DETERMINING THE PETROLEUM SUPPLY AND DISTRIBUTION CAPABILITIES OF THE UNITED STATES ARMY: SUPPORTING THE JOINT FORCE IN LARGE-SCALE COMBAT OPERATIONS

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Over the last 50 years, the Army has been slowly shifting its petroleum logistics infrastructure to the reserve forces. This shift in logistics forces has been a result of a growing trend in combatting insurgencies rather than large scale combat operations. It also resulted from an increase in the use of contracting to procure petroleum as a cost effective and relatively quick alternative in lower threat counterinsurgency environments. The shift in Army petroleum assets to the reserves has come as the military has increased its use of the joint force. This study addresses how the Army's petroleum logistics force has shrunk to a level that cannot support the Joint Force in LSCO. This study suggests that as the Army transitions back to preparing for Large-Scale Combat Operations against near peer competitors, the logistics force must transition its petroleum logistics force structure to be capable and ready to supply the joint force for LSCO in contested environments.

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The opinions and conclusions expressed herein are those of the student author and do not necessarily represent the views of the U.S. Army Command and General Staff College or any other governmental agency. (References to this study should include the foregoing statement.)

ABSTRACT

DETERMINING THE PETROLEUM SUPPLY AND DISTRIBUTION CAPABILITIES OF THE UNITED STATES ARMY: SUPPORTING THE JOINT FORCE IN LARGE-SCALE COMBAT OPERATIONS., by Jeffrey Alex Kromm Jr., 106 pages.

During Operation Iraqi Freedom and Operation Enduring Freedom it was apparent that bulk petroleum distribution and logistics infrastructure were becoming modular and many capabilities were moving to the reserves. Though the non-linear battlefield had a large impact on the reduction of divisional and corps logistics infrastructure, the Army has been using increased contracting to source and distribute fuel for decades, even as fuel consumption rates within Brigades and Divisions were increasing. During this time, though some capabilities were increased, overall many of the capabilities in the Army to supply fuel moved to the reserve. As the potential for Large-Scale Conflict increases and the Military is increasingly operating in joint capacity, the demand for the Army to supply fuel to the force increases. These changes in infrastructure, coupled with the increased potential for demand and an elevated risk for Large-Scale Combat Operations, requires the Army to look at how the past has shaped its ability to fuel the joint force and how it can adequately prepare to provide fuel in potential future conflicts. This examination should be informed by history, past and current doctrine, and the current bulk petroleum requirements of the joint force.

TABLE OF CONTENTS

Page

ACRONYMS

CSSB	Combat Service Support Battalion
DGDP	Directorate of Graduate Degree Programs
DESC	Defense Energy Support Center
DISCOM	Division Support Command
EAB	Echelon-Above-Brigade
GDP	Graduate Degree Programs
LSCO	Large-Scale Combat Operations
NDS	National Defense Strategy
OCS	Operational Contract Support
ODS	Operation Desert Storm
OEF	Operation Enduring Freedom
OIF	Operation Iraqi Freedom
POL	Petroleum, Oil, and Lubricants
SAMAREC	Saudi Arabian Marketing and Refining Company

TABLES

Page

CHAPTER 1

INTRODUCTION

The United States Army has consistently shifted how it supplies petroleum to the force. This has been shaped by the conflicts that the US has fought in and how they were conducted. Each conflict had a profound effect on the shape and doctrine of the operational logistics force. This has also been shaped by the increased use of joint forces[1], which lean heavily on the logistics structure of the US Army to provide sustainment from the theater gateway to the battlefield. Joint force operations have grown substantially in frequency of use, which has helped increase communication and reduce military blunders. These blunders were often created by disunity of command and lack of communication. As the force transitions its focus back to large-scale combat operations, the operational demand on the Army's logistics force will likely increase due to the demands of increased use of joint forces. This steady increase in the use of joint forces will likely increase the required capability of the Army to supply fuel, not only to itself, but to its sister services across the battlefield.

Vietnam

During the last 50 years of conflict, the US Army has faced multiple petroleum distribution issues. In Vietnam, the Army struggled with the procurement and storage of

[1] Mark Olinger, *Logistics and the Combatant Commander: Meeting the Challenge Logistics and the Combatant Commander: Meeting the Challenge,* The Land Warfare Papers No. 68 (Arlington, VA: The Institute of Land Warfare, Association of the United States Army, July 2008), accessed 19 May 2019, https://www.ausa.org/sites/default/files/LWP-68-Logistics-and-the-Combatant-Commander-Meeting-the-Challenge.pdf, v.

petroleum during a rapidly expanding conflict in an unimproved theater. As the US struggled to quickly expand the petroleum distribution base due to limited availability in the region, sabotage and pilferage made the problem increasingly difficult. Additionally, the Vietcong avoided direct conflict as much as possible. This created an insurgency which affected the way petroleum was stored and distributed. These issues led to changes in doctrine and force structure. Though the Army overcame the challenges, solving these problems came at significant costs and led to long term changes in the force that didn't adequately prepare the Army for the next conflict. Rapid changes, especially in petroleum procurement, storage, and distribution during conflicts come at a high cost to the taxpayer and though petroleum logistical issues arguably did not change the outcome of the conflict, it created significant challenges for the logisticians at the time.

Operation Desert Shield/Desert Storm

Operation Desert Storm/Desert Shield brought another range of challenges to the battlefield. The Army, having learned many lessons in Vietnam, transformed the way it performed logistics. This created a transition that better postured the sustainment force to supply the warfighter with petroleum. Procurement and storage were increased and contracting expanded to add flexibility.[2] Large stockpiles of fuel moved forward and the Iron Mountain[3] was built. Unfortunately, increased consumption and a faster pace of war

[2] Keith Beurskins, *The Long Haul: Sustainment Operations in Large-Scale Combat Operations* (Fort Leavenworth, KS: Army University Press, 2018), 108.

[3] U.S. Army Center of Military History (CMH), *War in the Persian Gulf, Operations Desert Shield and Desert Storm, August 1990-March 1991* (Washington, DC: Government Printing Office, 28 May 2010), 68.

out-paced distribution forcing the Army to take a tactical pause. This pause allowed petroleum supply and distribution to catch up and supply fuel to the rapidly advancing, fuel thirsty force. The US quickly dispatched the Iraqi Army, the 4th largest in the world with over a million soldiers.[4] at the time, however, the tactical pause led to additional organizational changes in the Army, adding distribution assets and storage capability farther forward which helped the US prepare for future Large-Scale Combat Operations (LSCO).

Operation Iraqi Freedom

The recent focus on the operations in Iraq required the United States Army to change its focus from large scale combat operations to limited contingency operations. Shifting the focus of the force is not a new concept. The Army has had to adapt to other combat environments in the past and has faced significant issues, each time adjusting to the changing nature of supplying bulk petroleum. However, the nature of the change has significantly reduced the Army's ability to fight large scale combat operations. These changes from training and preparing for the cold war to combat in Vietnam, to the Gulf War, and finally to limited contingency operations created a non-linear battlefield and a fundamental shift in the way the tactical logistics force supplies bulk fuel.

The conflicts in Iraq faced different challenges with petroleum distribution. During the initial stages of Operation Iraqi Freedom (OIF), bulk petroleum was shipped into country by military trucks from Kuwait, where it had been purchased. Concurrently, during OIF, the Army was also dealing with operations in Operation Enduring Freedom

[4] CMH, *War in the Persian Gulf,* 2.

in Afghanistan. In Afghanistan, fuel was initially contracted and delivered by rail into country. This limited the amount of stress on the petroleum force but did have some effects on OIF, since it was conducted concurrently and placed additional demand on the force. During both conflicts, the enemy had limited capability to attack bases and allowed the Army to stockpile supplies, including fuel. Fuel farms were created in underground tanks and bag farms surrounded by berms that allowed the US to maintain fuel levels far above usage requirements. This bulk storage capacity ensured that even if fuel trucks were destroyed in transit to deliver fuel to bases in support of operations, the units could easily continue the mission. Fuel tankers operated by military personnel and civilian contractors brought fuel to bases to be placed in large storage facilities, ensuring fuel supplies were always available at any forward operating base. This environment allowed the branches of the military to primarily self-support with limited strain to the force and when minor support hurdles prevented themselves, other branches could easily support.

Corps Support Group/DISCOM

Modular Sustainment Brigades replaced corps Support Groups (CSG) and Division Support Commands (DISCOM) that had been built to support Corps and Division elements in LSCO. The tactical logistics force at the Sustainment Brigade and Combat Service Support Battalion (CSSB) became independent organizations that could be tailored with transportation, quartermaster, and ordnance companies to fit the needs of the mission. Though this allowed the Army to custom tailor its logistic force to the fight required, capabilities were significantly reduced due to the nature of fighting a counterinsurgency. Petroleum Groups and Petroleum battalions were mostly deactivated because they weren't needed. The current modular sustainment brigades have some

Quartermaster Supply and bulk fuel hauling capability; however, it is limited and much of it was moved to the Army Reserve.[5] The Active Army deactivated its last active petroleum and water group and its last active petroleum battalion during the conflicts in Afghanistan and Iraq and currently has only one petroleum and water group in the Army Reserve and recently reactivated an active duty petroleum support battalion. The Army worked hard to shape its tactical logistics force to support the fight in Iraq and Afghanistan, which leaned heavily on contracted fuel movement. In Iraq fuel contractors moved fuel from Jordan, Turkey, and Kuwait. In Afghanistan, bulk fuel originally moved in from Pakistan by contract. When Pakistan stopped the flow of fuel due to international disputes, US military aircraft shipped petroleum for a short time. The reserves in country allowed the US forces to continue operations. That allowed enough time to ensure contracted distribution by rail and truck from the northern central Asian states through the Northern Distribution Network.[6] The Army retained some fuel transportation capability but could not self-sustain its entire force. These changes allowed the force to fight effectively in limited contingency operations, but have had a lasting effect in preparing to supply petroleum to a potentially much larger conflict.

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[5] Combined Arms Support Command (CASCOM), Force Development Directorate, *Sustainment Force Structure Book* (Fort Lee, VA: CASCOM, August 2018), 18 February 2014, accessed 19 May 2019, https://www.ako1.us.army.mil/suite/doc/50828174, 20.

[6] Michael J. Evans and Stephen W. Masternak, "The Silent Revolution within NATO Logistics: A Study in Afghanistan Fuel and Future Applications," (Thesis, Naval Postgraduate School, Monterey, CA, December 2012), accessed 19 May 2019, https://apps.dtic.mil/dtic/tr/fulltext/u2/a574221.pdf, 59.

Return to Large Scale Combat Operations

As the Army transitions back to focusing on LSCO, the force and how it is employed has changed. While the US was fighting in two counterinsurgency conflicts in Iraq and Afghanistan, multiple adversaries have developed peer or near peer military forces and are challenging American hegemony by acting aggressively against our vital interests.[7] Anti-access/area denial capabilities can severely restrict or negatively affect logistics operations and the opening of a theater gateway. Air supremacy is also no longer guaranteed and could be challenged. These changes require the Army's tactical logistics force to be agile enough to respond to changes in the battlefield.

Additionally, the force must be adaptive to enemy attacks while remaining robust enough to support multiple services in a joint environment in a contested air domain. The petroleum force will also likely be required to be large enough to sustain the force for a protracted period with limited contractors in a contested environment. The US' near peer enemies have increased ballistic missile and artillery ranges with satellite Intelligence, Surveillance, and Reconnaissance (ISR) capabilities that threaten fuel distribution and storage. Increased fuel consumption on the battlefield as well as limited contracting, as seen in previous conflicts, will also likely affect distribution.

The Army has faced many different challenges fighting in large scale combat operations and limited contingency operations across varied terrain and with varying

[7] Secretary of Defense (SecDef), *Summary of the 2018 National Defense Strategy of the United States of America: Sharpening the American Military's Competitive Edge* (NDS) (Washington, DC: Department of Defense, 2018), accessed 19 May 2019, https://dod.defense.gov/Portals/1/Documents/pubs/2018-National-Defense-Strategy-Summary.pdf, 4.

degrees of access. These operations have tailored the logistics force in a manner that is effective at fighting those conflicts; however, the Army must now work towards a structure that provides capability for joint forces operating in a LSCO. The ability to logistically support the Army's force as well as sister services, in a joint force, by ground resupply is a complex problem that requires in-depth analysis. The issue involves determining the ability to support an ad hoc Army force of undetermined composition along with an unknown joint force, in an uncertain environment against an enemy of unknown size. These adversaries may see logistics as a weak point to attack. Though the modular force supports this concept, it was restructured to support a heavily contract augmented force. The Army reduced its fuel storage and distribution capabilities while moving many assets to the reserve forces. Adding fuel shipping augmentation shifted the active army away from tactical petroleum distribution. Supplying petroleum to the Army, as well as a joint force, requires looking at the Army's tactical logistics from a capabilities approach while applying lessons learned from past wars through the study of history and historical analysis. The solution must first address what might reasonably be expected for logistics support in a joint LCSO fight. Those requirements must be reconciled with what the force can currently support and develop ways to ensure that adequate capabilities are created to support the force. This support must be available to ensure the joint force is supplied with fuel supply, storage, and distribution.

Researcher's Qualifications

I served as a Platoon Leader in the automotive and armament platoon of a Support Maintenance Company under the 10th Mountain Division Sustainment Brigade for three years deploying to OIF 09-11. I performed as an Operation Clean Sweep team leader in

Iraq. I supported brigade commanders in the cleanup and retrograde of supplies and equipment from theater to support base closures at six bases. After returning I served as the Maintenance Control Officer of the company and eventually moved up to manage the battalion Support Operations (SPO) maintenance section for one year. I worked with parts managers, Army Field Support Brigades, and subordinate units to track, supply, and support maintenance operations at the company level. I completed resident Combined Logistics Captains Career Course at Fort Lee in 2012. Upon completion, I served as the HHC Company Commander for the 16th Sustainment Brigade where I transitioned the company from Bamberg to Baumholder Germany to support the drawdown in Europe and closure of the base in Bamberg. I moved to the S3 position in Sustainment Task Force 16 at the Air Base in Mihail Kogalniceanu, Romania where I ran the operations cell in a Transit Center that was operated with the US and Romanian Air Forces to transfer deploying soldiers to and from the US Central Command area of operations. I became a planner and LNO at the 21st Theater Sustainment Command, where I planned, coordinated, and managed ammunition transfers to Iraq under Operation Inherent Resolve. I managed and coordinated the flight support, packing, loading, shipping, and receiving of ammunition from over a dozen donor nations across the European Command area of responsibility. These ammunition supply transfers supported the Iraqi Army in the fight against Daesh. I also served as the battalion senior Observer/Controller Trainer for company and battalion sustainment organizations across the Army Reserve in the 1-383rd Training Support Battalion within First Army.

Primary Research Question

My primary research question is: Is the Army's current sustainment brigade structure adequately designed to effectively provide bulk petroleum to the joint force in Large Scale Combat Operations?

Secondary Research Questions

To answer the primary research question, there are two secondary questions the research seeks to answer.

1. How effectively postured is the US Army modular sustainment brigade logistics system to support the joint force without contractors or air resupply from the port to the battlefield in a contested, non-permissive environment?
2. What changes has the Army made over the last 50 years to the DISCOM/CSG or Sustainment Brigade and what effect have those changes had on the Sustainment Brigade's ability to support a LSCO?
3. Would changing from the modular sustainment structure to the more traditional divisional sustainment structure of the last 50 years effectively support future joint operations?

Historical Analysis

Answering the primary research question requires an understanding of past petroleum issues during recent conflicts, how they shaped current capabilities, and what can be learned from those mistakes. This requires determining how the Army has provided fuel in the past, what challenges were faced, and what appropriate lessons can be learned from those mistakes. Using a multiple case study will develop an

understanding of how the Army adapted to its past conflicts over the last 50 years to develop its current logistics force structure. The best measurement of the capabilities of the petroleum force are presented in large, multi-corps deployments that allow the force to test its efficacy and capability on the battlefield.

The future logistics force must have the capability to supply fuel and sustain a joint force from a theater gateway, air or sea, on the ground across potentially contested terrain. The Army must be ready to conduct that logistical sustainment in a contested environment with limited aid from contractors. This requires some additional supporting questions to develop an understanding of what significant changes shaped the force and how the force can overcome contemporary challenges in its current form.

Definition of Key Terms

Sustainment Brigade – An Army sustainment organization that provides sustainment to Brigade Combat Teams as well as Division and Corps Headquarters in its area of operation. It deploys as a modular headquarters with an attached Special Troops Battalion and Headquarters and Headquarters Company and is generally comprised of 1-4 CSSBs. "The sustainment brigade executes logistics and personnel services associated with theater opening, sustainment, distribution, and theater closing missions."[8]

Division Support Command (DISCOM) – Division Support Commands are an obsolete organization of the United States Army that were replaced by the Sustainment

[8] Headquarters, Department of the Army (HQDA), Army Techniques Publication (ATP) 4-93, *Sustainment Brigade* (Washington, DC: Government Publishing Office, April 2016), accessed 19 May 2019, https://armypubs.army.mil/epubs/DR_pubs/DR_a/pdf/web/ATP%204-93%20FINAL%20WEB.pdf, 1-2.

Brigade. DISCOMs were a brigade level organization, in a Division, that provided supply, service, maintenance, and distribution support to the Combat Brigades and Headquarters Battalion of a Division.

Corps Support Group – Corps Support Groups are an obsolete organization of the United States Army that were phased out and were replaced by the Sustainment Brigade. Corps Support Groups provided supply, service, maintenance, and distribution support to divisions within a corps and could operate at the theater level.

Combat Service Support Battalion - An Army sustainment organization "that execute transportation (mode, terminal and movement control) operations, maintenance operations, ammunition operations, supply support activity operations, water operations, petroleum operations, aerial delivery operations and mortuary affairs."[9] It deploys as a modular headquarters with a Headquarters and Headquarters Company and is generally comprised of 2-6 additional companies that perform tactical logistics.

Large-Scale Combat Operation – A military operation that is massive in size and scope. It generally involves the military engaging in all domains of warfare, on a grand scale, with a capable opponent in an intense and lethal conflict.

Joint Force – A force built for a specific purpose made up of two or more services of the US Armed Forces.

Operational Contract Support – The process of acquiring supplies or services from non-military commercial vendors to meet operational requirements.

[9] HQDA, ATP 4-93, 3-1.

Theater Opening – The process of opening up aerial and seaports of debarkation to allow the transfer of personnel, equipment, and supplies into the theater to stand up organizations to prepare the theater for combat operations.

CHAPTER 2

LITERATURE REVIEW

The purpose of this literature review is to develop an understanding of how the Army's tactical bulk petroleum sustainment structure changed and developed over the last 50 years. This case study will help answer the primary research question; Is the Army's current sustainment brigade structure adequately designed to effectively provide bulk petroleum to the joint force in Large Scale Combat Operations? A review of literature on tactical petroleum support for the last three major US military conflicts will develop an understanding of how the force was structured, how the Army supported its sister services, and also how it procured, stored, and distributed fuel to the warfighters on the battlefield. Vietnam, the Gulf War, and the Global War on Terror each had a profound effect on shaping bulk petroleum operations at the tactical level from the initiation through the completion of major combat operations. This study will examine each of these conflicts from the initiation of major combat operations through their changing wartime environment, until the start of drawdown and retrograde operations. Understanding the lessons learned from these conflicts, the potential for future conflict, and how the modern force operates all help answer the primary research question.

Army Petroleum Logistics during Vietnam (1965-1973)

During Vietnam, Division Support Commands[10] and Corps Support Groups, the predecessors to Sustainment Brigades, operated within the division support area, ensuring Army Petroleum Logistics during Vietnam (1965-1973)

During Vietnam, Division Support Commands[11] and Corps Support Groups, the predecessors to Sustainment Brigades, operated within the division support area, ensuring tactical organizations had fully capable internal sustainment capabilities. The Division Support Command reported directly to the division commander and was commanded by an O-6. Class III bulk supply operations were conducted generally through CL III supply points in the division support area. The supply and transport battalion ran these supply points[12]. Brigade trains would pick up the fuel from the division support area and submit forecasts for future projected consumption. A Corps Support Command (COSCOM) would have a Petroleum Group[13] subordinate to with a Petroleum Supply Battalion, a Transportation Battalion (POL), and a Petroleum Pipeline and Terminal Operating Battalion. These organizations would store and distribute fuel to the divisions under the corps. Though divisions had their own fully operational logistics command with fuel

[10] Headquarters, Department of the Army (HQDA), Field Manual (FM) 54-2, *The Division Support Command* (Washington, DC: Government Printing Office, 1965), 4.

[11] Ibid.

[12] Ibid., 48.

[13] Headquarters, Department of the Army (HQDA), Field Manual (FM) 54-4, *The Support Brigade* (Washington, DC: Government Printing Office, 1969), 3-1.

distribution capabilities, they were not without shortfalls and they relied heavily on the COSCOM to supply their operations.

Fuel in Vietnam was typically transported inland by truck over the road or by rail. The roads in Vietnam were primitive, narrow, and few were paved.[14] In 1965, during the initial phase of the conflict, almost all petroleum was hauled inland by contractors in fuel trucks and local contract drivers continued delivering fuel throughout the conflict.[15] The majority of bridges were only two and a half to three meters wide. [16] Roads and Bridges would flood and sometimes wash away[17] during heavy rains making transport difficult, if not impossible, to some areas during the rainy season. After 1965, the railroads, due to increased enemy activity and their speed, size, fixed routes, and high visibility, were not an effective means of transportation.[18] These road and rail issues with transporting petroleum inland required the Military Assistance Command Vietnam (MACV) to get involved in improving roadways to build more effective Lines of Communication.

Of the four corps operating in Vietnam, all but I Corps had control of the petroleum

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[14] Caroll Dunn, U.S. Army Center of Military History Publication 90-6, *Base Development in South Vietnam 1965-1970* (Washington, DC: Government Printing Office, 30 March 1972), accessed 19 May 2019, https://history.army.mil/html/books/090/90-6/CMH_Pub_90-6.pdf*CMH PUB 90-6, Base Development* (1974), 9.

[15] Logistics Review Board, *Logistics Support in the Vietnam Era,* vol. 2 (Washington, DC: Office of the Assistant Secretary of Defense (Installations and Logistics), 1974), accessed 19 May 2019, http://www.dtic.mil/dtic/tr/fulltext/u2/877957.pdf, 30.

[16] Dunn, *Base Development in South Vietnam 1965-1970*, 9.

[17] Ibid., 11.

[18] Logistics Review Board, *Logistics Support in the Vietnam Era,* 67.

in their Area of Operations; the Navy controlled petroleum for I Corps.[19] until 1970. At the time of the force build up, Vietnam only had about 1.6 million barrels of petroleum storage for the whole country.[20] After 1970, the 1st Logistical Command took over fuel in the I Corps area, as well as the rest of the country, and had 2,350,000 barrels of in ground storage available, which was a 50% increase in total in-ground storage capacity.[21] The 1st Logistical Command, by 1970, was supplying over 32,000,000 gallons of fuel per month to forces in the country.[22] This was out of 36,450,000 barrels of fuel that was consumed in country during 1970.[23] The Army, Navy, and Marine Corps only had 10k collapsible assault bags for fuel storage as they were issued throughout the force. By 1969, Army Support Brigades, which were under Field Army Support Commands had 14 of the 10k collapsible tanks.[24] The Air Force had 50k collapsible bags, of which only 25 were available worldwide.

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[19] Joseph M. Heiser Jr., U.S. Army Center of Military History Publication 90-15, *Vietnam Studies: Logistics Support* (Washington, DC: Government Printing Office, 1974), accessed 19 May 2019, http://webdoc.sub.gwdg.de/ebook/p/2005/CMH_2/www.army.mil/cmh-pg/books/vietnam/logistic/, 72.

[20] Dunn, *Base Development in South Vietnam 1965-1970*, 125.

[21] Adjutant General, 1st Logistical Command, Memorandum for the Commander, Subject: Operational Report-Lessons Learned, Headquarters, 1st Logistical Command, Period Ending 1970 (Department of the Army, Headquarters, U.S. 1st Logistical Command, APO San Francisco, 13 May 1970), accessed 15 May 2019, https://apps.dtic.mil/dtic/tr/fulltext/u2/512785.pdf, 42.

[22] Ibid., 58.

[23] Beth Scott, James Rainey, and Andrew Hunt, *The Logistics of War: A Historical Perspective* (Maxwell AFB, AL: The Air Force Logistics Management Agency, 01 August 2000), 349.

[24] HQDA, FM 54-4, 8-18.

Additionally, in the III Corps area, fuel barges were used to store fuel[25] because of the lack of storage capability. This lack of field storage capability in the corps and division force structures led to the army to building permanent storage facilities in port areas to support the Corps'.[26] The issue of fuel storage was compounded by the use of four different fuel types: Motor Gasoline (MOGAS), Aviation Gasoline (AVGAS), Diesel (DF-2), and Jet Fuel (JP-8 or JET-A). Though permanent storage was built, the Army continued to add petroleum bag storage and additional distribution units during the war to further increase its capabilities.

During the entire Vietnam War, only five units providing petroleum support were deployed from the reserve forces. All five units were activated in 1968 after the Tet Offensive started. The 126th Supply and Services Company, a quartermaster company from Illinois, was the only National Guard Quartermaster unit sent to provide petroleum support to airfields by providing jet fuel for aircraft.[27] The 737th Medium Truck Company, 842nd Quartermaster Company (Petroleum Depot), and the 173rd Petroleum Company (Operational) from the Army Reserve, which provided petroleum line haul

[25] Commander, 64th Quartermaster Battalion, Operational Report–Lessons Learned, HQ, 64th Quartermaster Battalion (Petroleum Operating), (Headquarters, U.S. Army, Pacific, 15 February 1967), accessed 19 May 2019, https://apps.dtic.mil/dtic/tr/fulltext/u2/827120.pdf, 6.

[26] Dunn, *Base Development in South Vietnam 1965-1970*, 124.

[27] Robert J. Dixon, "Examining U.S. Army Logistics: Determining Relevance for 21st Century Operations" (Monograph, School of Advanced Military Studies, U.S. Army Command and General Staff College, Fort Leavenworth, KS, May 2012), accessed 19 May 2019, https://apps.dtic.mil/dtic/tr/fulltext/u2/a611841.pdf, 19, 20.

deployed in May of 1968.[28] Lastly, the 259th Quartermaster Battalion was activated over the 173rd Petroleum Company, the 737th Medium Truck Company, and the 842nd Quartermaster Company to provide command and control. These units were activated to support the surge after the Tet Offensive and show that the reserve forces were used to support the surge but were not part of the broader strategic plan for Vietnam.

The Vietnam War also revealed other shortfalls. Increased demand in fuel during Vietnam revealed insufficient quantities of military fuel trucks in the Corps which required civilian tank truck support. “Insufficient quantities of tank trucks both commercial and military and the Army's ability to install military Victaulic pipelines (constructed by joining 20 foot lengths of 6" steel pipe with bolted couplings) resulted in the decision to install these pipelines wherever they were most needed and they could be protected.”[29] This fuel shortage was due to an increase in motorized equipment without an equivalent increase in distribution at the DISCOM. The usage of shipping contracts and pipelines led to pilferage by shippers and the local population as well as the destruction of pipelines in theater due to insufficient security. These lessons learned forced the Army to invest millions of dollars in temporary petroleum storage[30] for forward units. Additionally, the Army increased pipeline and linehaul distribution capability to better prepare for future wars in unimproved theaters where fuel may not be readily available.

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[28] James T. Currie, “The Army Reserve and Vietnam,” *Parameters* 14, no. 3 (1984): 80, accessed 19 May 2019, https://apps.dtic.mil/dtic/tr/fulltext/u2/a531975.pdf.

[29] Heiser, *Vietnam Studies: Logistics Support*, 77.

[30] Logistics Review Board, *Logistics Support in the Vietnam Era,* 48.

Navy and Marine Corps Petroleum Supply in Vietnam

The Army's petroleum distribution and storage shortfalls in Vietnam affected the other services all differently. Though the US Military at the time was far from an integrated joint force, the services did work together in some capacity to source, distribute, and store petroleum. The US forces in Vietnam were task organized under the MACV. The Army was organized under the MACV as I Field Force, II Field Force, and the US Army Vietnam, which consisted of support forces. However, the other services had the Naval Forces Vietnam, the 7th Air Force, and the III Marine Amphibious Force. Each service also supported the MACV Advisory force to support the Army of the Republic of Vietnam.[31] The 7th Fleet operating around Vietnam under Naval Force Vietnam consumed 10,850,000 barrels just in 1965. Though this is a significant amount, most Navy equipment remained afloat and was refueled by oilers or barge, with over 70% of refueling occurring while underway.[32] This was important because Vietnam only had one deep draft port, in Saigon, that could take large, deep-draft vessels.[33] This capability allowed the Navy to maintain fuel ships or contract directly with carriers, out of harm's way. This was supported by the Navy's fleet of 55 T-1 and two T-2 tankers, which can hold 280,000 and 150,000 barrels of petroleum respectively.[34] This ensured

[31] Dunn, *Base Development in South Vietnam 1965-1970*, 14.

[32] Logistics Review Board, *Logistics Support in the Vietnam Era*, 38.

[33] Dunn, *Base Development in South Vietnam 1965-1970*, v.

[34] Salvatore R. Mercogliano, *Fourth Arm of Defense: Sealift and Maritime Logistics in the Vietnam War* (Washington DC: Naval History and Heritage Command, 2017), accessed 19 May 2019, https://www.history.navy.mil/content/dam/nhhc/research/publications/publication-508-pdf/NHHC4thArmDefense_final_508.pdf, 8.

that with contracted fuel purchases and internal shipping capability, the fleet could maintain its necessary fuel supply and fuel its fleet while underway in the waters around Vietnam. The Navy was also primarily responsible for supplying the Marine Corps with fuel from Ship to shore and their petroleum management system was completed tied into and relied on the Navy system.[35] Their storage system was composed mostly of 10,000-gallon collapsible fuel tanks.[36] and coastal fueling from Naval assets.

Air Force Petroleum Supply in Vietnam

The Air Force, which primarily consumed aviation fuels, relied heavily on the Army for petroleum support. This would often be done through Military Interdepartmental Purchase Requests to the Army's DFSC.[37] The Air Force's demand for petroleum was high. One Air Force refueling base in particular, Tan Son Nuht Airbase, received over 22 million gallons of JP-4 from the Army's 64th Petroleum Battalion in the first quarter of FY 1967 alone.[38] The Air Force initially relied on the Vietnamese Air Force owned storage at some air bases, such as Da Nang and Bien Hoa to provide storage capability early in the conflict.[39] Eventually the Air Force had to deploy all 25 R-1 hydrant fueling systems with 50,000-gallon collapsible tanks to Vietnam to support Air

[35] Logistics Review Board, *Logistics Support in the Vietnam Era*, 19, D-50.

[36] Ibid., 21.

[37] Ibid., 18.

[38] Commander, 64th Quartermaster Battalion, Operational Report–Lessons Learned, 3.

[39] Dunn, *Base Development in South Vietnam 1965-1970*, 126.

Force operations while trying to maintain a 30-day stockage of fuel[40]. The nature of Air Force operations and the limited number of Air Force bases in Vietnam allowed them to build bulk petroleum storage at all of their bases. These storage facilities enabled them to maintain enough fuel to support sorties, even when distribution issues arose, such as attacks or regional supply shortages.

MACV Advisors Embedded in Vietnam

The MACV advisory teams had a more flexible relationship in getting fuel. The teams were small, embedded teams working with the Army of the Republic of Vietnam. They sourced their petroleum from the Army of the Republic of Vietnam as needed, though their consumption was low.[41] This allowed them to reduce the load on the US system. However, since petroleum flow into the region was strained for all forces, this local sourcing helped with US distribution issues, but not overall petroleum shortages in the region.

Army Petroleum Logistics in Operation Desert Storm/Desert Shield (1990-1991)

In Operation Desert Storm bulk petroleum logistics once again faced new challenges that required adaptation. During the peak of petroleum consumption in Vietnam in 1968, US forces in Vietnam were consuming about 200 million gallons of bulk petroleum per month.[42] The Vietnam War required fewer tanks, due to the jungle

[40] Logistics Review Board, *Logistics Support in the Vietnam Era*, 38.

[41] Heiser, *Vietnam Studies: Logistics Support,* 229.

[42] Ibid., 73.

warfare but had transitioned to the M1 tank at the beginning of the conflict. The M1 tank consumes approximately 241% of the fuel consumed by the M60.[43] Consumption jumped to 250 million gallons of petroleum per month during only eight months in Desert Storm.

Additionally, the Army was in the process of moving to a single fuel concept which had started in 1988.[44] However, since Saudi Arabia was a developed theater and petroleum was readily available, these plans were set aside and multiple fuels were used for the operation. The lessons of Vietnam had been applied through the addition of tactical fuel storage and distribution at the Corps and Division Support Commands. Additionally, contracting capabilities had been vastly expanded to meet shortfalls in the Army's supply and distribution systems. However, increased consumption and a changing battlefield in future conflicts would once again present a logistical challenge in providing bulk fuel to the force.

The expansion of fuel distribution and storage assets at the tactical level helped support a more robust and effective petroleum distribution system. Even after Vietnam, in the mid-1980s studies projected a growth in bulk petroleum consumption by the Army's

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[43] U.S. General Accounting Office (GAO), *Abrams Tank: Operating Costs More Than Expected,* Report to the Chairman, Committee on Armed Services, House of Representatives (Washington, DC: GAO, February 1991), accessed 19 May 2019, https://www.gao.gov/assets/220/213784.pdf, 5.

[44] Russell K. Garrett, "Is a Single Fuel on the Battlefield still a viable option?" (Executive Research Project, The Industrial College of the Armed Forces, National Defense University, Fort McNair, Washington, DC, April 1993), accessed 19 May 2019, https://apps.dtic.mil/dtic/tr/fulltext/u2/a276757.pdf, 1.

vehicle fleet by 146%.[45] This led to doctrinal changes in the force and COSCOMs, were allocated non-divisional DS supply companies with two petroleum platoons that could receive, store, and issue 600,000 gallons of fuel a day.[46] This may seem like an enormous volume of fuel; however, it was estimated during Desert Storm that an armored division with M1 tanks would consume over 600,000 gallons of fuel per day, which was more than Patton's entire Third Army[47] during World War II. This clearly shows the Army's push to develop critical storage and distribution capability at the tactical level to ensure that the issues faced in Vietnam were not repeated. The Army also added Quartermaster Groups to handle petroleum distribution in the COSCOM. In a Quartermaster group they created Tactical Petroleum Terminals (TPTs), which consisted of fabric tanks, pumps, and fuel lines that could hold 2,100,000 gallons of fuel to distribute to the force.[48] Additionally, Quartermaster Groups were assigned transportation battalions with multiple transportation medium truck companies that operated 60 petroleum tank trucks, each with

[45] D. J. Sheeran Sr., R. D. Kavanaugh, G. A. Kupets Sr., "Survey of Current US Army POL Doctrine, Procedures, Personnel, and Equipment for the Supply and Inland Distribution of Bulk POL," Final Report prepared for Combat Service Support Directorate, U.S. Army Human Engineering Laboratory (Armanent Systems Inc., Aberdeen, MD, October 1985), 2.

[46] Headquarters, Department of the Army (HQDA), Field Manual (FM) 63-3, *Corps Support Command* (Washington, DC: Government Printing Office, 1993), 6-5.

[47] Richard D. Hill, "Depot Operations Supporting Desert Shield," *Military Review* 71, no. 4 (April 1991): 17, accessed 19 May 2019, https://apps.dtic.mil/dtic/tr/fulltext/u2/a252790.pdf.

[48] Joseph T. Thomas, "Petroleum Operations in the Gulf War, An Operation Desert Storm Personal Experience Monograph," (Study Project, U.S. Army War College, Carlisle Barracks, PA, 15 April 1993), accessed 19 May 2019, https://apps.dtic.mil/dtic/tr/fulltext/u2/a263676.pdf, 7.

a capacity of 5,000 gallons.[49]. These capabilities significantly increased tactical distribution in the force; however, due to increased consumption rates and high usage, there were still bulk petroleum shortfalls within the Corps and Divisions during operations.

During Operation Desert Shield and Operation Desert Storm (ODS), the Army Reserve components mobilized over 115,000 Reserve Component Soldiers consisting of over 235 units.[50] Over 100 of those mobilized and deployed reserve component units, operating in direct support, were logistics units.[51] These forces included 13,708 Transportation Soldiers and 13,716 Supply and Service Soldiers, many of whom were employed in the supply and distribution of fuel.[52] This represented a substantial increase from the usage of the Reserve and National Guard during Vietnam. These reserve assets were used to help mitigate some of the petroleum supply shortfalls and a lack of required capability in the active component.

A failure to effectively plan for the fast advance of the coalition eventually led to a lack of corps petroleum supply units in theater. Though the force was supplemented

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[49] Ibid.

[50] Steven Duncan, "Gulf War Was a Test of Reserve Units, and They Passed," in *Desert Shield/Desert Storm Employment of Reserve Component: Extracts of Lessons Learned* (Newport, RI: U.S. Naval War College, Operations Department, June 1991), accessed 19 May 2019, https://www.globalsecurity.org/military/library/report/1995/p162.pdf, 26.

[51] Association of the United States Army (AUSA), *The U.S. Army in Desert Storm: An Overview* (Arlington, VA: AUSA, June 1991), accessed 19 May 2019, https://www.ausa.org/sites/default/files/SR-1991-The-US-Army-in-Operation-Desert-Storm.pdf, 10.

[52] Duncan, "Gulf War Was a Test of Reserve Units, and They Passed," 26.

with the contracting of civilian fuel trucks, there were also issues with those vehicles, "However, the plumbing on these civilian tanker trucks was such that military fuel hose couplings could not hook up to them. This interface problem was substantial, and not overcome until interface adapters were found and procured."[53] These problems further highlighted shortfalls that were once again overcome at the tactical sustainment level. Fortunately, LTG Pagonis, Commander of the 22nd Support Command ensured this wouldn't affect maneuver, "His intent was to have enough stocks of class I (food and water), III (fuel) and V (ammunition), along with the transportation assets required to move them, pre-positioned to sustain combat operations for the VII Corps and XVIII Airborne Corps before ground combat operations began."[54] This approach was deemed the Iron Mountain and was effective in the short term. Though the organization ensured tactical units were sustained, VII Corps still had fuel shortages. These shortfalls in distribution ultimately led to a tactical pause during combat operations. However, the 22nd Support Command Commander, LTG Pagonis claimed there were 300 5,000 gallon fuel trucks within 25 miles of the VII Corps assets requiring fuel and that they were awaiting orders from the Logistics Operation Center, meaning the shortage may have

[53] Mitchell H. Stevenson, "Desert Shield/Storm Logistics," (Study Project, U.S. Army War College, Carlisle Barracks, PA, 1993), accessed 19 May 2019, http://www.dtic.mil/dtic/tr/fulltext/u2/a264943.pdf, 11.

[54] Bill Davis, "Our Logistics Failure: The Military's Overreliance Upon Sustainment Contracting," (Master's Thesis, Joint Advanced Warfighting School, Norfolk, VA, 20 May 2011), accessed 19 May 2019, http://www.dtic.mil/dtic/tr/fulltext/u2/a545550.pdf, 37.

been just a failure to effectively coordinate, rather than an actual shortage.[55] Though there may not have been a shortage, a lack of effective communication hurt distribution.

Prepositioned Stock and the US Navy in Desert Storm

The concept of prepositioning supplies for war in forward areas to prepare for military action is not a new one. Long before the US joined World War II, the US started stationing forces and equipment in England to support its ally and prepare for the potential to join the war. However, before Desert Storm, the US had begun building Prepositioned Stocks around the globe in case hostilities were to arise. For petroleum products, this was managed by the Defense Fuel Support Center who maintained an office in the region in Bahrain. They had contracted fuel supplies through the nation of Bahrain and would routinely test it to ensure it met DOD standards.[56] This fuel, like other commodities, is delivered on Navy contracted tankers through the Military Sealift Command under TRANSCOM.[57]. These tankers allowed the Navy easy access to fuel and they could refuel their ships while underway in the Persian Gulf while also delivering fuel to the tactical forces on ground in Kuwait. These prepositioned stocks helped ensure

[55] Bernard L. Moxley Jr., "Class III (Bulk) Distribution Successes: What Can Be Learned?" (Monograph, School of Advanced Military Studies, U.S. Army Command and General Staff College, Fort Leavenworth, KS, 26 May 2005), accessed 19 May 2019, https://apps.dtic.mil/dtic/tr/fulltext/u2/a436108.pdf, 9.

[56] Thomas, "Petroleum Operations in the Gulf War," 5.

[57] U.S. General Accounting Office (GAO), *Military Afloat Prepositioning: Wartime Use and Issues for the Future,* Report to Congressional Requestors (Washington, DC: GAO, 9 November 1992), accessed 19 May 2019, https://www.gao.gov/assets/160/152534.pdf, 18.

that the Navy's tactical assets were easily fueled and that the Army's tactical force could quickly receive fuel from these vessels at the ports in Kuwait.

Marine Corps Petroleum Supply in Desert Storm

The Marine Corps still required the Army to support over the land petroleum supply and distribution support during Operation Desert Shield and Operation Desert Storm. The 1st Marine Expeditionary Force (MEF) arrived in Saudi Arabia with preloaded equipment with the ability to provide 30 days of internal petroleum support.[58] They also had prepositioned petroleum stocks at Mishab and Kibrit to support the Marines, including over 1.8 million gallons of fuel storage at Kibrit.[59] This gave them substantial fuel resources upon arrival and in the defense for Operation Desert Shield, so long as they remained in the defense.

When the coalition transitioned to the offense, the Marines would have to rely heavily on the Army for bulk petroleum support. The Army assigned four petroleum truck companies and the 240th Quartermaster Battalion in direct support of the Marine

[58] James D. Blundell, *Operations Desert Shield and Desert Storm: The Logistics Perspective* (Arlington, VA: The Institute of Land Warfare, Association of the United States Army, September 1991, accessed 19 May 2019, https://www.ausa.org/sites/default/files/SR-1991-Operations-Desert-Shield-and-Desert-Storm-The-Logistics-Perspective.pdf, 7.

[59] Charles Quilter II, *U.S. Marines in the Persian Gulf, 1990-1991: With the I Marine Expeditionary Force in Desert Storm and Desert Shield* (Washington, DC: History and Museums Division, Headquarters, U.S. Marine Corps, 1993), accessed 19 May 2019, https://www.marines.mil/Portals/59/Publications/U.S.%20MARINES%20IN%20THE%20PERSIAN%20GULF%201990-1991%20EXPEDITIONARY%20FORCE%20PCN%2019000317200_1.pdf, 53.

Expeditionary Forces to provide bulk petroleum.[60] This petroleum truck support from the Army helped ensure the Marines had the fuel they needed to maneuver in Operation Desert Storm as they moved forward. The 240th Quartermaster Battalion provided excellent support and was able to sustain the Marine Corps forces as they moved north due to a high operational tempo and the limited distance they traveled since they were conducting a breach rather than a fuel intensive maneuver over 300-500 miles like the VII and XVIII Corps forces.[61] The Army provided petroleum support was critical in ensuring the Marine forces was fuel for the fight in Kuwait and Iraq.

Air Force Petroleum Supply in Desert Storm

The Air Force, unlike the Navy, generally must rely on the Army for some degree of fuel support in Joint Operations. This was not the case in Desert Storm. The Saudi Arabian government had been building bases and stockpiling fuel there in case support from their US ally was ever needed. Upon arrival, the Air Force had 21 bases, ready for operations.[62] These prepositioned stocks at Saudi Air Bases helped facilitate a rapid initiation of operations and buildup of Air Forces. Even as the Air Force expanded from initially operating at three bases to 23 total locations[63], the increase in size required little

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[60] Thomas, "Petroleum Operations in the Gulf War," 35.

[61] Blundell, James D. *Operations Desert Shield and Desert Storm*, 13.

[62] John A. Warden III, "Air Force Performance in Desert Storm," (Operation Desert Storm White Paper, Office of the Secretary of the Air Force, The Pentagon, Washington, DC, April 1991), https://www.scribd.com/document/199712171/Air-Force-Performance-in-Desert-Storm, 9.

[63] Thomas, "Petroleum Operations in the Gulf War," 16.

work since fuel, fuel storage, and runways were pre-stocked at most locations. Since Saudi Arabian fuel stocks and storage were already established, fuel shipments could easily be contracted through the allied government in country, and they were not operating any airfields in hostile area, the Army's tactical petroleum supply and distribution system was not needed to support the Air Force in Operation Desert Shield or Operation Desert Storm.

Army Petroleum Logistics during OIF (2001-2010)

Operation Iraqi Freedom once again changed the way the Army's tactical sustainment operates. Though not adequately tested in Afghanistan, Operation Enduring Freedom also affected tactical sustainment. These operations, which have been ongoing under differing names, for the last 18 years have had a significant impact on the structure of the force. Though different in culture, geography, governance, and operations, the operations in each country have focused primarily on fighting counterinsurgencies[64], rather than LSCO. After years of fighting counter-insurgencies in Iraq and Afghanistan, some believed that the most likely future conflicts would be unconventional wars[65] which would consist primarily of counter-insurgencies. This led to the most significant restructuring of the Army's sustainment force in the modern era.

[64] Javier Salmeron and Jeff Appleget, "Reshaping the US Army: Brigade Combat Team Optimization," *Military Operations Research* 19, no. 3 (2014): 51, accessed 19 May 2019, https://faculty.nps.edu/jsalmero/docs/2014_MOR.pdf.

[65] Andrew Feikert, *Does the Army Need a Full-Spectrum Force or Specialized Units?: Background and Issues for Congress,* Congressional Research Service Report for Congress (Washington, DC: Library of Congress. 2010), 10.

LSCO in Operation Iraqi Freedom only lasted for one month.[66] Though combat operations began in March of 2003, preparation began the summer prior in 2002.[67] This preparation included the construction of fuel farms in northern Kuwait, along the Iraq border, that could hold 7.3 million gallons of fuel. The fuel farms were connected by a pipeline, constructed by the Kuwait National Oil Company to Kuwaiti refineries.[68] This created a supply at the Corps Support Area, next to the Iraqi border, before the invasion that allowed the Army to focus on distribution assets below the corps level. Seven reserve echelon above brigade petroleum distribution companies were also authorized the summer prior to the invasion,[69] to support active duty divisions in distributing petroleum to the force from the border. The Army also tasked 62d Engineer (Heavy) with constructing an Inland Petroleum Distribution System (IPDS), or petroleum pipeline inland to Tallil, Iraq.[70] This construction started in January 2003, prior to the invasion, and went all the way to the border before the invasion began in March of 2003. These

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[66] Gregory Fontenot, E. J. Degan, and David Tohn, *On Point: The United States Army in Operation Iraqi Freedom* (Washington, DC: Operation Iraqi Freedom Study Group, Office of the Chief of Staff, U.S. Army, 2004), xxiv.

[67] Eric Peltz, Marc L. Robbins, Kenneth J. Girardini, Rick Eden, John M. Halliday, and Jeffrey Angers, *Sustainment of Army Forces in Operation Iraqi Freedom: Major Findings and Recommendations* (Santa Monica, CA: Rand Arroyo Center, 2005), accessed 19 May 2019, https://www.rand.org/content/dam/rand/pubs/monographs/2005/RAND_MG342.pdf, 50.

[68] Peltz et al., *Sustainment of Army Forces in Operation Iraqi Freedom*, 51.

[69] Ibid., 12.

[70] Anthony De Simone and Norm Gauthier, "The Inland Petroleum Distribution System in Kuwait and Iraq," *Engineer* (July-September 2003): 13, accessed 19 May 2019, https://apps.dtic.mil/dtic/tr/fulltext/u2/a593051.pdf.

factors helped ensure an ample amount of fuel was available to brigades during the initial invasion.

In 2003, 46 percent of the Army's logistic force was in the Army Reserve components of the Army Reserve and Army National Guard.[71] This led to a higher need for Reserve Component forces to augment the Active Component. At the end of the initial campaign, 120,000 of 369,000 Service Members serving in CENTCOM were in the reserve component with a majority serving in support roles[72]. By November of 2005, there were 78,490 Active Duty Army, 10,320 Army Reserve, and 34,662 Army National Guard personnel in Iraq.[73] With over 30% of forces consisting of Reserve Component forces, many of them supporting petroleum operations, the petroleum supply and distribution force in the Army during OIF became increasingly dependent on the reserve forces to ensure petroleum continued flowing to the forces in Iraq.

After the invasion, the 62d Engineer (Heavy) completed the IPDS from Camp Virginia in Kuwait to LSA Adder in Tallil, Iraq,[74] over 224 miles within two months of

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[71] Joseph Adams, Amy Alrich, John Brinkerhoff, Rachel Dubin, Ann Gilbride, Lance Hancock, Jeffery Jaworski, Drew Miller, Daniel Nakada, Pete Picucci, Richard Polin, Jenns Robertson, Brandon Shapiro, and Katherine Vinci, *Sharing the Burden and Risk: An Operational Assessment of the Reserve Components in Operation Iraqi Freedom* (Alexandria, VA: Institute for Defense Analyses, October 2016), accessed 19 May 2019, https://apps.dtic.mil/dtic/tr/fulltext/u2/1023069.pdf, 7.

[72] Dixon, "Examining U.S. Army Logistics," 41.

[73] Linwood B. Carter, *Iraq: Summary of U.S. Forces,* Congressional Research Service Report for Congress (Washington, DC: Library of Congress, updated 28 November 2005), accessed 19 May 2019, https://fas.org/sgp/crs/mideast/RL31763.pdf, CRS-1.

[74] Ibid.

the invasion. This allowed the 49th Quartermaster Group (POL) to control the flow of fuel from the supplier to the sustainers into Iraq. One Brigade, 49th Group, was moving fuel from the source to over 200 miles into Iraq. This pipeline could supply 720,000 gallons per day of fuel from the fuel farm in Kuwait, which could store 7.3 million gallons.

An insurgency began growing in Iraq after the initial invasion as repeated attempts to stabilize the country failed. This insurgency changed the US Army's focus to counterinsurgency operations.[75] Troop levels surged to fight the growing counter-insurgency. To meet the increase in demand of deployed Soldiers and due to the nature of the counter-insurgency fight, that didn't require division sized maneuver elements, the Army changed its primary unit of action to Brigade Combat Teams from combat divisions.[76] Division Support Commands and Corps Support Groups were removed from the division and corps and made to be standalone modular Sustainment Brigades in 2006.[77] The newly formed Sustainment Brigades would coordinate directly with Brigade Combat Teams to supply fuel. The sustainment capability was no longer needed at the Corps level. Corps' in Iraq didn't need fuel assets to get fuel to the divisions since the 49th group could move fuel from the supplier to the Iraq Border in Kuwait and could transport 262,000,000 gallons per year over 200 miles into Iraq. This significantly reduced the number of trucks needed to haul fuel into the country, though demand would

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[75] Buerskins, *The Long Haul*, v.

[76] Andrew Feikert, "The Army's Sustainable Readiness Model (SRM)," (Congressional Research Service Insight, Washington, DC, 31 March 2017), accessed 19 May 2019, https://fas.org/sgp/crs/natsec/IN10679.pdf, 21.

[77] Ibid., 8.

grow. Expeditionary Sustainment Commands (ESC) and Theater Sustainment Commands (TSC),[78] which were created from the former COSCOMs, would control the flow of fuel. The new Sustainment Brigades were pulled out of divisions and placed under TSCs and ESCs and conducted the distribution of fuel to the Brigade Combat Teams. Brigade Combat Teams were created with Brigade Support Battalions that would interface with the modular tactical sustainment organizations in the newly formed Sustainment Brigades. Brigade Support Battalions in Brigade Combat Teams directly interacted with Sustainment Brigades that were not in their division, to coordinate resupply to their organization.

Demand for bulk petroleum grew in Iraq and contracts for delivered fuel were used to augment the force to sustain fuel deliveries to maintain consumption. In 2004, the US used 1,092,200,000 gallons of fuel.[79] Fuel not shipped by pipeline was bought through five companies in three different countries. Kuwait Petroleum Corporation shipped the fuel through Jassim Transport and Stevedoring Company from Kuwait to Iraq. International Oil Trading Co. shipped fuel through Jordan by truck and was also delivered to Iraq, however by multiple contractors. Petrol Ofisi, Golteks, and Tefirom were based in Turkey and shipped their fuel to Iraq by truck by multiple different

[78] Marc Thoreson, "Army Bulk Petroleum Current Force Structure Mix and its Implications," (Strategy Research Project, U.S. Army War College, Carlisle Barracks, PA, March 2013), accessed 19 May 2019, https://apps.dtic.mil/dtic/tr/fulltext/u2/a590233.pdf, 17.

[79] Anthony Andrews and Moshe Schwartz, *Department of Defense Fuel Costs in Iraq,* Congressional Research Service Report for Congress (Washington, DC: Library of Congress, 23 July 2008), accessed 19 May 2019, https://apps.dtic.mil/dtic/tr/fulltext/u2/a486025.pdf, 4.

contractors under an agreement made under the Intra-theater Commercial Transportation Branch, European Command.[80] The fuel would be delivered to Logistics Support Areas which were logistical hubs in Iraq. From these hubs, Army units would deliver fuel to smaller Forward Operating bases along delivery routes. These agreements allowed the US to rely on contractors to fill the majority of the additional fuel transportation requirements to deliver the needed fuel to hubs in Iraq.

Force changes to create a brigade-based modular sustainment force were not only due to the changes in the BCTs, they were also due to the way that the force was sustained. The creation of semi-permanent Forward Operating Bases allowed for the creation of bulk fuel storage at every location across the entire theater. Logistics Support Areas (LSA) were stocked by contract, except Forward Logistics Base Cedar which was supplied by pipeline. Early on, fuel farms were established at LSA Bushmaster and Forward Logistics Base Cedar that could hold 1.2 million gallons of fuel each.[81] These storage facilities, or bag farms spread across all of Iraq and allowed units to stockpile fuel at Forward Operating Bases (FOB) and store multiple days of supply where they operated. This decreased the need for large tactical logistical distribution forces and ensured the maneuver units and their vehicles were consistently fueled for operations. This allowed the Army to continue to reduce its petroleum sustainment force while maintaining a vast fuel distribution network and ensuring fuel was always available to the warfighter in Iraq.

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[80] Ibid.

[81] Peltz, et al., *Sustainment of Army Forces in Operation Iraqi Freedom*, 14.

Army Petroleum Supply during Operation Enduring Freedom

The Army's operations, to include petroleum support, in Operation Iraqi Freedom were directly affected by Operation Enduring Freedom, even if a multi-corps petroleum operation was not set up during OEF. This is partly because LSCO did not occur in Afghanistan during the beginning of Operation Enduring Freedom. After 9/11, the US requested extradition of Osama Bin Laden, as they had asked before in 1998. When the Taliban refused, it quickly escalated to the overthrow of the poorly organized Taliban forces from power, from October to December of 2001.[82] The US Army in Afghanistan has relied on truck and rail transportation of fuel to get fuel into the land-locked country. Most fuel was trucked in from Pakistan over Khyber Pass from 2001-2009, however, since 2009 more than 70% of fuel comes from Turkmenistan by rail and truck.[83] Contractors moved the fuel once in country; however, unlike Iraq, the contracts were directly with the US government and not the fuel seller. Much like in Iraq, Forward Operating Bases in Afghanistan allowed for the stockpiling of food, water, ammunition, medical supplies, repair parts, and of course, fuel. Unlike in a LSCO, a counterinsurgency political posture led to a limited military role and the role of contractors in providing tactical sustainment skyrocketed.

Contractors took on an increasing role in Afghanistan and Iraq throughout OIF and OEF. The number of contractors in Iraq soared to over 163,000 in June of 2008 when there were just over 146,000 troops in the country with the majority of them providing

[82] Joseph Collins, *Understanding War in Afghanistan* (Washington, DC: National Defense University Press, 2011), 46.

[83] Evans and Masternak, "The Silent Revolution within NATO Logistics," 55.

logistics.[84] Almost all fuel was contracted through the Defense Logistics Agency (DLA) and was shipped overland by contractors to the bases where it was needed. 70% of fuel came by rail through the northern Line of Communication (LOC) and approximately 30% went through the southern LOC through Pakistan.[85] This reliance on contractors led to the deactivation of the 49th Quartermaster Group, the last active duty Petroleum and Water Group which included the last active duty Petroleum pipeline and terminal operating company; this left the bulk of the Army's limited bulk petroleum movement capability in the Army Reserve.[86]

The Reserve Component also played a role in logistics support during Operation Enduring Freedom in Afghanistan. As of 2008, the Army Reserve and Army National Guard had 1,369 and 3,284 personnel respectively supporting operations in Afghanistan while the Active duty had 15,728.[87] However, only a small number of those reserve component personnel provided oversight of petroleum sustainment to the force. Though

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[84] Moshe Schwartz and Jennifer Church, *Department of Defense's Use of Contractors to Support Military Operations: Background, Analysis, and Issues for Congress,* Congressional Research Service Report for Congress (Washington, DC: Library of Congress, 17 May 2013), accessed 19 May 2019, https://fas.org/sgp/crs/natsec/R43074.pdf, 25.

[85] Schwartz and Church, *Department of Defense's Use of Contractors to Support Military Operations,* 25.

[86] CASCOM Force Development Directorate, *Sustainment Force Structure Book*, 20.

[87] Michael Waterhouse and JoAnne O'Bryant, *National Guard Personnel and Deployments: Fact Sheet,* Congressional Research Services Report for Congress (Washington, DC: Library of Congress, 17 January 2008), accessed 19 May 2019, https://fas.org/sgp/crs/natsec/RS22451.pdf, CRS-5.

the reserve component was heavily used for support in Afghanistan during OEF, petroleum was almost exclusively contracted and the Army merely provided oversight.

Naval Petroleum Supply in OIF and OEF

The Navy, during Operation Iraqi Freedom and Operation Enduring Freedom, as in other conflicts and for various reasons, has had little need for fuel support from its sister services. The expansion of the US Navy's nuclear propelled ships has skyrocketed since Vietnam, with over 40% of the modern fleet using nuclear propulsion[88], significantly reducing petroleum consumption of the Naval forces. The vast majority of the navy operates underway on the seas, meaning they would not need petroleum hauled tactically, over the land, through the operational environment. The Navy's sea operations ensure they have direct access to the fuel that they purchase, even with the increase in contracting. This coupled with the limited involvement of naval forces in Afghanistan due to it being landlocked ensured that the Navy had minimal, if any, effect on the Army's tactical bulk petroleum distribution system during Operation Iraqi Freedom. This was also the case in landlocked Afghanistan, which has no ports for the Navy to moor their ships or resupply.

[88] Charles Ferguson, Bethany Goldblum, Alireza Haghigat, Paul Ingram, Alan Kuperman, Charles Leidig, Bojan Petrovik, and Nick Ritchie, *Naval Nuclear Propulsion: Assessing Benefits and Risks: The Report of an Independent Task Force (*Washington, DC: Federation of American Scientists, March 2015), accessed 19 May 2019, https://fas.org/wp-content/uploads/2015/03/FAS_Naval_Nuclear_Propulsion_Assessing_Benefits_and_Risks2015.pdf, 17.

Marine Corps Petroleum Supply in OIF and OEF

The Marine Corps in Operation Iraqi Freedom and Operation Enduring Freedom had to work through contracting and its sister services to meet its fuel needs while operating during Operation Iraqi Freedom and Operation Enduring Freedom. The Marine Corps operating at ports or conducting amphibious landings can draw fuel from Naval fuel ships afloat at the port however it must rely on the Army or contractors due to its limited petroleum fleet and storage capabilities.[89] Due to the limited availability of fuel assets and the counterinsurgency warfare, the Marine Corps leaned on contracted fuel supply much like its sister services during OIF and OEF.

During the opening months of Operation Iraqi Freedom, the Marine Corps expected to rely on the Theater Sustainment Command for Logistics support. When logistics shortfalls occurred at the TSC, the Marine Logistics Command had to contract over 300 cargo and fuel trucks to meet their fuel needs.[90]. The Marines also built an ad hoc joint element, the 1st Transportation Support Group with elements from the Marine Corps' 1st Transportation Support Battalion, elements from the Marine Corps Reserve's 6th Motor Transport Battalion, and the Army Reserve's 319th POL Company. This

[89] Headquarters, U.S. Marine Corps (HQMC), Marine Corps Reference Publication (MCRP) 3-40B.5, *Petroleum and Water Logistics Operations* (Washington, DC: HQMC, 02 May 2016), accessed 19 May 2019, https://www.marines.mil/Portals/59/Publications/MCRP%203-40B.5.pdf?ver=2017-03-28-141021-523, E-2.

[90] Michael Kibler, "A Different Air War: Marine Air Control in Operation Iraqi Freedom," in *US Marines in Iraq, 2003: Anthology and Annotated Bibliography: U.S. Marines in the Global War on Terrorism,* compiled by Major Christopher M. Kennedy, Wanda J. Renfrow, Evelyn A. Englander, and Nathan S. Lowrey (Washington, DC: History Division, U.S. Marine Corps, 2006), accessed 19 May 2019, https://www.marines.mil/Portals/59/Publications/U.S.%20Marines%20in%20Iraq,%202003_Anthology%20and%20Annotated%20Bibliography_1.pdf, 160.

organization operated from Kuwait to Baghdad, supplying over 7,000,000 gallons of fuel to the Marine Corps in Iraq.[91] This allowed them to meet the fuel needs of their force with limited support from the Army during the initial invasion of Iraq. The limited capability of fuel support from 377th TSC continued to prove inadequate to support both V Corps and I MEF, as increases in fuel support units did not arrive, Marine Logistics Command's fuel contracting mission grew. MLC eventually had over 230 third country nationals, from 11 different countries, shipping fuel to the I MEF from Kuwait into Iraq. The Marines, like the other services, continued contracting for fuel throughout the war.

The Marine Corps did not play a large role in Operation Enduring Freedom in Afghanistan. Their limited role was due in part to the fact early on in the operation, General Franks accepted that the Marines' doctrinal role and capability is within 200 miles of the Pakistani Coast. This led to the creation of one Marine Corps element known as Task Force 58 in southern Afghanistan[92]. The Marines' small contingent, much like their sister services in Afghanistan had few options to contract fuel shipping into country

[91] Wallace Gregson, "I Marine Expeditionary Force Summary of Action," in *US Marines in Iraq, 2003: Anthology and Annotated Bibliography: U.S. Marines in the Global War on Terrorism,* compiled by Major Christopher M. Kennedy, Wanda J. Renfrow, Evelyn A. Englander, and Nathan S. Lowrey (Washington, DC: History Division, U.S. Marine Corps, 2006), accessed 19 May 2019, https://www.marines.mil/Portals/59/Publications/U.S.%20Marines%20in%20Iraq,%202003_Anthology%20and%20Annotated%20Bibliography_1.pdf, 7.

[92] Nathan S. Lowrey, *U.S. Marines in Afghanistan, 2001-2002: From the Sea: U.S. Marines in the Global War on Terrorism* (Washington, DC: History Division, U.S. Marine Corps, 2011), accessed 19 May 2019, https://permanent.access.gpo.gov/gpo20162/FROM%20THE%20SEA.pdf, 24.

on their own and had to receive fuel from fuel shipped through Pakistan via rail and then throughout Afghanistan by contractors and US military personnel.[93]

Air Force Petroleum Supply in OIF and OEF

The counterinsurgency conflicts in Operation Iraqi Freedom and Operation Enduring Freedom affected the fuel support of the Air Force. The non-linear battlefield put the Air Force in a position where they were no longer able to order all of their fuel to their airfields along safe roads, far from the range of enemy attack. During Operation Iraqi Freedom, the fuel stocks in Kuwait that were prepositioned proved adequate for early air operations. Air campaigns could be conducted from the safety of Kuwait and the fuel was already in place and replenished by contract by the Kuwaitis. However, upon entering Iraq, the Air Force had to find another way to resupply bulk petroleum. The fuel in Iraq was filled like it was by the other services, by contracted shipping. This was maintained at joint bases, since air bases were in contested areas on the non-linear battlefield. They relied on the same bag farms that the Army and Marine Corps used at the bases which they also occupied: such as Tallil Air Base, Joint Base Balad, and Kirkuk Air Base. In Afghanistan, the Air Force relied on the joint distribution of fuel that was hauled into the country over land. This fuel was shipped through Pakistan via rail and then through Afghanistan by contractors and US military personnel.

[93] Benjamin S. Lambeth, *Air Power Against Terror. America's Conduct of Operation Enduring Freedom* (Santa Monica, CA: Rand Corporation, 2005), accessed 19 May 2019, https://www.rand.org/content/dam/rand/pubs/monographs/2006/RAND_MG166-1.pdf, 67.

Summary

The cornerstone of modern tactical logistics centers on the sustainment brigade's ability to support and supply the brigade combat teams effectively. Historically tactical logistics was built into the divisional support structure, as a Division Support Command, and was built around supporting the Division in which it was embedded. Corps also had a Corps Support Group to ensure they had adequate logistical support. As logistics at the tactical level changed, so did tactical logistics in supporting the ever-changing fight.

These changes over the last 50 years have had a significant impact on the way Army tactical logistic organizations provide petroleum to the joint force. The Army's ability to supply bulk petroleum to the joint force is increasingly important as it is clear that future military operations will be jointly executed.[94] This increase in joint execution comes as contracting has increased as a means to meet fuel distribution shortfalls. Even back to Vietnam, contracting and local procurement were necessary to provide enough petroleum for combat operations. That role has dramatically expanded, but it may prove difficult in a LSCO, where contractors and local nationals may not be welcome or willing to support in such a large capacity on or near the battlefield. These conflicts overcame problems as they encountered them, but against a peer or near peer threat, the combat environment may not be so forgiving and fuel shortage issues may not be so easily overcome when fighting a more capable enemy.

Most of the literature on the topic focuses on logistics shortfalls of the past and the shift to a contracting heavy force. This research is excellent in providing a framework

[94] Olinger, *Logistics and the Combatant Commander*, v.

for why the force is built the way it is and how the Army has had difficulty in effectively planning for logistics operations of the future. This research is limited in scope and will be augmented with further research on the capabilities of the current force in critical tactical logistics requirements to conduct offensive operations in a joint force in LSCO.

CHAPTER 3

RESEARCH METHODOLOGY

The purpose of this research is to determine whether the Army's current sustainment brigade structure is designed adequately to effectively provide bulk petroleum to the joint force in Large Scale Combat Operations. This study examines how the changes made to the Sustainment force structure during the three most significant conflicts of the last 50 years and how those changes affected the Army's ability to provide bulk petroleum support to the joint force. This study will help advance the body of knowledge on requirements for the future distribution and storage capability of bulk petroleum at the tactical level. The research will provide a through an analysis on the Army's current ability to provide bulk petroleum to a joint force assembled to fight in the next potential large-scale combat operation.

Methodology Type

The research methodology used in this thesis is a case study of Army bulk petroleum support, within a bounded system.[95] This qualitative analysis will be conducted through a multiple case study[96] with three cases. The three examples are Vietnam from 1965 until 1973, Desert Storm from 1990 until 1991, and the war on terror, specifically Operation Iraqi Freedom and Operation Enduring Freedom from 2001-2010.

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[95] Sharan Merriam, *Qualitative Research: A Guide to Design and Implementation* (San Francisco: Jossey-Bass, 2009), 40.

[96] John Creswell, *Qualitative Inquiry & Research Design: Choosing among Five Approaches* (Lincoln: University of Nebraska, 2007), 74.

These cases were selected because they were the most extensive, multi-corps combat operations involving US Forces during the last 50 years. This will help answer the questions of how and why the Army's petroleum and distribution systems are structured in their current form, presenting an advantage in this case study.[97] This method allows for a comprehensive review of historical petroleum logistics support capabilities within the Army as it evolved to meet requirements of the joint force during the major conflicts of the last 50 years. As the Army adapted to overcome petroleum shortfalls of the past, analysis can help show why the Army's current tactical bulk petroleum supply and distribution force is structured in its current form. Researching the development of these changes allows for analysis on how it is structured to support potential future conflicts.

Variable Selection

This multiple case study requires the use of variables, or something of interest that can take on different values and can be measured.[98] The variables must be qualitatively measurable to support building operational definitions of those variables.[99] Chapter four (Table 1) provides a table that tracks each measured variable by case. Setting these variables will help determine the shifting capabilities of the tactical logistics forces in the Army as it maintains the joint force during LSCO through the storage and distribution of petroleum. This makes the most critical variable the supply and distribution throughput

[97] Merriam, *Qualitative Research*, 41.

[98] Bernard C. Beins, *Research Methods: A Tool for Life,* 2nd ed. (Ithaca, NY: Ithaca College, 2009), 123.

[99] Ibid.

capability of the petroleum distribution force in the US Army. These variables can be studied in the cases by the Army's ability to distribute fuel in combat operations based on the fuel supplied, issues faced, and the area and number of forces supported; measuring the Army's petroleum throughput capability can help determine how large of a force the Army can support. A second variable that should be measured is the ability of the Army tactical logistics force to support its sister services during each major conflict studied. This helps determine the interoperability, one of the principles of joint petroleum doctrine[100], of the petroleum force and how well it is prepared to support other forces that operate over the land. A third critical variable is the amount of petroleum support the Army has supplied through contracts. As contracting has grown to over $206 billion during OIF and OEF from 2001 until 2011[101], it has had a substantial effect on logistics support. Though this has helped cover shortfalls in the logistics force, it would likely not be available in the forward area during many potential LSCO fights. Therefore, the usage of petroleum contract support during the studied cases must be factored, since reliance on contracting may show a weakness in petroleum support infrastructure that cannot be easily overcome. The Last variable is the Army's use of the Army Reserve and National Guard to support its petroleum force. Lower readiness and training as well as the amount of time it takes to prepare and mobilize the reserve forces lessen the capability of the total

[100] Joint Chiefs of Staff (JCS), Joint Publication (JP) 4-03, *Joint Bulk Petroleum and Water Doctrine* (Washington, DC: Joint Chiefs of Staff, 11 January 2016), accessed 16 May 2019, https://www.jcs.mil/Portals/36/Documents/Doctrine/pubs/jp4_03pa.pdf?ver=2018-02-08-091424-107, ix.

[101] Commission on Wartime Contracting in Iraq and Afghanistan, *Transforming Wartime Contracting: Controlling Costs, Reducing Risks* (Arlington, VA: Commission on Wartime Contracting, August 2011), 20.

force to supply petroleum when needed. These variables give quantifiable measurements on how capable the Army's Corps and Divisional sustainment elements are at supplying petroleum with internal assets and supporting its sister services. Measuring the level of contracting support quantifies how much the force relies on contracting, which can reduce demand in the corps and divisional areas, even if only used at the theater level. Measuring the usage of Reserve Component forces helps determine how capable the force is to deploy on short notice, since the Army Reserve takes time to prepare, train, and mobilize. These variables together provide the best measure of the ability of the Army to support the Joint Force in a timely, effective, and efficient manner.

Each variable will be weighted equally in the thesis. The higher the variable, the more valuable the capability is to LSCO. This weight will be used to measure the effectiveness of the variable. These variables will be used to measure the effectiveness of the Army's tactical logistics force, based in the Sustainment Brigade, to support a joint force in a potential future LSCO fight based on its past capabilities and its evolution through time. This weighted score will be from 1-5, with five being the highest, and one being the lowest. Studying these variables across the evolution of the Army's petroleum logistics force will help show how much fuel the Army can supply, how able the Army is to provide the Joint Force, and how contracting may mask shortfalls in petroleum capabilities which may not be available in the future.

Table 1. Data Analysis Table Design

Petroleum Supply and Distribution Analysis			
Case / Variable	Vietnam War	Desert Storm/ Desert Shield	Iraqi Freedom/ Enduring Freedom
Army Storage & Distribution Capability			
Army's ability to support sister services			
Army reliance on Petroleum Contracting			
Army Reliance on Reserve POL units			

Source: Created by author.

Analysis of Cases

The employment of a multiple case study across four variables will help determine the petroleum supply capabilities of the Army to supply bulk petroleum. This will allow for an analysis of the petroleum supply capability for future LSCO. These qualitative measurements of the Army's capabilities and shortfalls in past conflicts including the distribution and supply capability, the ability to support sister services, and the reliance on petroleum contracting will help develop a picture of how the Army has shaped its petroleum force for future conflicts. These variables, coupled with the current force structure and taking into account the potential petroleum requirements for the joint force in LSCO in the future can help determine possible shortfalls in the Army's current ability to supply bulk petroleum. The information will be analyzed with current Army

distribution capabilities to determine how effective the Army can move, store, and supply fuel from port to theater while support joint forces in a non-permissive environment. This will create a detailed analysis of how the Army is tailored and able to support the joint force in potential future conflicts. A disadvantage of this method is the availability of information on the topic.

The first step in this methodology is analyzing how the current Army Sustainment Brigade structure has supplied fuel to the force in recent history during major conflicts. This study must examine the ability not only to distribute fuel at the Corps and Division level but also to store it in case of shortfalls. The number and type of petroleum organizations available in the force, at the time, have a substantial effect on this. The equipment available and those capabilities also affect this support. This can be measured by the amount of storage and distribution capability the Army could provide during each case. The more capable the petroleum force is in supplying fuel, the more likely it is to be prepared to supply fuel in LSCO. Sustainment brigades, or DISCOMs and CSGs will be measured in each case for their total throughput capacity. Throughput capacity will be assessed by the ability to ship fuel during multi-corps operations in theater. Culmination or tactical pauses must also be taken into consideration as a potential negative factor. Throughput should be measured against a benchmark that measures a quantity of fuel that could supply the total current force at modern consumption rates. This means each potential service member from the Army and Marine Corps who could be supported by the Army's Corps and Divisional Sustainment Structure must be able to be supported. At

22 gallons per day, per service member,[102] with 1,216,241 service members in the Army, Army Reserve, Army National Guard, Marines Corps, and Marine Corps Reserve in March of 2019 .[103] there is a potential for 22,837,430 gallons of fuel to be moved by Corps and Division echelon sustainment brigades (See Table 2). That amount of daily, organic petroleum supply by the sustainment brigade, or DISCOM and CSGs will set a benchmark for the top of the scale of measurement of the variable. Therefore, a five will be assessed for the ability of the petroleum force to distribute 22,837,430 gallons of fuel or more, per day. A four will be assessed for between 10,000,000 gallons of fuel per day and 22,837,430 gallons of fuel per day. A three will be evaluated between 4,000,000 and 10,000,000 gallons of fuel per day distributed. A two will be assessed for between 1,000,000 and 4,000,000 gallons of fuel per day. A one will be assessed for less than 1,000,000 gallons of fuel per day of distribution. These measurements allow for an excellent measure of throughput capability. However, any culminations or operational pauses must be taken in to account. Operational pauses or culminations of division sized elements or higher will decrement the score by one to take into account failure to adequately supply the force since this is a critical measure of the ability to provide fuel.

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[102] Charles Wald and Tom Captain, *Energy Security: America's Best Defense* (New York: Deloitte, 2009), accessed 19 May 2019, https://www.offiziere.ch/wp-content/uploads/us_ad_EnergySecurity052010.pdf, 3.

[103] Defense Manpower Data Center, "DoD Personnel, Workforce Reports & Publications," Department of Defense, 2019, accessed 16 May 2019, https://www.dmdc.osd.mil/appj/dwp/dwp_reports.jsp.

Table 2. Potential Joint Fuel Requirements

Joint Petroleum Throughput Calculation			
Component	**Personnel**	**Fuel/SM**	**Potential Consumption**
Active Army (FORSCOM + 6 GCCs)	299,097	22	6,580,134 gallons
Army Reserve (Compo 1 Units)	180,985	22	3,981,670 gallons
National Guard (Compo 2 Units)	333,283	22	7,332,226 gallons
Marine Corps	186,493	22	4,102,846 gallons
Marine Corps Reserve	38,207	22	840,554 gallons
		Total Fuel	22,837,430 gallons

Source: Defense Manpower Data Center, "DoD Personnel, Workforce Reports & Publications," Department of Defense, 2019, accessed 16 May 2019, https://www.dmdc.osd.mil/appj/dwp/dwp_reports.jsp; Charles Wald and Tom Captain, *Energy Security: America's Best Defense* (New York: Deloitte, 2009), accessed 19 May 2019, https://www.offiziere.ch/wp-content/uploads/us_ad_EnergySecurity052010.pdf.

Next, the analysis must determine what level of support the Army provided to sister services during the conflict. The necessary support and how it has been shaped can help determine what capabilities the Army has been able to provide. Measuring support to sister services will also help show the potential for future requirements from sister services in LSCO. The more support the Army has provided and can provide shows how effective the Army is at supplying its fellow services while also providing petroleum supply for its forces. This can be measured by the number of assets that the Army dedicated to sister services during conflicts. A one will be assessed for no dedicated petroleum assets to sister services from within CSGs, DISCOMs, or sustainment brigades. A two will be assessed for a dedicated company or less of dedicated petroleum units. A three represents two companies to a battalion of support dedicated to sister service support and a four will represent two battalions to a brigade of support. A five will represent multiple sustainment brigades of support.

The next major variable that must be evaluated and assessed is the level of contracting required to sustain the force. This variable is important because contracting is a very effective means to support the force, especially at the theater level. However, in the corps and division areas, contractors and other non-combatants may not be allowed in a LSCO against a near-pear enemy. The inability of contractors to operate in the corps and division areas would likely mean the Army's sustainment brigades must be able to support corps and divisions internally. The study will evaluate the reliance on contractors in each major conflict. The study will evaluate the employment of contracting by the number of contractors, measured by the ratio of contractors to Soldiers. A one will be assessed for more contractors than Soldiers during a conflict and a two will represent between one and four Soldiers to each contractor. A three will be assessed for between 10 and 5 Soldiers for each contractor and a two will be evaluated for between 10 and 50 Soldiers to each contractor. A five will be assessed for a ratio of more than 50 Soldiers to each contractor. This will help measure how much contracting was used to sustain the force.

The last variable that will help assess the ability and effectiveness of the force to supply petroleum in LSCO is the employment of the Army Reserve and National Guard components. These reserve forces are part of the total force; however, they require more time and training to support the force. These forces cost substantially less but take at least 53 days to mobilize[104] for deployment at a minimum. Reserve forces also often have

[104] Thomas Lippiatt, Michael Polich, Ronald Sortor, and Patricia Dey, *Mobilization and Train-Up Times for Army Reserve Component Support Units* (Santa Monica, CA: Rand Arroyo Center, 1992), accessed 19 May 2019, https://www.rand.org/pubs/monograph_reports/MR125.html, 36.

lower readiness as well as manning and equipment issues. In a LSCO that may require forces to be trained, manned, equipped, and shipped out on a moment's notice, Army Reserve and National Guard Soldiers increase risk and lengthen timelines. This means that they reduce the overall capability to supply the Joint Force in a LSCO, especially if they are needed very quickly. Due to this lowered capability, as the employment of the reserve forces increases, the capability of the Joint Force to supply petroleum to the force decreases. Throughout the cases, the employment of Army Reserve and National Guard forces will be measured to determine how reliant the force is on the reserve forces to provide tactical petroleum sustainment. A one will be assessed for deployment of over 30% of the reserve forces. A two will be assessed for deploying 20-30% of the reserve forces and a three will be assessed for deploying 10-20% of the reserve component forces. A four will be assessed for utilizing 5-10% of the reserve forces and a five will be assessed for deploying 5% or less of the reserves. This will allow for a measurement of the requirement of the reserves to provide fuel to the force.

Analyzing each case across the four variables of petroleum supply and distribution across these three case studies helps determine where the Army is going and what capabilities it has developed. The four variables; The Army's storage and distribution capability, the Army's ability to support its sister services, the Army's reliance on petroleum contracting, and the Army's reliance on reserve POL units will allow for measurement of how capable the Army has been at supplying petroleum to the Joint Force and how well it is postured to supply petroleum for future conflicts. Analysis of these variables will allow the research to establish trends and determine how the force developed into the current force.

The next step will be to take historical, qualitative data on how the Army has been able to supply petroleum and reconciling it with current capabilities. This will be based on the force structures of recent historical conflicts. Identifying this will help determine future requirements for fueling the Joint Force over the land, to include the Army and Marines. It will also address the potential to supply some forward Air Force elements but must consider that the Air Force can generally operate its strategic airlift from a safe distance and can locally procure most of its fuel for those aircraft. It will also consider the fact that only limited bombing and fighter units would potentially need fuel supplied in a forward environment. This measurement will provide an estimate of what support the tactical logistics force can contribute to the Army and joint force. It will focus on the tactical sustainment structure and its capabilities from the Sustainment Brigade down to the company level, including known quantities and amount of support they can provide.

The final step is to reconcile the capabilities versus potential capability requirements to determine potential shortfalls in the Army tactical logistics support capabilities. This should provide an unbiased and reasonable assessment of where Army tactical logistics capabilities could fall short of providing the joint force with its bulk petroleum requirements in future LSCO.

Summary

This research methodology used in this study is a multiple case study. This multiple case study aims to answer the primary research question, Is the Army's current sustainment brigade structure adequately designed to effectively provide bulk petroleum to the joint force in Large Scale Combat Operations? The cases being analyzed are Vietnam from 1965-1973, Operation Desert Shield and Operation Desert Storm from

1990-1991, and Operation Iraqi Freedom from 2001-2010. These cases are the only examples of the Army conducting multi-corps petroleum operations with its tactical petroleum supply system within the sustainment brigade and its predecessors. The ability to supply petroleum in these cases will be measured by four variables: The Army's storage and distribution capability, the Army's ability to support its sister services, the Army's reliance on petroleum contracting, and the Army's reliance on reserve POL units. These variables will help measure how the Army's petroleum system was able to support the Joint Force in prior conflicts and how it became what it is today. The study will also help develop trends on petroleum requirements the Army's petroleum force within the sustainment brigade will see in the future. Lastly, the study will look to what the future may require of the sustainment brigade in supporting the Joint Force in LSCO. Analyzing the ability of the sustainment brigade structure to support LSCO in the future will help answer the primary research question. Answering the primary research question can identify likely shortfalls and potential solutions.

CHAPTER 4

ANALYSIS

The purpose of this study is to answer the primary research question: Is the Army's current sustainment brigade structure adequately designed to effectively provide bulk petroleum to the joint force in Large Scale Combat Operations? Additionally, this study seeks to answer the secondary research questions:

1. How effectively postured is the US Army modular sustainment brigade logistics system to support the joint force without contractors or air resupply from the port to the battlefield in a contested, non-permissive environment?
2. What changes has the Army made over the last 50 years to the DISCOM/CSG or Sustainment Brigade and what effect have those changes had on the Sustainment Brigade's ability to support a LSCO?
3. Would changing from the modular sustainment structure to the more traditional divisional sustainment structure of the last 50 years effectively support future joint operations?

Answering these research questions will add to the professional body of knowledge on Army petroleum capabilities within the Sustainment Brigade. This study will also help identify potential shortfalls in petroleum supply and distribution and courses of action to mitigate those shortfalls.

To help answer this question, a multiple case study provides the ability to measure the effectiveness of the force across set periods. Measuring the effectiveness of the petroleum force during major conflicts, involving multiple corps, allows the study to measure trends in the petroleum force and helps determine what has shaped the tactical

petroleum force in the DISCOMs, CSGs, and ultimately the sustainment brigades. Though each conflict has variable factors, such as differing road and rail networks, host nation support, force strength, and enemy behavior, these cases still provide the best examples of the application of the United States Army's petroleum logistics force to measure its effectiveness. This historical analysis, when factored with the sustainment brigade's current petroleum storage and distribution capability and the potential needs in future conflicts will help answer the primary research question.

Analysis of Variable Factors

Four major variables affect the supply and distribution of petroleum within the Army for the Joint Force. The first variable, the basic throughput capability of the force, is determined by the amount of storage and distribution capability that the Army has to move petroleum across the battlefield in its Sustainment Brigades. This has varied dramatically over the last 50 years and has been shaped by the major conflicts in which the US has participated. This variable includes all the active and reserve force units, prepositioned stocks of Quartermaster petroleum units, and Transportation units that line haul petroleum. This variable must also take into consideration the maximum ready pool of forces since some forces will not be in their mission or ready modules. Analysis of the three cases will help determine what should be available based on past conflicts and trends over the last 50 years. The current model, the Sustainable Readiness Model, must be factored since its goal is to increase available forces. However it still has a limit of approximately 66% of forces as available.[105] The best benchmark to measure the Army's

[105] Feickert, "The Army's Sustainable Readiness Model," 2.

ability to store and distribute petroleum is its overall throughput capacity. The uninterrupted flow of fuel provides a baseline that is measurable measurable. This factor, though very relevant, doesn't account for shortfalls in the force that are covered by other means, such as the reserve component's mobilization times or contracting's possible inability to operate in the Corps or Division area during LSCO. It does, however, give a picture of what the Army could provide when needed, with organic assets, over the land to its tactical forces. A five will be assessed for the ability of the petroleum force to distribute over 22,837,430 gallons of fuel a day. A four will be assessed for between 10,000,000 gallons of fuel per day and 22,837,430 gallons of fuel per day. A three will be assessed for between 4,000,000 and 10,000,000 gallons of fuel per day distributed. A two will be assessed for between 1,000,000 and 4,000,000 gallons of fuel per day. A one will be assessed for less than 1,000,000 gallons of fuel per day of distribution. This study will decrement the score of any measurement by one to take into account failure to adequately supply the force by way of culmination or operational pause since this is a critical measure of the ability to supply fuel.

The second variable is the Army's ability to support its sister services. This variable is focused on the Army Sustainment Brigade's ability to provide over the land petroleum not to itself, but to Marine Corps and Air Force units that may be too far forward for contract resupply; this also includes any Navy or other forces that may be operating in the JOA. This variable must consider throughput of the available Army Sustainment Brigade's logistics forces to provide petroleum beyond the needs of just the Army. This will be measured by the number of Sustainment Brigades or elements that exist within the sustainment brigade structure, that the Army provides to support its sister

services. A one will be assessed for no dedicated petroleum assets to sister services from within CSGs, DISCOMs, or sustainment brigades. A two will be assessed for a dedicated company or less of dedicated petroleum units. A three represents two companies to a battalion of support dedicated to sister service support and a four will represent two battalions to a brigade of support. A five will be assessed for multiple sustainment brigades of support to sister services.

The next variable focuses on the Army's reliance on contracting. This variable addresses the Army's increased reliance on contracting and how it holistically affects the ability to supply fuel where contracting may not be available. This variable must be analyzed across the cases to address the Army's reliance on petroleum contracting and what effect that will have on the Sustainment Brigade's ability to support the Joint Force in future LSCO. A one will be assessed for more contractors than Soldiers during a conflict and a two will represent between 1 and 4 Soldiers to each contractor. A three will be assessed for between 5 and 10 Soldiers for each contractor and a two will be assessed for between 10 and 50 Soldiers to each contractor. A five will be assessed for a ratio of more than 50 Soldiers to each contractor. This will help measure how much contracting was used to sustain the force.

The last variable is the amount of the Army's logistics forces to the Army Reserve and Army National Guard. These forces cost the Department of Defense substantially less while not activated and generally take 53 days to mobilize[106] for deployment when needed. Due to the maintained modular structure of the Army's Sustainment Brigade,

[106] Lippiatt et al., *Mobilization and Train-Up Times for Army Reserve Component Support Units*, 36.

reserve component units, which exist in all tiers of the Sustainment Brigade structure, have a noticeable effect on the Sustainment Brigade's ability to supply fuel to the Joint Force. Overreliance on these forces could have a detrimental impact on a war that starts rapidly and requires immediate establishment of logistics, especially the supply and distribution of petroleum. A one will be assessed for deployment of over 30% of the reserve forces. A two will be assessed for deploying 20-30% of the reserve forces and a three will be assessed for deploying 10-20% of the reserve component forces. A four will be assessed for utilizing 5-10% of the reserve forces and a five will be assessed for deploying 5% or less of the reserves. This will allow for a measurement of the requirement of the reserves to provide fuel to the force.

These variables allow the study to focus on the ability of the Army's Sustainment Brigades throughout the force to supply and distribute fuel to the Army and its sister services operating in the JOA in a LSCO. It will also take into consideration the effects of utilizing reserve forces and contracting, which can significantly affect supplying the force promptly in a contested environment.

Vietnam Analysis

The conflict in Vietnam, from 1965 to 1973, had a profound and lasting effect on how the DISCOM provided petroleum logistics in the United States Army. The nation of Vietnam lacked petroleum infrastructure and was not prepared for the fuel hungry American forces. The country only had one deep-draft port and limited petroleum storage capabilities. Additionally, Vietnam's roads and bridges were extremely inadequate for transporting fuel. The insurgency created a non-linear battlefield which required the Army to defend convoys and not use trains for supply as they were easy targets. Many of

these challenges were new for the Army, even with past lessons learned. These factors shaped the DISCOM and CSGs to distribute and store petroleum effectively.

The DISCOMs and CSGs ability to store and distribute petroleum in Vietnam was built around LSCO for the force structure of the time. DISCOMs relied on their Transportation Battalion distribution of Class III bulk to the brigades within the division.[107] The DISCOM used a combination of unit and supply point distribution, which consisted of tankers. The higher echelon field army or corps support command's support group would deliver the fuel in tankers to the division tankers within the supply and transportation battalion.[108] The 1st Logistical Command regulated fuel and distributed to the four Corps. Doctrinally, however, the intent for petroleum, oil, and lubricants was to maintain as much of a throughput concept as possible to minimize the need for storage.[109] The fuel distributed by organic assets from the 1st Logistical Command to the Corps was them sent to DISCOMs and made its way to the units. During the first four months of 1968, the year of the Tet Offensive, the 1st Logistical Command distributed between 2.0 and 2.4 million barrels of fuel per month, at an average of 2.25 million barrels. [110] This comes out to an average of 3.15 million barrels of fuel per day to the four corps in Vietnam. This assesses the fuel distribution capability

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[107] HQDA, FM 54-2, 20.

[108] Ibid., 21.

[109] Headquarters, Department of the Army (HQDA), Field Manual (FM) 54-3, *The Field Army Support Command* (Washington, DC: Government Printing Office, 1968), 3-19.

[110] 1st Logistical Command, *Fact Book: 1968* (APO San Francisco: Department of the Army, Headquarters, U.S. 1st Logistical Command, 1968), 41.

of the CSGs and DISCOMs, during one of the periods of highest usage in Vietnam, at a two.

The Army's ability to support sister services in Vietnam was limited. Joint support capability was possible, but likely not used in the DISCOM because its purpose was to support the division to which it was assigned. The 1st Logistical Command provided all fuel after 1970 over the land in Vietnam, including I CTZ, the area formerly supplied by the Navy.[111] The Navy still provided the Marines some ship to shore fuel support to supply their vehicles and 10k fuel bags, but the DISCOMs within the Divisions did not provide external sustainment support for the Marines. The Air Force, like the Marine Corps, received fuel from the Army, which was delivered to their bases. Though the Army was charged with its delivery, the majority of their fuel came from the 64th Petroleum Battalion[112] and there is no evidence that DISCOMs provided any of that fuel. These factors lead to the assessment of the Army's capability of DISCOM and CSGs in Vietnam to supply fuel to its sister services as a one out of five.

Military contracting grew substantially during the conflict in Vietnam. Due to the poor road network and inadequate petroleum infrastructure, the Army relied heavily on contracts to ship petroleum into the country. Throughout the conflict, the Army at the theater level supplemented its military trucks with 2,600-gallon civilian contracted fuel trucks[113] to move enough fuel inland to the Corps and Divisions operating inland. During

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[111] 1st Logistical Command, Operational Report-Lessons Learned, 42.

[112] Commander, 64th Quartermaster Battalion, Operational Report–Lessons Learned, 3.

[113] Logistics Review Board, *Logistics Support in the Vietnam Era*, 47.

the conflict, there was an average of one contractor for every five military personnel in country, most of whom were conducting Combat Support and Combat Service Support roles. This petroleum force provided fuel to the sister services and the Army tactical units, much like a modern sustainment brigade. Due to the role that the contractors played in supporting the tactical force, the reliance on contractors is assessed a three out of five.

Lastly, the Army's reliance on reserve forces in Vietnam was minimal. Exclusively in 1968, after the need for a quick surge with limited tactical petroleum assets available for use did the Army utilize reserve petroleum forces. The Army only mobilized and deployed three reserve companies, one reserve battalion HQ, and one National Guard company to support the effort in Vietnam.[114] These forces provided fuel to the Air Force and other forces that needed fuel from the 1st Logistical Command. In 1968, the Army Reserve and National Guard had approximately 648,000 Soldiers.[115] A total of 5,869 reserve component soldiers were sent to Vietnam[116], not even 1% of the total reserve forces available. This level of reliance on the reserve components to fill the petroleum capability gap assesses the reliance on the reserve a five out of five.

Operation Desert Shield/Desert Storm Analysis

Operations Desert Shield and Desert Storm from 1990 to 1991 were substantially different from the previous major conflict in Vietnam. It represented a return to LSCO

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[114] Currie, "The Army Reserve and Vietnam," 80.

[115] Office of the Under Secretary of Defense (Comptroller), *Selected Manpower Statistics* (Washington, DC: Department of Defense, 15 April 1971), accessed 16 May 2019, https://apps.dtic.mil/dtic/tr/fulltext/u2/a954022.pdf, 71.

[116] Currie, "The Army Reserve and Vietnam," 80.

from counterinsurgency. Saudi Arabia and Kuwait lacked rivers and wetlands like Vietnam and the vehicles could easily cross the open expanses of desert. The Kingdom of Saudi Arabia and the government of Kuwait also supported the force, which helped with the sustainment of the operation, more so than the controversial conflict in Vietnam. This vastly different environment greatly affected how the DISCOM and CSG supplied fuel to the joint force.

The DISCOM and CSGs ability to supply the Army's tactical fuel force in Operation Desert Shield and Operation Desert Storm was well structured for the fight. Divisions deployed with their own DISCOMs, which were created to support their fuel needs. The Corps Support Commands each had adequate Corps Support Groups. The 1st COSCOM had the 43rd CSG, 46th CSG, 171st Corps Support Group, and the 507th CSG and the 2nd COSCOM had the 7th CSG, 16th CSG, 30th CSG, and the 159th CSG.[117] Each of these COSCOMs had two dedicated POL battalions, a POL Group, and multiple transportation companies and battalions to provide distribution.[118] This provided adequate fuel storage and distribution for the XVIII and VII Corps for the initial invasion. The Corps were supplied by 22nd Support Command with 4.5 million gallons per day, 2.4 million gallons per day for VII Corps and 2.1 million gallons per day for XVIII Airborne Corps.[119] The 22nd Support Command supplied this fuel to its two corps, which they distributed to their divisions. This was however disrupted by an operational pause, though

[117] Transportation Corps, "Desert Storm/Desert Shield Order of Battle," https://transportation.army.mil/history/OrderOfBattle/DesertShield.html.

[118] Ibid.

[119] Blundell, *Operations Desert Shield and Desert Storm*, 15.

whether it was due to coordination with full fuel trucks available and standing by, as stated by LTG Pagonis, or an overall shortage of fuel in the VII Corps is still up for debate.[120] Regardless, the operational pause slowed the initiative and effectively showed a weakness in the ability to supply fuel to the force. The fuel distribution was between four and ten million gallons per day; however, the operational pause reduces the assessment of fuel storage and distribution in the CSGs and DISCOMs to a two out of five.

The Army's support of its sister services grew during Operation Desert Storm/Desert Shield. The tactical support provided did not come from the traditional Corps Support Group or DISCOM, but from the 240th Quartermaster Battalion, a tactical petroleum battalion, under the 475th Quartermaster POL Group, 22nd Support Command. The 240th Quartermaster Battalion provided fuel to the Marine Expeditionary Force.[121] At the time, Quartermaster POL battalions could be used at Corps or higher; two were in Corps Support Groups, while two were under the 22nd Support Command.[122] This analysis assesses the CSGs and DISCOMs as a three out of five for the ability to support the joint force since the Army provided a battalion of support from its CSG structure to support a sister service.

The Army's tactical petroleum system relied on petroleum distribution from the host nation more than US Government contracting. The Saudi Arabian government had a

[120] Moxley, "Class III (Bulk) Distribution Successes," 9.

[121] Thomas, "Petroleum Operations in the Gulf War," 35.

[122] Transportation Corps, "Desert Storm/Desert Shield Order of Battle."

quasi-governmental organization, the Saudi Arabian Marketing and Refining Company (SAMAREC) that provided petroleum supply and delivery. SAMAREC had a fleet of 5,000 fuel trucks, which were a combination of organization-owned and contracted trucks.[123] The vast support of the Saudi Arabian government substantially decreased the need for the US military to use its resources to move fuel into theater and supported the movement of fuel within theater. The Saudi Arabian logistics support and robust American supply system across all classes of supply and methods of distribution was so effective that the Department of Defense had only one contractor for every 55 service members in the theater, the majority of which provided combat service support.[124] Though effective host nation support, the US didn't need to rely so heavily on contracting to supply fuel for its forces. This analysis assesses the reliance on contracting of the tactical petroleum force during Operation Desert Shield and Desert Shield as a five out of five for a ratio of over 50 service members to each contractor.

The Army's reliance on the Army Reserve for petroleum supply and distribution in Operation Desert Storm and Desert Shield was very high. This was in stark contrast to Vietnam and came about from the Total Force Policy, which the Army enacted in 1973. The Total Force Policy meant that the Army Reserve was expected to be able to deploy

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[123] Thomas, "Petroleum Operations in the Gulf War," 18.

[124] Congressional Budget Office (CBO), *Contractors' Support of U.S. Operations in Iraq* (Washington, DC: CBO, August 2008), accessed 16 May 2019, https://www.cbo.gov/sites/default/files/110th-congress-2007-2008/reports/08-12-iraqcontractors.pdf, 13.

forces quickly and play a role in major contingency operations in the future.[125] The Army reserve was able to supply one CSG, the National Guard supplied two CSGs, and both reserve components provided dozens of supporting quartermaster battalions, fuel transportation companies, and POL companies.[126] Unlike DISCOMs, which were organic to a division, Corps Support Groups and their assets were more fluid and could be moved around. Army Reserve units made up a substantial part of the petroleum force in theater. The Army Reserve had 13,708 Transportation Soldiers and 13,716 Supply and Service Soldiers, many of whom provided supply and distribution of fuel within the Corps Support Groups.[127] Overall, the Reserve Component mobilized 115,000 Soldiers, many of whom were combat service support Soldiers.[128] This was out of a total of 683,000 Soldiers in the Army Reserve and the National Guard, at the time. This equates to a mobilized force of approximately 17% of the available reserves. Due to the mobilization of roughly 17% of the reserve forces, which is between 10 and 20% of the total, the reliance on the reserve force in ODS is assessed as a three out of five.

Operation Iraqi Freedom

Operation Iraqi Freedom started as a LSCO but eventually became a counterinsurgency fight. Petroleum supply and distribution in OIF began as a large

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[125] Lippiatt et al., *Mobilization and Train-Up Times for Army Reserve Component Support Units*, 5.

[126] Transportation Corps, "Desert Storm/Desert Shield Order of Battle."

[127] Duncan, "Gulf War Was a Test of Reserve Units, and They Passed," 26.

[128] Ibid.

buildup of forces at the Kuwait border with multiple petroleum forces ready to support LSCO. The local Kuwaiti government supported the efforts, local contracts were established, and ports were available to bring additional petroleum. Even after the invasion, with the increasing demand for fuel and the breakdown of the linear battlefield, the Army quickly adapted with additional fuel distribution contracting rose and FOB storage capabilities increased. [129]

Leading up to the invasion of Iraq, units were prepositioned along the border of Iraq in Kuwait. The Kuwaiti government, collaborating with the US government, built pipelines and massive storage tanks to support US forces for the potential invasion. [130] This allowed COSCOMs and CSGs to focus on moving the fuel form the border to the DISCOMs during the invasion, which led to a lower risk of running out of fuel. After the initial invasion of Iraq, resupply was conducted by truck until March 2003 when the initial IPDS started pumping fuel into Iraq, reducing distribution distances for many CSGs. [131] This pipeline helped lessen the burden on the force and reduced the distance the Corps Support Groups had to travel to deliver fuel. The large volume of petroleum distribution assets and the incredible support of the Kuwaiti government ensured that petroleum supply and distribution into Iraq to the tactical forces was incredibly successful. [132] Additionally, the pipeline built by the 62nd Engineers helped reduce

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[129] Peltz et al., *Sustainment of Army Forces in Operation Iraqi Freedom*, 14.

[130] Ibid., 51.

[131] De Simone and Gauthier, "The Inland Petroleum Distribution System in Kuwait and Iraq," 13.

[132] Peltz et al., *Sustainment of Army Forces in Operation Iraqi Freedom*, 50.

distribution distances for the units delivering fuel. This helped ensure that fuel operations remained stable through the LSCO portion of the invasion and initial occupation of OIF. The great fuel distribution successes of the initial LSCO operations in OIF helped ensure tactical victory for the maneuver units. During the initial invasion, the 101st Airborne Division set up multiple refueling locations, such as Rapid Refuel Point Exxon, Forward Area Refueling Point Shell, and FOB 5.[133] As units established these refueling points and FOBs, logisticians worked to increase storage for follow on operations. These FOBs built up over time and as the insurgency intensified, these bases helped reduce the uncertainty of supply. These facts are important to the petroleum supply and distribution operations during the conflict. Ultimately, the ability to measure the Army's capability to supply and distribute fuel effectively during LSCO is best measured during the LSCO of the initial invasion of OIF. During the initial invasion of Iraq in 2003, the Army's supply and distribution at the DISCOM and CSG level was very successful. However, it slowly transitioned to contracted supply and distribution of fuel as the conflict transitioned to a counterinsurgency. Though during the first three months of the invasion, in 2003, the Army's 3rd COSCOM easily supplied 402,000 gallons daily to the V Corps in theater.[134] However, over a few short years, the supply and distribution of fuel moved almost exclusively to contracts with Army oversight. Due to this small distribution throughput that eventually moved almost entirely to contracting, the Army's demonstrated organic storage and distribution capability in OIF is assessed a one out of five.

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[133] Fontenot et al., *On Point*, 113.

[134] Peltz et al., *Sustainment of Army Forces in Operation Iraqi Freedom*, 14.

The Army's ability to support its sister services with petroleum support in Iraq showed the increased reliance between services in the Joint Force. At the beginning of the invasion of Iraq, I MEF was assigned a Corps Support Group with seven transportation companies and various other subordinate units that helped provide storage and distribution of petroleum.[135] The Army had learned its lessons from past conflicts and ensured it kept its Marine Corps brethren supplied. The Navy during the invasion had over 40% of the modern fleet using nuclear propulsion[136] and maintains significant fuel barges with its fleets. Additionally, the Air Force, especially during the invasion, maintained its forces in Kuwait until it was safe to occupy bases in Iraq during the transition to stability which turned to counterinsurgency operations. Since the Army provided an entire Corps Support Group to another service support, this study assesses the Army's ability to support its sister services in OIF as a four out of five.

During OIF and OEF the Army became increasingly reliant on contracting, including petroleum contracting, to maintain the force. During the invasion of Iraq, the Army provided the majority of its fuel to its forces. The Army, with support of the Kuwaiti government and the other members of the coalition, prepared for the invasion before moving into Iraq. The coalition stockpiled fuel on the border,[137] sourced substantial fuel distribution resources, and prepared to build the IPDS into Iraq.[138] Army

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[135] Fontenot et al., *On Point*, 64.

[136] Ferguson et al., *Naval Nuclear Propulsion*, 17.

[137] Peltz et al., *Sustainment of Army Forces in Operation Iraqi Freedom*, 51.

[138] De Simone and Gauthier, "The Inland Petroleum Distribution System in Kuwait and Iraq," 13.

engineers completed early fuel farms and built the IPDS to store and ship fuel into Iraq.[139] These assets helped support the initial invasion, however, as the forces in Iraq began facing an insurgency and fuel consumption topped one billion gallons per year,[140] contracting increased substantially. This led to fuel contracts with five different companies in Kuwait, Turkey, and Jordan supplying the additional needed fuel.[141] Though all fuel is purchased through contracts, whether from US companies or foreign entities, the contracted delivery of fuel on the battlefield presents a more significant threat to preparation for LSCO. As Operation Iraqi Freedom continued, Defense Energy Support Center (DESC) contracted the delivery of fuel from the source to the battlefield, reducing the need for Army fuel shipping.[142] Eventually, as the war continued, contractors eventually made up 50% of the DoD workforce in Iraq. This was even worse during the concurrent conflict in Afghanistan, where 59% of the DoD workforce was contractors. This ratio was the highest ratio of contractors in a major American conflict.[143] Part of this increase in contracting was the reduced cost and part of it was due to the fact that the Army did not have the resources available to supply all of the fuel required. This would have required 9,103 Soldiers in an oversized Quartermaster POL

[139] De Simone and Gauthier, "The Inland Petroleum Distribution System in Kuwait and Iraq," 13.

[140] Andrews and Schwartz, *Department of Defense Fuel Costs in Iraq*, 4.

[141] Ibid.

[142] Ibid., 5.

[143] Schwartz and Church, *Department of Defense's Use of Contractors to Support Military Operations*, 5.

Brigade and 2,760 7.5k fuel tankers, which is four times more than the Army currently owns.[144] This study assesses the Army's reliance on contractors during OIF as a two out of five due to the 1:1 ratio of contractors employed during the conflict.

The Army Reserve forces were heavily utilized in OIF. Though Army Reserve forces initially supported much of the petroleum storage and distribution in Iraq through Engineers constructing pipelines, to quartermaster companies providing storage, to transportation companies delivering fuel. In 2005, over 120,000 Soldiers out of just over 550,000 Reserve and National Guard component Soldiers. These Soldiers made up almost a third of the total Soldiers in Iraq.[145] This was partially due to the fact that a large percentage of the logistics force has been deactivated or moved to the reserve component. By 2012, the Army had reduced echelon-above-brigade petroleum companies down to three truck companies and three petroleum support companies to provide petroleum supply and distribution to the force.[146] This study assesses the reliance on the reserve forces as a two out of five due to over 20% of the reserve forces being mobilized.

Trend Analysis

Analyzing data trends of the United States Army's petroleum supply system through the major conflicts of the last 50 years yields information that can be used for

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[144] Jeffrey Carra and David Ray, "Evolution of Petroleum Support in the U.S. Central Command Area of Responsibility," *Army Logistician* 42, no. 5 (September-October 2010), accessed 14 May 2019, https://alu.army.mil/alog/issues/sepoct10/petrol_support.html.

[145] Dixon, "Examining U.S. Army Logistics," 41.

[146] Thoreson, "Army Bulk Petroleum Current Force Structure Mix and its Implications," 11.

planning. This information can help determine the path the Army has been on and where the Army is currently headed. These trends, when analyzed against current threats and potential operating environments, can produce the knowledge of potential shortfalls and course corrections that may help the Army's Sustainment Brigades, and assets contained within, prepare for the future.

The Army's petroleum and distribution capability to supply the force is an ever-changing dynamic. Over time, the Army has generally adopted more equipment that requires more fuel, in turn, increasing the demand for petroleum across the force. Additionally, as maneuver force compositions change, sustainment units adapt to supply them. During Vietnam, the Army established 1st Logistical Command and four full Corps, each with Corps Support Groups. Each Division maintained its internal DISCOM. This robust fuel system helped supply the force, though it was supported by some local fuel contractors. Road networks were poor and storage was inadequate, but the Army built up storage and had adequate fuel forces in the CSGs and DISCOMs to support operations.

The Active Army grew to over 1,500,000 (Table 4) Soldiers through a draft and had a more than sufficient petroleum force to supply the Army. Only during the surge, after the Tet offensive, were reserve forces a necessity and even then, they were limited. As the Army shrank from the end of major combat operations in Vietnam in 1973 until the start of Operation Desert Shield in 1990, the US military maintained a LSCO focused force with a robust fuel supply and distribution system. Fortunately, the Army did not require as many combat or support forces for Operation Desert Storm and Operation Desert Shield.

Additionally, the Saudi Government greatly aided the force in supplying petroleum, allowing the Army to focus its petroleum supply and distribution efforts within the Corps. The force had adequate petroleum resources for the war and the eight CSGs ensured the fuel continued flowing. Even during the tactical pause, LTG Pagonis ensured the force the fuel shortage was merely a coordination issue since there was a more than adequate supply of fuel in the area. This marked the peak of internal fuel supply and distribution for the United States Army. After 9/11, the total Army was one third smaller than the force that had fought and won Operation Desert Storm (Table 4). The Army never fully established an organic supply and distribution network of fuel in Afghanistan and relied on contracting instead. In OIF, petroleum forces in CSGs and DISCOMs were successful at the onset of the war in storing and supplying petroleum to the force. Eventually, the war transitioned to a counter-insurgency. The Army reduced its petroleum forces to create a modular force, relying more on reserve forces. DISCOMs and CSGs became sustainment brigades and many of their assets were deactivated or moved to the reserves. The petroleum force was not as robust in the former CSGs and DISCOM and it was further reduced and replaced to make more room for modular maneuver forces. This led to the Army declining after Desert Storm in its ability to supply its force with petroleum (Table 3).

The Army's ability to support its sister services has grown over time. During Vietnam, services primarily self-supported. The Marine Corps, the only other ground force, relied heavily on the Navy. Army tactical units were built to self-support as well. CSGs supported their Corps and DISCOMs supported their divisions. During Operation Desert Shield and Operation Desert Storm that changed. The Army attached a petroleum

battalion to the 1st MEF and it paid dividends in providing tactical support, though sister service support was still limited. The Saudi Arabian government provided the majority of the support to the Air Force. During OIF the Army attached a heavily augmented CSG to the Marine Corps during the invasion of Iraq. Attaching these forces helped ensure the Marines were well supplied with petroleum. This tactical support was part of increased interoperability and indicative of more future joint support. Though the Army did not provide a petroleum infrastructure in Afghanistan, the forces worked together in Iraq and Afghanistan to contract and supply fuel as the services have increased their interoperability and cooperation (Table 2).

The Army's reliance on contractors has always existed but has changed substantially over the last 50 years. In Vietnam, fuel contractors drove smaller local fuel trucks to supply the force with fuel. [147] The use of contractors remained low as the force was very large and capable, with the ratio remaining one contractor to five service members.[148]. This went substantially down during Operation Desert Shield and Operation Desert Storm since the Saudi Arabian government was willing to provide supplies to the force because they felt an existential threat. Their support reduced the number of contractors needed by the US to 1 contractor per every 55 Soldiers.[149], the lowest ever in an American conflict. The Saudi government still contracted fuel distribution and supply

[147] Logistics Review Board, *Logistics Support in the Vietnam Era*, 30.

[148] CBO, *Contractors' Support of U.S. Operations in Iraq,* 13.

[149] Ibid.

through SAMAREC, but they were not US contractors.[150] Contracting again increased during OIF and OEF to never before seen levels. The contractor to Soldier ratio was over one to one, with 50% of the DoD workforce in Iraq as contractors and 59% in Afghanistan.[151] The contractors quickly overtook the US forces supplying fuel and eventually supplied almost all of the fuel to the joint force. As the counterinsurgency continued, the force became incredibly reliant on the use of fuel contractors to supply the force.

The reserve forces have seen varying degrees of action during the last 50 years. During Vietnam, reserves were only called up to meet the demands of the surge in 1968. Only five reserve petroleum units were activated and deployed from the reserves.[152] This changed substantially after the reserve forces were operationalized in 1973 under the total force policy.[153] The Army mobilized and deployed over 115,000 Soldiers from 235 units, which made up over a third of the Army's forces in ODS,[154] yet only 17% of the total Army Reserve and National Guard's overall personnel strength. A large percentage of these forces performed petroleum supply and logistics in Corps Support Groups. The number of reserve forces required increased again in OIF and OEF. By the end of the

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[150] Thomas, "Petroleum Operations in the Gulf War," 18.

[151] Schwartz and Church, Church. *Department of Defense's Use of Contractors to Support Military Operations,* 5.

[152] Dixon, "Examining U.S. Army Logistics," 19.

[153] Lippiatt et al., *Mobilization and Train-Up Times for Army Reserve Component Support Units*, 5.

[154] Duncan, "Gulf War Was a Test of Reserve Units, and They Passed," 26.

initial campaign, 120,000 of 369,000 Soldiers were from the reserve components. [155] 46% of sustainment resided in the reserve components and that ensured that reserve forces would continue to be needed to sustain the force. [156] This demand for reserve forces continued to increase and though petroleum primarily went to contracting and will likely continue trending up in future conflicts.

Table 3. Data Analysis

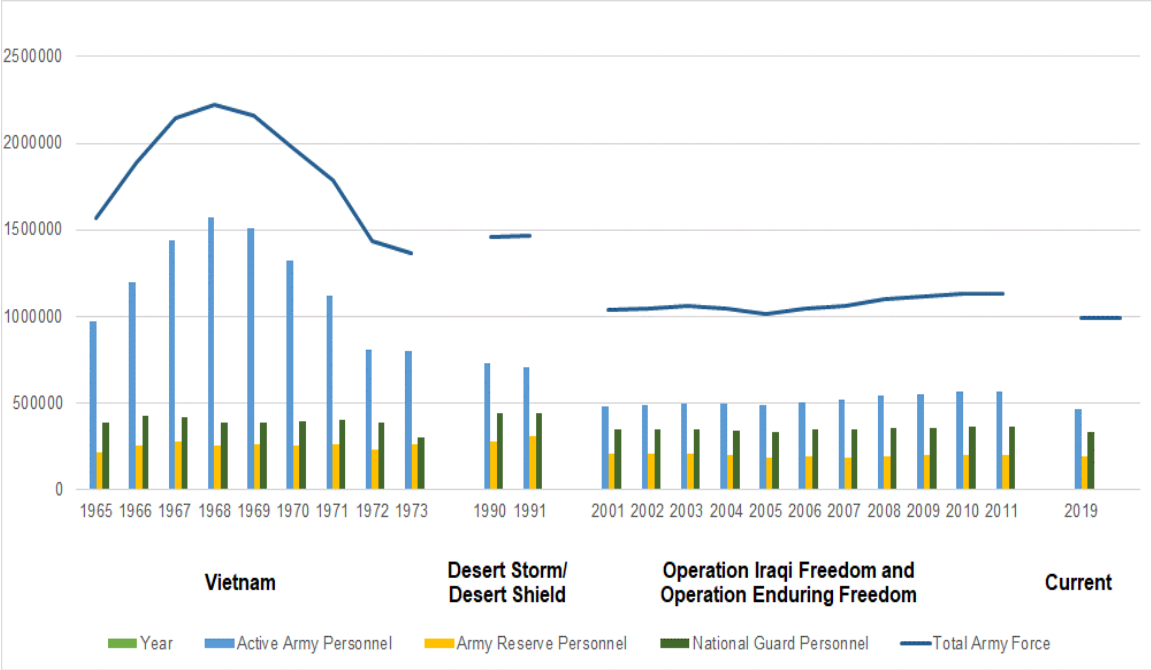
Petroleum Supply and Distribution Analysis			
Case / Variable	Vietnam War	Desert Storm/ Desert Shield	Iraqi Freedom/ Enduring Freedom
Army Storage & Distribution Capability	2	2	1
Army's ability to support sister services	1	3	4
Army reliance on Petroleum Contracting	3	5	2
Army Reliance on Reserve POL units	5	3	2

Source: Created by author.

[155] Dixon, "Examining U.S. Army Logistics,' 41.

[156] Adams et al., *Sharing the Burden and Risk*, 7.

Table 4. Army Total Personnel End Strength during Three Cases



Sources: Defense Manpower Data Center, "DoD Personnel, Workforce Reports & Publications," Department of Defense, accessed 16 May 2019, https://www.dmdc.osd.mil/appj/dwp/dwp_reports.jsp; Office of the Under Secretary of Defense (Comptroller), *Selected Manpower Statistics* (Washington, DC: Department of Defense, 15 April 1971), accessed 16 May 2019, https://apps.dtic.mil/dtic/tr/fulltext/u2/a954022.pdf; Federal Research Division, Library of Congress, *Historical Attempts to Reorganize the Reserve Components* (Washington, DC: Library of Congress, October 2007), accessed 16 May 2019, https://www.loc.gov/rr/frd/pdf-files/CNGR_Reorganization-Reserve-Components.pdf.

Potential Requirements of the Joint Force in LSCO

Many prognosticators attempt to predict when and where the next major American conflict will be and how it will play out. Some predict LSCO with near peer competitors. Some believe it will be a proxy war, while others think there will be another counterinsurgency fight. The US has conducted 18 years of counterinsurgency and tailored its forces to conduct that fight. This, however, has not prepared the US for a

potential LSCO fight with a competitor like Russia or China, each of which would have an array of belligerents and an unknown composition of forces. Despite being unknown, the location, belligerents, and composition of the forces are some factors that will affect the petroleum consumption of the force. The M1 tank burns 241% more fuel than the M60 or M48 tanks and has only really been used in Iraq during ODS and OIF.[157] This main battle tank's usage resulted in an operational pause during ODS. During OIF the estimates are that this fuel thirsty tank could make Army divisions require 600,000 gallons of fuel per day,[158] which over long distances could stress the petroleum force. Though there are far fewer tank formation today than in prior conflicts, this is still a cause for concern. That does not factor in the likelihood of sustainment brigades supporting Marine Corps MEFs that can use up to 1,204,856 gallons of petroleum per day while performing an assault or 950,010 gallons per day at sustained rates,[159] based on Marine Corps doctrine. Using doctrinal fuel consumption rates quickly takes estimates into the multiple millions of gallons per day. However, this estimate becomes difficult since measuring individual formations is tedious and overly complicated due to the vast number of different formations used on the battlefield, the limited data on some formations fuel consumption rates, and the various configurations they come in. A more straightforward estimation that takes into account current burn rates across the force per Soldier allows for a more expedient calculation. In 2009, each service member on the

[157] GAO, *Abrams Tank*, 5.

[158] Hill, "Depot Operations Supporting Desert Shield," 17.

[159] HQMC, MCRP 3-40B.5.

battlefield required an average of 22 gallons of fuel per day. This rate, which has increased by 2.6% every year for the last 40 years, may lack precision, but takes into account more modern equipment and modern warfare's higher demand for energy.[160] These rates of consumption by formation and by Soldier help develop some idea of how much fuel the US could require in future conflicts.

The Army's sustainment brigade must be ready to supply fuel to the entire generating force consisting of FORSCOM and GCCs as well. The Army's petroleum force should also be prepared to provide petroleum for the whole Marine Corps tactical force as well. A high estimate for fuel consumption would take into account supplying fuel to the entire operational force of the Active Army, Army Reserve, National Guard as well as the whole Marine Corps and Marine Corps Reserve. Though it does not take into account training units in the Marine Corps, it gives an estimate for fuel that leaves some room for a small, potential, and undetermined amount of fuel required by Special Operations, Air Force, or Navy forces over the land as well. This estimate uses the number 22 gallons per day stated above and estimates the entire generating force within FORSCOM, Geographic Combatant Commands, Army Reserve forces, National Guard forces as well as the Marine Corps and Marine Corps Reserve. It also doubles the fuel across the Army forces, since the Army supplies fuel from ESC sustainment brigades to division sustainment brigades. The Marine Corps fuel amounts are not doubled since the Marine Corps has internal petroleum forces once the Army's sustainment brigade supplies the Marine Corps with fuel. This gives an estimated potential requirement of

[160] Wald and Captain, *Energy Security*, 3.

40,731,460 gallons per day for providing fuel to the total force in a LSCO against a near peer.

Table 5. Sustainment Brigade Petroleum Throughput Estimate

Potential Joint Fuel Requirements for Sustainment Brigades					
Component	**Personnel**	**Fuel/SM/Day**	**Gallons/Day**	**DIV Echelon***	**Potential Consumption**
Active Army (FORSCOM + 6 GCCs)	299,097	22	6,580,134	6,580,134	13,160,268 gallons
Army Reserve (Compo 1 Units)	180,985	22	3,981,670	3,981,670	7,963,340 gallons
National Guard (Compo 2 Units)	333,283	22	7,332,226	7,332,226	14,664,452 gallons
Marine Corps	186,493	22	4,102,846	N/A	4,102,846 gallons
Marine Corps Reserve	38,207	22	840,554	N/A	840,554 gallons
		Total Fuel			40,731,460 gallons
**Army units typically require Sustainment Brigades: one at Corps and one at Division to move the same fuel for each echelon, the Marine Corps can internally transport fuel once received.*					

Source: Charles Wald and Tom Captain, *Energy Security: America's Best Defense* (New York: Deloitte, 2009), accessed 19 May 2019, https://www.offiziere.ch/wp-content/uploads/us_ad_EnergySecurity052010.pdf; Defense Manpower Data Center, "DoD Personnel, Workforce Reports & Publications," Department of Defense, 2019, accessed 16 May 2019, https://www.dmdc.osd.mil/appj/dwp/dwp_reports.jsp; U.S. Army Directorate of Force Management, Force Management System Website, https://www.fmsweb.army.mil/.

Summary

This Chapter focused on analyzing data from the literature review to determine shaping factors and trends in the structure of the sustainment brigade, as well as DISCOM and CSG, within the Army through the largest three conflicts over the last 50 years. Variable factors, such as road and rail networks, host nation support, and enemy behavior play a role. However, these historical cases provide the best tests of DISCOMS, CSGs, and sustainment brigades in providing petroleum to the force in actual conflicts. These cases, when analyzed with the current sustainment brigade's capabilities and potential modern demands, determine a measure of effectiveness of the sustainment

brigade to provide petroleum support to the force. This analysis helped determined what factors shaped the sustainment brigade and its structure and how effectively it could supply fuel by four variables; the storage and distribution capability of the Army, the Army's ability to support its sister services, the reliance on contracting support, and the reliance on the reserve forces within the sustainment brigade structure. This analysis also determined that the Army's storage and distribution were relatively effective in Vietnam during the counterinsurgency. The storage and distribution capability were more robust during ODS than during previous LSCO, though it was heavily augmented. This support was slightly less effective during OIF, though contracting soon replaced the majority of internal petroleum support and in OEF the Army's petroleum force within the DISCOM, CSG, and sustainment brigade received little to no use. The Army's ability to support sister services was very weak during Vietnam. Organizations in Vietnam worked very much in silos and services worked together at the strategic level more than the tactical, unless required. This changed during Operation Desert Storm where the Marine Corps received a petroleum battalion to support 1st MEF. This support increased in OIF where the Army attached a CSG with seven transportation companies to ensure effective joint support of their sister service. In OEF, however, contracting again sustained the force. The Air Force also had little need for fuel from the Army since they relied heavily on fuel support from Saudi Arabia and Kuwait, as well as contracted fuel delivery. Contracting during all three conflicts helped fill petroleum supply gaps. During Vietnam, contracted fuel truck drivers augmented fuel distribution and the ratio of contractors was one to five Soldiers. Though Vietnam had relatively moderate contract support, this was not the case in ODS. Saudi Arabian host-nation petroleum support through SAMAREC helped ensure

the Army required far less contracting, especially in petroleum. The demand for petroleum contracting to maintain the tactical force skyrocketed on OIF and OEF where high troop numbers, a large infrastructure, counterinsurgency fights, and difficult terrain created a substantial increase in petroleum contracting to maintain the force. The use of reserve forces to augment the petroleum force has increased steadily since Vietnam, where only a few units were activated to support the force during and after the Tet Offensive. In 1973 the Total Force Policy required the Army to use the reserve forces, if needed, rather than require a draft. This led to a larger reserve force call up to ensure successful petroleum support in ODS. The reliance on the reserve forces continued trending up, increasing again for OIF and OEF as high demand for forces and lower total force strength required increased numbers, though petroleum forces were often repurposed as contracts took over for petroleum storage and distribution. These trends towards lower total capability in the petroleum force, increased joint support of sister services, increased contracting, and increased reliance on the reserve component will likely only continue to increase. These tendencies, coupled with the current petroleum forces available in sustainment brigades and the increased demand for petroleum in a fuel reliant force, paint a picture of where the sustainment brigade's petroleum force was, where it currently is, and how it will likely be able to support the joint force in LSCO in the future.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

Summary

The primary research question for this thesis is, is the Army's current sustainment brigade structure adequately designed to effectively provide bulk petroleum to the joint force in Large Scale Combat Operations? The conclusion is that the Army has the ability to self-supply petroleum through Sustainment Brigades to the Corps and Divisions for a limited force in a LSCO on short notice. This capability was increasing until OIF and OEF, where decades of reliance on contracting in a counterinsurgency environment led to a reduction in Active duty petroleum supply and distribution capability.

Additionally, as the Army shifted to a modular focus, the Army collapsed the number of DISCOMs and CSGs since sustainment brigades filled both roles. This ultimately created a shortage as the Army transitions back to LSCO because sustainment brigades will need to fill roles at both echelons since petroleum convoys have a limited travel distance and as units maneuver on the battlefield, one sustainment brigade cannot support a division directly, hundreds of miles from the theater supply of petroleum. The ability of the Army's current sustainment brigade to supply petroleum to corps and divisions increases substantially if the Army has adequate time to activate reserve forces, however, even with all 31 sustainment brigades, the Army would have difficulty supplying the modern fuel thirsty joint forces, even if that only included the Marine Corps and the Army, assuming the Air Force maintained their bases back near the theater gateway where contracting and pipelines can safely operate. The Army's move of petroleum units from the active component to the reserve component as well as

deactivating units entirely could lead to a petroleum force that cannot adequately supply the divisions and corps in a smaller counterinsurgency or peacekeeping operations. However, the current supply and distribution capability definitely would not support the entirety of the US force from the Field Army to the Division if the US Army was required to deploy its entire force to fight a peer or near peer threat.

Addressing the secondary research questions adds context and depth to the conclusion. Firstly, how effectively postured is the US Army modular sustainment brigade logistics system to support the joint force without contractors or air resupply from the port to the battlefield in a contested, non-permissive environment? The Army is not effectively postured to support the joint force without contractors or air resupply from the port to the battlefield in a contested, non-permissive environment. In a highly contested environment where contractors may not be welcome, may be targeted by the enemy to send a message, or may choose not to go, the Army would have little option at the tactical level within the corps and division but to use its own forces. If the Army had to rely entirely on its own petroleum forces within the sustainment brigade and its subordinate structures, the Army lacks the troops necessary to supply its entire force in LSCO, let alone a joint ground force, which would likely only need to supply the Marine Corps.

To answer the question; what changes has the Army made over the last 50 years to the DISCOM/CSG or Sustainment Brigade and what effect have those changes had on the Sustainment Brigade's ability to support a LSCO, helps show how the Army has shaped its force for the conflicts it has fought. In Vietnam, the Army was focused on a LSCO fight they could not get from the Vietcong. This left the force built for LSCO and

after the war, as the Army transitioned to the M1 tank, and the rest of the "Big 5" developments of the 1980s, the Corps Support Group and Corps Support Commands grew to meet the growing fuel consumption of the force. Operation Enduring Freedom was an anomaly at the start due to the unconventional warfare fight, with limited conventional forces at the outset, in a landlocked mountainous country. That fight quickly lent itself to contracted logistics. However, at the onset of OIF, the petroleum force, in the DISCOMs and CSGs, was extremely useful in supporting the LSCO fight as US forces invaded Iraq. The Army even had a fuel heavy CSG supporting the Marine Corps. However, as the battle moved toward counterinsurgency, the prevailing belief was that LSCO was no longer relevant and the Army created the modular sustainment brigade to replace the Corps Support Group and the DISCOM. Though it may be able to fill both roles effectively, it creates an illusion of more forces than there are, because corps and divisions would both need sustainment brigades and their subordinate units. The change to modularity could be effectively used for LSCO, but there need to be enough to support divisions and corps in the active force. This leads to the last question, would changing from the modular sustainment structure to the more traditional divisional sustainment structure of the previous 50 years effectively support future joint operations? This would probably help because it would serve as a reminder of the different tiers of sustainment, but it isn't necessary. Modular sustainment brigades are built with robust Support Operations staff sections to be able to manage commodities, including petroleum.

Recommendations

There are three recommendations that merit discussion. They fall within the training, materiel, and organization categories of Doctrine, Organization, Training,

Materiel, Leadership, Personnel, and Facilities (DOTMLPF). As the Army refocuses on LSCO, it is vital to ensure that organizations are built and trained to support the next LSCO fight. These recommendations are to create more petroleum distribution equipment sets, create more petroleum truck companies, train sustainment brigades to support each other as they operate under ESCs and divisions, and to shift more Sustainment Brigades to the active component.

The most important recommendation in petroleum supply and distribution within the sustainment brigade exists within the subordinate structures that form the sustainment brigade. The Army's petroleum supply and distribution companies within the sustainment brigades across the force lack the capability within the force to supply and distribute adequate fuel in a LSCO fight, in a contested environment, where the Army must distribute the fuel. As the Army downsized petroleum supply and distribution companies during OIF and OEF, the sustainment brigade lost capabilities. Additionally, some of these forces were moved to the reserve forces. This lack of capability, especially in the active component reduces readiness across the force. The Army should look to build a larger and more capable fuel truck fleet through a materiel or organizational solution. The Army could create equipment sets from petroleum truck companies, which would increase capability. However prepositioned equipment adds lead time because Soldiers must be trained for the equipment or brought from other organizations, leaving behind their equipment. This solution would, however, maintain the current force cap. An organizational solution would be to create more transportation companies, 7.5k, POL line haul provide an excellent corps asset to move 450,000 gallons of fuel per day, more than any other petroleum truck distribution company. These units could significantly increase

capability while reducing demand on the total number of soldiers needed to supply petroleum since 7.5k fuel trucks are more efficient. Increasing these distribution resources would help support the Corps, Division, and theater, or field army, with petroleum distribution. This is critical since current supply and distribution assets are modular. They are the only assets available to theater, corps, and division sustainment brigades, which means ultimately, they will likely be divided to support each echelon quickly. Dividing the petroleum supply and distribution capability to support each echelon vastly reduces the entire force petroleum distribution capability. Each additional Transportation Companies, 7.5k, POL line haul to the active component would provide an additional 450,000 gallons per day to the Corps and Divisions in theater. [161] Units like these are critical to restoring distribution capability in the force with a smaller personnel impact than other less capable units, which would require more personnel for the same capability.

Additionally, the Army should focus sustainment brigade training on not only supporting divisions but also supporting divisional sustainment brigades from the corps level. Rather than solely focusing on transporting fuel for division level exercises, as the majority of sustainment brigades in the active component are doing, there should be a focus on also adding that additional tier of support. Coordinating with ESCs under a corps to receive fuel adds another layer of complexity for the sustainment brigade in the division and the sustainment brigade operating under the ESC. This would help leaders within the organizations understand the complexity, time management, and fuel

[161] CASCOM Force Development Directorate, *Sustainment Force Structure Book*, 20.

management required when there are variable factors on both ends of distribution, rather than civilians or contractors supplying fuel from a constant fixed location.

Finally, there is a lack of sustainment brigades within the current active component force structure.[162] The Army grew its logistics capabilities within the Active Component until OIF and OEF, where contracting and reserve components filled the gap. OIF and OEF led to the deactivation of CSGs in the active component. The reduction in brigade-sized sustainment units, during the transition to modularity, helped make way for a reduced sustainment footprint during the transition to fight a counterinsurgency. As the Army did away with corps support groups, all active component sustainment brigades aligned under expeditionary sustainment commands deactivated but one, the 16th Sustainment Brigade in Germany. These decreases coupled with an increase of support for joint forces over the last 50 years could potentially create a massive shortfall in logistics support if the Army uses sustainment brigades to support Marine Corps units and possibly other Joint Forces. Sustainment brigades, as the only brigade-level, modular corps and division sustainment element in the Army, must be able to support the Army's force and any Joint Force elements that need support with not just petroleum but all classes of supply. Without adequate available sustainment brigades in the Active Component, the Army lacks rapidly deployable sustainment forces to support the joint force in LSCO.

[162] CASCOM Force Development Directorate, *Sustainment Force Structure Book*, 31.

Limitations and Future Research

This thesis primarily focuses on the historical changes and adaptations that tactical sustainment brigade-level organization's petroleum storage and distribution system within Corps and Divisions took from Vietnam to 2010. Most of the study's data and analysis end at 2010, and though much of it is still relevant today, the Army has begun shifting focus to LSCO. The research focused on those adaptations through the cases of the Vietnam Conflict, Operation Desert Storm and Desert Shield, and Operation Iraqi Freedom and Operation Enduring Freedom show how the sustainment brigade became what it is today and help determine where it was going at the end of the study, but current changes are not qualified in the research. Additionally, the research focused on the changes made through those cases and how the organizational structure developed and how effectively it could support LSCO. Lastly, the thesis addressed potential shortfalls and how the Sustainment Brigade could overcome those shortfalls, through expanding the petroleum structure and bringing more sustainment brigade petroleum forces to the active component.

Another limitation was the inability to answer the final, secondary research question. The question, would changing from the modular sustainment structure to the more traditional divisional sustainment structure of the last 50 years effectively support future joint operations, is not conclusively answered by this study and would merit further research. Measuring whether or not the old structure is more effective than the new structure is an important question but would require measuring the effectiveness of both structures against each other in a study, likely focused on only comparing the two structures for effectiveness and efficiency.

Future research needs to focus on the current force structure and the way ahead for petroleum supply in sustainment brigades. More research could explore DOTMLPF analysis and dig more into the shortfalls that exist. Future analysis could address quantitative solutions to the problem as well as total army analysis within the sustainment brigade. Analysis could also look beyond just the capabilities within the sustainment brigade. The Army's shift to LSCO requires looking at how the force has supplied petroleum to past LSCO, while also ensuring that a modern lens is applied to ensure that the force is maintaining a modern, relevant force for the challenges of today's battlefield.

Conclusion

The idea of increasing the logistics fight is not always a popular one when there is a fixed force cap. Many branches compete for more of their critical capabilities in the Army to support the force for LSCO. Adding additional fuel capability, training, and materiel may come at a cost. However, a force without fuel cannot fight and running out of fuel when fighting a near peer would likely be much more costly than running out during the rout of Iraq in ODS. Petroleum supply and distribution at the tactical level must not be taken lightly, as the force has become increasingly mobilized and mechanized, as have the enemies of the United States. They will work diligently to ensure they supply their forces over the land with fuel for the fight and it is imperative that the US can do the same for its joint force, or it could easily face dire consequences.

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