the Theater Army Engineer.[102] Colonel Flowers managed theater construction by setting construction priorities of helipads, supply routes,

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[97] McDonnell, *Supporting the Troops*, 20.

[98] Ibid., 41.

[99] The initial set of facilities around ad Dammam and Al Jubayl hosted up to 40,000 soldiers. These facilities were colloquially called “Hotel California,” “Dew Drop Inn,” “Seaside,” and “MGM Grand.” Bourque, *Jayhawk!*, 59.

[100] McDonnell, *Supporting the Troops*, 41.

[101] Ibid., 113.

[102] McDonnell, *Supporting the Troops*, 19.

ammunition storage points, petroleum terminals, force protection, and life support areas.[103] By doctrine, a Theater Engineer Command, not an Engineer Brigade, manages Engineer operations at echelons above corps. In this case, the 416th Engineer Command, led by MG Terrance Mulcahy, would not be activated until December 1990.[104]

From October to December 1990, the 20th Engineer Brigade supported ARCENT SUPCOM in the establishment of the TAAs and LOGBASEs throughout the Saudi Arabian desert. To execute projects, COL Flowers consolidated arriving Engineer units under the 20th Engineer Brigade.[105] The 20th Engineer Brigade performed missions throughout the operational area. The increasing demand for Engineer support puts stress on the Soldiers and equipment. To support the Engineer Soldiers, USACE contracted Saudi Arabia construction companies to work with the Soldiers or to provide them with needed construction materials. To address the equipment issues, the 20th Engineer Brigade worked with USACE to contract the use of host nation construction equipment.[106] The Engineer Soldiers learned road building techniques and dust control measures from the local laborers that significantly improved their ability to create roads and airfields.[107] The most significant advantage of teaming Soldiers with local contractors was the sharing of best practices.

The November 1990 announcement of VII Corps deployment met the condition to activate the 416th Theater Engineer Command. Upon arrival in Saudi Arabia, the 416th established command and control relationships of the Engineer Brigades in the theater. It established Task Force 43 and Task Force 864. Task Force 43 specialized in the construction of

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[103] Robert B. Flowers and James E. Meredith, "Engineer Brigade Initiatives for Desert Shield," *The Engineer* 21 (April 1991): 51.

[104] Terrence D. Mulcahy, "Engineer Support in the COMMZ," *Military Review* LXXII, no. 3 (March 1992): 14.

[105] McDonnell, *Supporting the Troops*, 20.

[106] Flowers and Meredith, "Engineer Brigade Initiatives for Desert Shield," 51.

[107] Ibid.

heliports, landing ramps, all-weather supply routes, and prisoner of war camps.[108] Task Force 43 missions focused on Army level support to the maneuver plan. Task Force 864 specialized in petroleum pipelines and pumping stations, supply route maintenance, prisoner of war camps, combat airstrips, and protective positions for Patriot batteries.[109] Task Force 864 missions focused on Army level support for sustainment and protection functions.

By January 1991, the Engineer forces realigned to support their echelons. The 20th Engineer Brigade refocused support to XVIII Airborne Corps. The newly arrived 7th Engineer Brigade supported the VII Corps, and the 411th Engineer Brigade assumed responsibility for the ARCENT SUPCOM support area. The partnership with the host nation proved invaluable to the success of the mission and deployment of USACE provided the needed flexibility before the Engineer and Logistics units arrived in theater.

Building the Coalition

Nations from around the world converged in Saudi Arabia in response to the Iraq aggression into Kuwait. Saudi Arabia's King Fahd bin Abdul-Aziz Al Saud requested help from the United States and the international community to help resolve this security problem. As the crisis grew too big for the traditional instruments of Arab diplomacy, King Fahd knew the Iraqi Army posed a severe threat to his rule. He also knew that Saddam Hussein would not leave Kuwait willingly and that no Arab force alone could expel him.[110] The international response created a unique coalition, position in the heart of the Arab world, consisting of thirty-seven nations.[111] The two key players in this coalition, the United States and Saudi Arabia, formed a parallel command structure.

The United States entered the conflict by request from Saudi Arabia and brought the

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[108] McDonnell, *Supporting the Troops*, 27.

[109] Ibid.

[110] Khaled bin Sultan and Seale, *Desert Warrior*, 18.

[111] Khaled bin Sultan and Seale, *Desert Warrior*, 217.

predominance of forces. Saudi Arabia emerged as the lead-nation to coalesce the Arab militaries into a fighting force titled the Joint Forces Command.[112] General Khalid bin Sultan commanded the Joint Forces Command. In general, the non-Arab militaries formed the coalition command under the USCENTCOM Commander in Chief, General H. Norman Schwarzkopf. Under the parallel command structure, the coalition formed the Coalition, Coordination, Communications, and Integration Cell (C3IC) to address any issues in the operational environment.[113] Through the C3IC structure, the host nation and international community were able to unify effort and create unique solutions.

Saudi Arabian support to real estate and construction efforts proved vital in the opening months of Operation Desert Shield. Host nation support filled the logistics and engineering gap to execute construction and sustainment functions. Initially, the Saudi's provided available real estate for coalition use, such as Ad Damman and KKMC. The USACE Real Estate Specialists established the leases for these facilities.[114] In addition to leasing existing facilities, the coalition acquired land for military use. Along Tapline Road and in the vicinity of KKMC, the coalition established military training areas and ranges.[115] When disputes arose with the landowner from land usage, the Saudi government helped adjudicate the real estate issues through the C3IC.[116] The construction efforts improved the living conditions for coalition members and helped build the coalition into a cohesive team.

Host nation support also extended into supply and service contracts. The USACE contract professionals provided supply and service contracts for temporary facilities, expedient structures, sunshades water, latrines, washstands, equipment, and vehicle rentals from Saudi

[112] Khaled bin Sultan and Seale, *Desert Warrior*, 248.

[113] Ibid., 34–5.

[114] McDonnell, *Supporting the Troops*, 155.

[115] Bourque, *Jayhawk!*, 106–7.

[116] McDonnell, *Supporting the Troops*, 118.

Arabian companies.[117] The services and supplies provided to the coalition helped to enable mission success. Saudi Arabian development and contract ability mitigated the risk of not initially deploying Engineers.

In addition to providing physical resources, the Saudi Arabian government provided financial resources as well. The contracts initiated by USACE and other DoD entities were assumed by the Saudi government, as part of the assistance agreement. Financial support also came from the international community through the Gulf Peace Fund.[118] This fund provided another means to finance construction, supply, and service contracts with international construction companies. The increased flexibility in the contracting process enabled the inclusion of companies outside of Saudi Arabia to support the coalition.

The host nation and international support to construction, supplies, and equipment enabled the prioritization of combat forces over support forces during the early part of Operation Desert Storm. Saudi Arabia's fear of further Iraqi aggression led to the invitation of coalition assistance. The mature infrastructure and willingness to work with US Contract Professionals enabled the rapid buildup of forces. The host nation and international support also demonstrated the unity of effort that enabled success. The coalition aligned interests to achieve a common goal.

Operational Art

As the Engineers shaped the physical terrain in the Saudi Arabian desert, the coalition focused on transitioning to the offense. The basing strategy decided in early August 1990, directly influenced the tempo, lines of operation, and operational reach of the coalition forces. The establishment of the logistics bases served multiple roles (See Figure 9). They served the current tactical situation, the strategic plans for the mission, and enabled options for the offensive.[119]

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[117] McDonnell, *Supporting the Troops*, chap. 6. This chapter provides detailed descriptions of the various service and supply contracts that USACE managed during Operation Desert Storm.

[118] Established by the government of Japan, the Gulf Peace Fund provided funds for noncombat support to the US forces. McDonnell, *Supporting the Troops*, 78–9.

[119] Pagonis and Cruikshank, *Moving Mountains*, 119.

Understanding the logistics limitations and Engineer capabilities and the operationally significant terrain enabled the success of Operation Desert Storm.

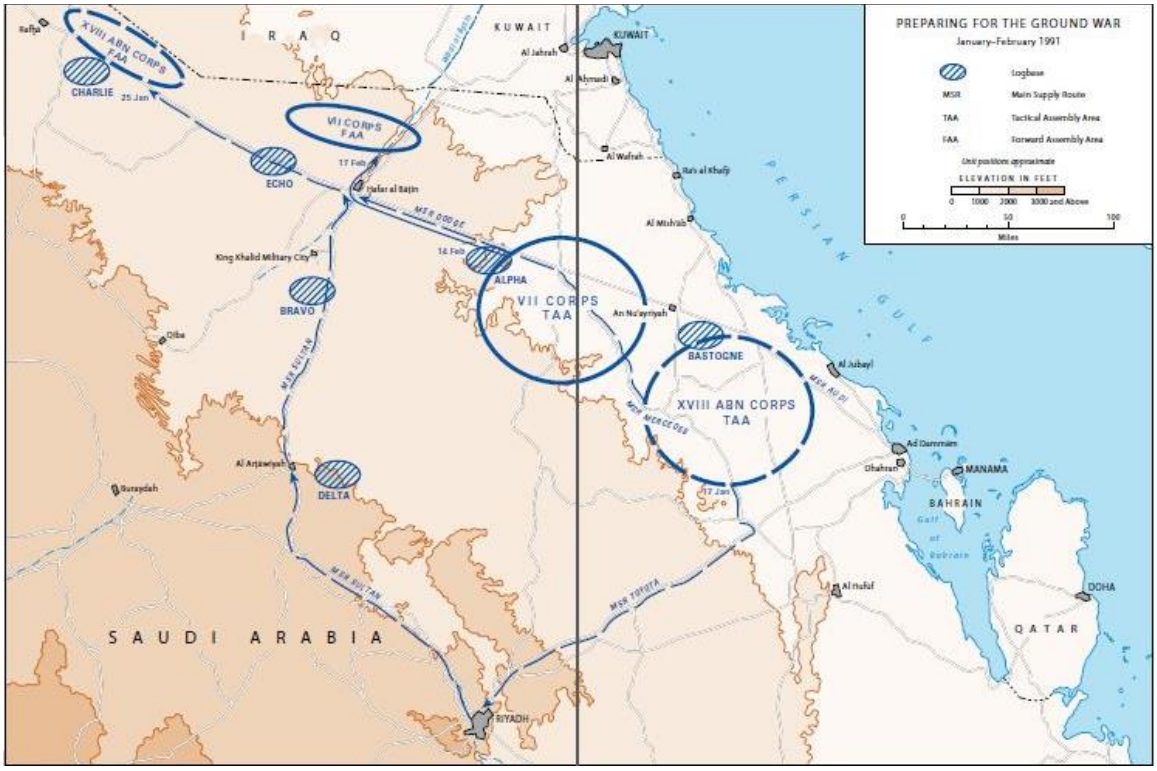

Figure 9. Operation Desert Shield supply routes, assembly areas, and logistics bases. Taken from: Richard W. Stewart, War in the Persian Gulf: Operations Desert Shield and Desert Storm, August 1990-March 1991, CMH pub 70-117–1 (Washington, DC: Center of Military History, US Army, 2010), 30–1.

The construction of the coalition bases during Operation Desert Storm followed Tapline Road, MSR Dodge, from east to west. As coalition forces occupied the desert, the bases pushed to the west. To support the operational plan, the construction of LOGBASEs Echo and Charlie did not begin until the start of the air campaign. The Engineers then established the bases by building temporary facilities and roads to support the logistics effort.[120] During the initial stages of the offensive, VII Corps depended on LOGBASE Echo.[121] The coalition chose the location of

[120] VII Corps, "FRAGO 85-91, Displacement of CS and CSS Backbone in Support of Phase I (Opns)," January 23, 1991.

[121] VII Corps Main CP (Plans), "OPLAN 1990-2, Operation Desert Saber," January 13, 1991, 31–2.

LOGBASE Echo, fifty miles west of Wadi al Batin, to extend the operational reach of VII Corps and enable the corps to maintain a rapid tempo during their assault. LOGBASE Charlie, 150 miles west of Wadi al Batin, served the same purpose for XVIII Airborne Corps. By staging equipment and supplies at LOGBASE Bravo, adjacent to KKMC along MSR Sultan, the coalition accomplished the construction and occupation of LOGBASEs Charlie and Echo.[122] These forward bases enabled the ground assault and transition to Operation Desert Storm.

Engineer forces extended the operational reach during Operation Desert Shield by establishing and maintaining roads and combat trails. The roads enabled logistics to move forward to maintain the operational tempo of combat forces. Precise navigation in the open desert is a prerequisite for ground maneuver.[123] The resupply plan for Operation Desert Storm included the construction of logistics bases, located every ninety miles along the corps lines of operation.[124] The construction of roads and trails through the desert supported coalition navigation. To provide the combat maneuver units with needed supplies, the Engineers established and maintained forward resupply routes. As part of the "two-wheel" logistics plan, the routes enabled the sustainment commands to provide fuel, ammunition, equipment, and supplies directly to the troops at the fighting front.[125] By building roads and forward logistic sites, the Engineers extended operational reach. The operational reach enabled combat forces to maintain operational tempo throughout the war.

In summary, military construction enabled coalition forces to project military forces to Saudi Arabia in Operation Desert Shield. The infrastructure development of Saudi Arabia by the USACE since the 1950s proved invaluable in the relationships and capabilities they built when Iraqi invaded Kuwait. As the coalition formed and operations took shape, the construction of

[122] Pagonis and Cruikshank, *Moving Mountains*, 141.

[123] Yeosock, "Army Operations in the Gulf Theater," 7.

[124] Pagonis and Cruikshank, *Moving Mountains*, 146.

[125] Ibid., 135.

logistics bases, assembly areas, tactical ranges, and roadway enabled military access to the remote Saudi Arabia desert. Saudi Arabian support proved critical to accomplish these construction projects with their technical expertise and supply of materials, labor, and equipment to accomplish the mission. Subsequently, these actions enabled strategy, shaped operations, and facilitated tactical actions in Operation Desert Storm.

Access, basing, and lines of communication proved essential factors in the conduct of the Gulf War. The engineering effort in support of operational design enabled the coalition forces the ability to execute movement and maneuver in Southwest Asia. The support of the coalition partners in the engineering effort enabled the construction of critical logistics bases throughout the desert. Contingency construction, Military Engineering, and contracted construction play a vital role on the battlefield by enabling the commander to execute the desired course of action by shaping the terrain and setting conditions.

Chapter Five: Conclusion

Compare Case Studies

The strategy and strategic context in the CBI theater and Operation Desert Storm had similarities concerning infrastructure development. The case studies demonstrate the importance of building infrastructure to support operations and the theater strategy. In both cases, the military command had the support of political leaders for the construction efforts. In CBI, these leaders included the key actors of the United States, China, and the British. The assignment of construction resources portrays national and coalition leadership support for the Ledo Road. This support was evident despite the unclear military command structures in the theater. In Operation Desert Storm, the support of Saudi Arabia in the development of desert assembly areas, logistics bases, and use of existing infrastructure demonstrated this support.

The most significant differences between the case studies were the funding sources and the structure of the Engineer Commands. In CBI, the United States provided the funding for the

construction activities and equipment as a part and in support of the lend-lease agreement between China and the United States. In Operation Desert Shield, the Saudi Arabian and Japanese governments provided funding for Engineer activities. The Saudi government assisted in the contract negotiations for all contracted construction projects and the lease agreements made by USACE in support of USCENTCOM operations.

The second difference is the system and organization of the Engineer Commands in each theater. Looking at the context, function, structure, and processes of the system provides a better understanding of each Engineer's Command system.[126] The context of both cases is similar, a multi-national coalition in a challenging physical environment with limited resources. The function of both Engineer Commands was also similar to improve the existing infrastructure to enable operational and strategic success. The Engineer Command systems in CBI and Operation Desert Shield had a similar context and function, but different structure and processes.

The structures of the commands were initially similar. The SOS command provided the Commander of US forces CBI with the Logistics and Engineering support required throughout the theater. The SOS Command reported directly to LTG Stilwell. Under the SOS Command, the Engineer and Logistics efforts were divided into several bases and advance sections. One of the base sections was the Ledo Road construction. Brigadier General Pick, the commander in charge of the Ledo Road, reported to MG Wheeler Commander SOS-CBI, then to LTG Stilwell. This structure enabled Engineer resources to be allocated by the SOS Command in support of the US Forces CBI's priorities.

In Operation Desert Shield, the ARCENT SUPCOM served a role similar to the SOS Command in CBI. Initial Engineer forces were allocated by the ARCENT SUPCOM Commander MG Pagonis until the deployment of the 416th TEC in November 1990. The TEC created a command outside of ARCENT SUPCOM, reporting directly to both ARCENT and CENTCOM.

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[126] Jamshid Gharajedaghi, *Systems Thinking: Managing Chaos and Complexity: A Platform for Designing Business Architecture*, Third edition. (Burlington, MA: Morgan Kaufmann, 2011), 93.

The separate commands created conditions for competing priorities, bureaucracy, and reduced efficiency. The process in CBI was more linear, as the SOS maintained control of the engineering resources.

In terms of geography, both case studies occur in challenging physical environments. The challenges of distance, resources, and limited initial infrastructure forced leaders to think of creative and unique solutions. The jungle and mountain environment of CBI forced soldiers to work through rain, mud, and malaria conditions throughout the war. In the desert environment of Saudi Arabia, the heat, sand, and distance created operational issues that infrastructure development needed to overcome. To further complicate issues, the isolation of both regions made decisions of resource allocation vitally important. In both cases, insufficient local supply required the transportation of resources to the region. To overcome the challenging environments and to support military operations, the commands built infrastructure. Although the physical environments were drastically different, the considerations for the use of military forces in those regions faced some of the same issues.

The construction challenges in CBI were the competing requirements, project phasing, and equipment shortages. In Operation Desert Shield, the challenges were reception areas, tactical assembly areas, and logistics bases. Both of these case studies demonstrate challenges in resources and time. Both cases had initial resource constraints of personnel and equipment in building the necessary infrastructure. In CBI, this was the slow buildup of US Engineers and forces into the theater from the project started in 1942 to completion in 1945. Initially, Ledo Road relied on coalition partners for the construction of the road and, over time, built the road construction force up to 14,000 soldiers. In Operation Desert Shield, the Engineer force buildup was slower than the combat force buildup based on the initial requirements. However, the delayed deployment of Engineer capabilities was mitigated by the use of construction and real estate contracts to enable construction progress.

Both case studies demonstrate the importance of securing real estate. For CBI, it was the tea plantations in the Assam region that enabled storage of supplies and housing of personnel working on the Ledo Road. In Saudi Arabia, it was the existing infrastructure in the ports of debarkation, KKMC, and the land in the desert acquired for the construction of the logistics bases and tactical assembly areas. Similarly, both cases used local workers to assist in the construction effort. Although in Operation Desert Shield, the labor was skilled construction labor vice the unskilled laborers used on the Ledo Road.

The most significant construction difference between the two cases is the capability and number of Military Engineers. In CBI, the number of Military Engineers far exceeded the capability in Operation Desert Shield. Contracted construction and technological advancements helped to offset the fewer Engineer units during Desert Shield. Globalization and the increase of international companies enable the US Army to leverage companies with worldwide operations. Technological advancements also improve efficiency and engineering capability. Mechanization and use of digital tools for Engineer tasks, such as surveying, resulted in increased efficiency and a reduced workforce. In leveraging international companies and modern technology, the US Army can maintain a smaller Engineer force.

Building coalitions through construction became a part of both theater strategies. In CBI, the project relied on the support from the United Kingdom, China, India, and local Burmese populations. In Operation Desert Storm, the host nation, Saudi Arabia, and the international community were able to unify effort and create unique solutions. Both case studies integrated the use of local labor and materials into construction projects. The use of local labor and materials demanded to work with local leaders to secure the necessary resources for project success. In CBI, this translated into the use of local Indian, Burmese, and Chinese labor for the construction of facilities supporting the Ledo Road and the Ledo Road. In Saudi Arabia, this translated into the use of Saudi construction companies and the supply of construction materials, equipment, and facilities. The use of local resources in construction created the conditions for the coalition

partners to work together to set priorities and allocated the necessary resource to achieve the strategic vision. In CBI, this vision was creating a new ground line of communication to China. In Operation Desert Shield, this meant creating the basing to achieve victory in the ground war through an operational turning movement of Operation Desert Storm. Both case studies could not have been accomplished without the support of the coalition for resources and working together to achieve a common goal.

The case studies demonstrate the relationship between operational art and construction. In CBI, the coalition was able to increase the operational reach, shape the lines of operation in the theater, and reduce the risk to Allied forces through the construction of the Ledo Road. In Operation Desert Shield, the basing strategy influenced the tempo, lines of operation, and operational reach of the coalition forces through the construction of the logistics bases, tactical assembly areas, and combat roads. In both cases, construction created the necessary infrastructure to enable the commander's vision. By shaping the terrain, construction was able to influence the location of battles along the line of operation. It also enabled the continued advance of each of the coalition forces by extending operational reach through the basing strategy. As such, construction will continue to play an essential role in shaping operations into the future.

Future Application

Coalition construction will continue to be a method to create unity of effort, achieve strategic and military aims, and shape operational art. Military construction efforts will continue to occur in challenging physical environments, with limited resources, and with our partners and Allies. Capabilities like Real Estate and Construction Contracting need integration into campaign planning. It must also be able to take multiple requirements and synchronize actions with efficiency. The structure of the SOS in CBI, having a single headquarters manage theater Logistics and Engineer resources, is ideal. The current structure of the Theater Engineer Command, as a separate headquarters under a theater army, creates bureaucracy and inefficiency.

This structure also forces issues to be resolved at the theater army level. A TEC is required; however, a structure similar to the service of supply of World War II may be more efficient than the current structure.

Construction takes time to complete and be ready for mission execution. Therefore, it is crucial to identify requirements early so that the projects with the most significant operational and strategic impact receive the necessary resources. Similar to the basing strategy and construction of Operation Desert Shield and Ledo Road, the earlier the identification of requirements, the more options the commander has to execute operations. Not all theaters of the future will have the port capacity and existing military infrastructure of Saudi Arabia in 1990. The construction effort and partnership with the United States during the preceding decades enabled the rapid buildup of forces during Operation Desert Shield. The lesson to be learned from this is that partnering with strategically located nations provides immeasurable benefits at the operational and strategic levels hen a conflict occurs in the region. The investment over time creates relationships and a shared understanding that serves as the foundation for military coalitions.

Anticipating future conflict zones involves selecting future scenarios and planning against them. Scenario planning such as this is hard, but it must consider a range of possible futures to help think through unfolding reality.[127] Planning for contingencies and setting the conditions for a rapid response and buildup of forces into a theater is ideal, but only comes from relationship building and infrastructure development over time.

As the US Army transitions its focus to large-scale ground combat operations, there are lessons to be learned from the Ledo Road and Operation Desert Shield. First, Engineer capability is needed at every echelon to support the combat forces. This requirement includes both General Engineering and Combat Engineering Battalions to enable maneuver forces and increase operational reach. Front line units will continue to need Combat Engineers and limited General

[127] Peter Schwartz, *The Art of the Long View: Paths to Strategic Insight for Yourself and Your Company* (New York: Bantam Doubleday Dell Publishing Group, 1996), 28.

Engineer support. The current US Army force structure requires Army National Guard or Army Reserves augmentation to the Brigade Engineer Battalions, in the brigade combat teams, to meet the brigade's General Engineering requirements. Similar augmentation to the active army is required at the division and corps levels as well. Leaning heavily on augmentation to the active force will present challenges in rapid response large-scale ground combat operations.

The second lesson learned from these case studies, with the current transition to large-scale ground combat operations, is the need to plan and anticipate basing and line of communication requirements. As the joint force develops contingency plans, the basing strategy needs to be an early operational decision. In both case studies, once the command decided on the strategy, it took several months to set the conditions, through construction, before the start of operational maneuver. Also, in both cases, the location of the bases drove the operational reach of the units. Through detailed planning, anticipating requirements, and communicating capabilities and limitations of Engineer forces, Engineers enable force movement and maneuver. The integration into planning early on will enable the commander to visualize the operational area and understand the option available and select an approach that appreciates the military geography and force capabilities.

Areas of further study

Further research based on this monograph should investigate the influence of construction contractors, or contractors in general, on the battlefield. The discussion of military contractors could include how the increase of contractors on the battlefield has changed or will change the character of war. This monograph did not address issues that arise when working with international companies in a multi-national coalition. International companies create challenges in the operational environment. The large-scale use of construction contracts has increased since Operation Desert Shield during the more recent conflicts in Iraq during Operation Iraqi Freedom and in Afghanistan during Global War on Terror. Investigations into the construction practices

during these cases study would identify relevant norms of today that have changed since Operation Desert Shield thirty years ago.

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