Engineer Support to the Brigade Combat Team

A Monograph
by
Major Dennis J. McGee
United States Army

School of Advanced Military Studies
United States Army Command and General Staff College
Fort Leavenworth, Kansas

AY 2010

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE (DD-MM-YYYY)	**2. REPORT TYPE**	**3. DATES COVERED** *(From - To)*
20-05-2010	SAMS Monograph	July 2009 – May 2010

4. TITLE AND SUBTITLE
Engineer Support to the Brigade Combat Team

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
Major Dennis J. McGee (U.S. Army)

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
School of Advanced Military Studies (SAMS)
250 Gibbon Avenue
Fort Leavenworth, KS 66027-2134

8. PERFORMING ORG REPORT NUMBER

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Command and General Staff College (CGSC)
731 McClellan Ave.
Fort Leavenworth, KS 66027-1350

10. SPONSOR/MONITOR'S ACRONYM(S)
SAMS / CGSC

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for Public Release; Distribution is Unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT
The recent transformation in the Army to a more expeditionary modular force, focused on brigade combat teams (BCT), has brought with it significant challenges to the engineer regiment. The simultaneity called for in the Army's operating concept of full spectrum operations will require a robust maneuver support element with the flexibility to support offensive, defensive, and stability operations. The challenge the Army faces is that the current modular BCTs do not have the organic capability to conduct all three operations simultaneously without significant augmentation. Engineers have been executing a parallel transformation effort focused on modularity and building specialized capabilities that are tailorable and can be task organized. By examining engineer support to BCTs in Vietnam, Operation Enduring Freedom, and Operation Iraqi Freedom this monograph discovers that there continues to be a need for both combat and general engineering support. The units that either had organic engineer battalions supporting their BCTs or were augmented with them were better able to execute their missions. The current embedded engineer companies are insufficient to provide a BCT with the required full spectrum engineer support. Heavy Brigade Combat Teams (HBCTs) and Stryker Brigade Combat Teams (SBCTs) are better suited to provide combat engineering but are still severely limited in general engineering capabilities. The Infantry Brigade Combat Team (IBCT) does not have sufficient engineer augmentation to perform missions across the full spectrum of operations.

15. SUBJECT TERMS
Engineer Operations, Brigade Combat Team, Full Spectrum Operations, Stability Operations, Transformation, Vietnam, Operation Enduring Freedom, Operation Iraqi Freedom

16. SECURITY CLASSIFICATION OF: (U)			**17. LIMITATION OF ABSTRACT**	**18. NUMBER OF PAGES**	**19a. NAME OF RESPONSIBLE PERSON**
					Stefan J. Banach COL, U.S. Army
a. REPORT	**b. ABSTRACT**	**c. THIS PAGE**			**19b. PHONE NUMBER** *(include area code)*
(U)	(U)	(U)	(U)	80	913-758-3302

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std. Z39.18

SCHOOL OF ADVANCED MILITARY STUDIES

MONOGRAPH APPROVAL

Major Dennis J. McGee

Title of Monograph: Engineer Support to the Brigade Combat Team

This monograph was defended by the degree candidate on 21-April 2010 and approved by the monograph director and reader named below.

Approved by:

_____ Monograph Director
Thomas A. Bruscino, Jr., Ph.D.

_____ Monograph Reader
Mr. Bruce E. Stanley

_____ Director,
Stefan J. Banach, COL, IN School of Advanced Military Studies

_____ Director,
Robert F. Baumann, Ph.D. Graduate Degree Programs

Abstract

ENGINEER SUPPORT to the BRIGADE COMBAT TEAM by MAJ Dennis J. McGee, US Army, 40 pages.

The recent transformation in the Army to a more expeditionary modular force, focused on brigade combat teams (BCT), has brought with it significant challenges to the engineer regiment. The simultaneity called for in the Army's operating concept of full spectrum operations will require a robust maneuver support element with the flexibility to support offensive, defensive, and stability operations. The challenge the Army faces is that the current modular BCTs do not have the organic capability to conduct all three operations simultaneously without significant augmentation. Engineers have been executing a parallel transformation effort focused on modularity and building specialized capabilities that are tailorable and can be task organized to any engineer command & control structure that is supporting a maneuver force. By examining engineer support to BCTs in Vietnam, Operation Enduring Freedom, and Operation Iraqi Freedom this monograph discovers that there was, and continues to be, a need for both combat and general engineering support. The units that either had organic engineer battalions supporting their BCTs or were augmented with them were better able to execute their missions. The current embedded engineer companies are insufficient to provide a BCT with the required full spectrum engineer support. Heavy Brigade Combat Teams (HBCTs) and Stryker Brigade Combat Teams (SBCTs) are better suited to provide combat engineering but are still severely limited in general engineering capabilities. The Infantry Brigade Combat Team (IBCT) does not have sufficient engineer augmentation to perform missions across the full spectrum of operations. All the BCTs have sufficient geospatial capabilities embedded on their staffs. The proposed Brigade Engineer Battalion has some promising characteristics to it offering a balanced engineer capability of both combat and general engineering which may overcome these shortfalls.

TABLE OF CONTENTS

"My engineers can do anything. There just aren't enough of them."

—Major General Raymond Odierno
Commander, 4th Infantry Division Operation Iraqi Freedom[1]

Introduction

US Army Engineers traditionally provide a range of mission support to the maneuver force engaged in all forms of operations including humanitarian missions and peace keeping operations, small scale contingency operations, and full scale combat operations. Recently, the Army has shifted its concept from a division centric force to a brigade centric force. The focus of this monograph is to evaluate engineer support in a full spectrum operation and its capability to support the new brigade centric Army concept. The United States Army remains engaged in many operations across the spectrum of conflict from stable peace to general war.[2]

Historically, the Army Engineers have provided a variety of support including combat, general, and geospatial engineering. Combat engineering is defined as those engineering capabilities and activities that support the maneuver of land combat forces and that require close support to those forces. Combat engineering consists of three types of capabilities and activities: mobility, counter-mobility, and survivability. General engineering is defined as those engineer capabilities and activities, other than combat engineering, that modify, maintain, or protect the physical environment. Examples include the construction, repair, maintenance, and operation of infrastructure, facilities, lines of communication and bases. Geospatial engineering is the art and science of applying geospatial information to enable understanding of the physical environment for military operations. The art is the ability to understand the geospatial information available in

---

[1] Department of the Army, FM 3-34.22, Engineer Operations - Brigade Combat Team and Below, Washington, DC: U.S. Government Printing Office, 2009, 1-1.

[2] Department of the Army, FM 3-0, Operations, Washington, DC: U.S. Government Printing Office, February 2008 p 2-1. "The spectrum of conflict is the backdrop for Army operations. It places levels of violence on an ascending scale marked by graduated steps. The spectrum of conflict spans from stable peace to general war. It includes intermediate levels of unstable peace and insurgency."

order to explain the military significance of the terrain to the commander and create geospatial products for decision making; the science is the ability to exploit geospatial information, producing spatially accurate products for measurement, mapping, visualization, modeling, and all types of analysis of the terrain.[3] The geospatial engineering support has undergone a significant technological transformation from its original roots in the topographic engineering field. Today it may include the integration of imagery, data point collection from a local engineer survey, existing historical maps and information and other geospatial data into one field. This monograph will study how all three forms of engineer support work together in a full spectrum environment to provide support to the brigade combat team.

Today's operational environment continues to find the Army engaged in various types of military operations including peacetime military engagements, limited intervention, peace operations, irregular warfare, and more recently major combat operations throughout the world.[4] Even more significant is the simultaneous combination of these types of operations in the same operational area. Current operations in Iraq and Afghanistan require the simultaneous application of offense, defense, and stability operations. Looking back through recent history the United States Army has conducted these types of missions before. A historically recent example of this is the Vietnam War. The conflict required the United States to fight both the regular North Vietnamese Army in traditional military combat operations while simultaneously engaging Viet Cong guerilla units in a counterinsurgency throughout the South Vietnam operational area.

Both the current operations in the Global War on Terror (GWOT) and the Vietnam War required hundreds of thousands of troops and can agreeably be considered large scale operations due to these resource commitments alone. Both operations required the deployment of multiple

---

[3] Department of the Army, *FM 3-34, Engineer Operations*, Washington, DC: U.S. Government Printing Office, February 2009, 3-1.

[4] FM 3-0, 2-4.

Corps and division level units whose tactical operations were executed and controlled at the Brigade Combat Team (BCT) level. Both of these operations required simultaneous application of offensive, defensive, and stability operations and full spectrum engineering support.

When the United States commits forces into a new operational area, one of the most important planning factors it must consider is the required duration of the mission. Obviously, if a force is going to be deployed beyond a 90 day window it will most likely require a certain level of external logistic support to sustain itself beyond its own organizational capabilities. This will often necessitate the need for the construction, upgrade, and maintenance of logistical nodes, base camps, lines of communication, and operations to secure the areas between them. These missions are inherently those executed by engineer units, primarily ones found outside of the BCT, often requiring considerable augmentation from a non organic engineer unit. The focus of this monograph is to look at the BCT's organic engineer capability performance and determine what engineer missions they could accomplish on their own and what ones they needed external engineer support to perform during the unit's initial 90 day build up period.

Army Transformation

The US Army initiated its current long term transformation plan in March of 1994 with the Task Force XXI concept, moving toward a more modular and expeditionary force. This concept was originally focused on the digitalization of divisions to their subordinate units by the "linking of combat elements by computer, allowing for a higher situational awareness and a speedy transmission of reports and orders easing command and control and logistics accordingly."[5] A major engineer lesson learned from the Gulf War was the need for organic engineer assets in the maneuver brigades and the structure to command and control them

[5] John J. McGrath, *The Brigade: A History Its organization and employment in the US Army* (Fort Leavenworth, KS: Combat Studies Institute Press, 2004), 104-105.

including the flexibility to task organize or receive additional specialized engineer augmentation units from outside the division. The Army recognized this and initiated the Engineering Restructuring Initiative (ERI) which added an engineer brigade headquarters and two engineer battalions to each heavy division providing them with one battalion for each brigade. This was a fairly easy initiative under Force XXI as virtually every maneuver brigade had an engineer battalion already assigned or attached to it during the Gulf War.[6] This transformation process has evolved over the last two decades and has been significantly affected by the current military operations in both Iraq and Afghanistan.

This monograph will center on one of the more recent, and significant, changes to the way the Army operates - its shift from a Division to a Brigade centric force. The Army's switch to a brigade centric force was rooted in the modular concepts of Chief of Staff of the Army, General Eric K. Shinseki, with the Interim-Brigade Combat Team which became today's Stryker Brigade Combat Team (SBCT). This concept called for "… a rapidly deployable, medium weight combat force that could operate throughout the full spectrum of conflict."[7] Furthermore, in December 2006, General Peter J. Schoomaker as the Army Chief of Staff testified before Congress, "…the Army is steadfast in its determination to transform the total force from a Cold War structured organization into one best prepared to operate across the full spectrum of conflict; from full-scale combat to stability and reconstruction operations…"[8] This speech presented the initial guidance providing the shift towards the modular brigade centric Army that exists today.

---

[6] Ibid., 105.

[7] Andrew Feickert, *U.S. Army's Modular Redesign: Issues for Congress*, (Congressional Research Service, Library of Congress May 5, 2006), http://fpc.state.gov/documents/organization/67816.pdf, accessed 1April 2010.

[8] GEN Peter Schoomaker, *Congressional Testimony before the Commission on National Guard and Reserves*, Dec 14, 2006, http://www.army.mil/-speeches/2006/12/14/989-statement-by-general-peter-schoomaker-chief-of-staff-united-states-army-before-the-commission-on-national-guard-and-reserves/index.html, accessed 1April 2010.

Focusing specifically on Army Engineer units' parallel transformation this monograph will attempt to determine whether or not they are properly designed to support the current BCT planning and executing full spectrum operations.

The *Army's 2009 Posture Statement* calls for restoring balance through transformation stating that, "We must transform our force to provide the combatant commanders dominant, strategically responsive forces capable of meeting diverse challenges across the entire spectrum of 21st Century conflict."[9] The missions that the engineer forces performed in Vietnam are similar in concept and scale to the missions engineers are performing today in support of the GWOT and will most likely continue to perform in the near future. The requirement to conduct combat and construction operations simultaneously in support of a BCT still exists today. The organizations have changed since Vietnam and the Army's focus has shifted to a brigade centric force, but has the engineer regiment's parallel transformation correctly postured itself to support the requirements of a BCT?

This monograph will conduct a brief historical survey of the history of engineer support to brigade combat teams in full spectrum operations. To reduce the scope of the historical analysis, the project will focus on combat, general, and geospatial engineer support during the initial build up of forces in the Vietnam War by analyzing the types of organizations, their operations, and their significant achievements during various types of military operations. Additionally, it will analyze any changes that occurred as a result of the Vietnam War experience to both the Army as a whole and the engineer community. After completing the historical analysis, this paper will outline the current operational environment and future expectations of the Army across the spectrum of conflict, drawing from the Army's current strategic and operational

---

[9] Department of the Army. *2009 Army Posture Statement*, May 7, 2009, http://www.army.mil/aps/09/index.html, accessed 17 September 2009.

guidance. Using this environmental framework, an attempt will be made to determine the engineer requirements for a BCT engaged in full spectrum operations. Initially looking at all the elements of full spectrum operations, both independently and jointly, an examination of one or more specific elements will be used to determine a required future engineer structure. This structure will be applied against today's menu of engineer organizations to determine if the engineer capability exists and if not, a recommendation will be made to fill the requirement or overcome the identified shortfall.

Engineers in Vietnam

The United States' military commitment in South Vietnam in January 1965 consisted of about 23,000 men of whom fewer than a hundred were Army engineer troops. The initial build up of forces in Vietnam called for a Marine unit to Da Nang to protect the airfield and an Army division to deploy to the central Highlands of Vietnam to help "...defend important towns and installations and to free South Vietnamese troops to concentrate on critical coastal regions…"[10] The increase in US troop commitment began in March 1965 when Marines of the 9th Marine Expeditionary Brigade landed at Da Nang. Shortly thereafter on 5 May the 173d Airborne Brigade was airlifted from Okinawa. The mission of the 173d was to conduct a mobile defense around the airfields at Bien Hoa and Vung Tau, both in the southern portion of Vietnam around Saigon and, if necessary, conduct limited counter-insurgency operations.[11] Included in both of these brigades were their organic engineers; the Marines had an Engineer Group of 299 Marine engineers and the 173d arrived with their organic brigade engineer company of about 204

---

[10] John M. Carland, *United States Army in Vietnam: Combat Operations Stemming the Tide: May 1965 to October 1966* (Washington, D.C., United States Army Center of Military History, 2000), 17.

[11] Ibid., 21-23.

Soldiers. [12] Both of these units brought with them combat engineering skills and capabilities, but due to the immature infrastructure of South Vietnam, they focused primarily on base camp construction for their parent units. It was with the arrival of the 35th Engineer Group (Construction) a week later that the primary general engineering tasks of base camp development and construction shifted away from the divisional/brigade engineer units. The 35th Engineer Group brought with it two construction battalions, the 84th and 864th, and four separate specialized engineer companies who landed at Cam Ranh Bay on 9 June 1965. Additionally, the 937th Engineer Group was supporting the buildup at the port of Qui Nhon and the 70th Engineer Battalion (Combat) supported the 1st Cavalry Division at An Khe. Here they conducted typical engineer operations including base camp construction, mapping, bridging, and road construction.[13] Reinforcing the buildup of combat forces at Bien Hoa were elements of the 2d Brigade of the 1st Infantry Division and the 1st Brigade of the 101st Airborne Division who also sent elements to help secure the expanding logistics port at Camh Ran Bay.[14]

The engineer forces arriving in theater were more organic combat engineer companies with their parent brigades, B/1st Engineer Battalion with 2/1 Infantry Division, A/326th Engineer Battalion with 1/101st Infantry Division, and then the 8th Engineer Battalion arrived with the 1st Cavalry Division (Airmobile). This build up was just the beginning of a large escalation of both tactical combat units and the supporting engineer forces to help develop the expanding logistical base requirements. By December of 1965 the 18th Engineer Brigade had grown to three group headquarters, ten battalions, and twelve separate companies, now totaling over seven thousand

---

[12] Robert R. Ploger, MG, USA, *Vietnam Studies: U.S. Army Engineers 1965-1970* (Washington, D.C., United States Army Center of Military History, 1974), 3-4.

[13] MG T.J. Hayes III, "Army Engineers in Vietnam," *The Military Engineer*, 53 (January-February 1966): 8-9.

[14] Carland, 34-38.

engineers. [15] The following year the brigade would grow to five engineer groups and in 1967 there would be two engineer brigades with the addition of the 20th Engineer Brigade, and six engineer groups under the US Army Engineer Command – Vietnam. The total engineer force structure would eventually approach 40,000 Soldiers.[16]

The divisional/brigade combat engineer battalions provided the majority of the combat engineering tasks that directly supported their maneuver units. Initially, the first units were responsible for the upgrade, and in most instances the construction of the roads, landing zones and airfields that would be used to support their operations. The majority of the divisional/brigade engineer forces also conducted maneuver support operations, including demolition, land clearing and mind sweeping of their operational areas adjacent to their bases. The initial base camp development tasks were eventually turned over to an additional construction unit provided by one of the theater engineer brigades or groups.

Geospatial Engineering in Vietnam

At the time engineer mapping, surveying, and terrain visualization was referred to as topographic operations. Initially, the requirements and needs for terrain visualization products of Vietnam were thought to be adequate. The mapping coverage of Southeast Asia had benefitted from the previous French efforts and the US involvement in Indochina since the 1950s.[17] The challenge that reality provided was the need to produce a large amount of maps quickly while simultaneously ensuring that they would be accurate enough to plan from. This proved to be a challenge in the immediate time frame due to the lack of assets to gather terrain data in order to

---

[15] Ploger, 70.

[16] *The United States Army Corps of Engineers: A History* (Alexandria, VA, Headquarters, US Army Corps of Engineers, 2007), 168.

[17] MG T.J. Hayes III, "A New Map for Vietnam: the Pictomap," *The Military Engineer,* 57 (July-August 1966): 255-256.

create specialized products for the planning effort. The area maps were suitable for aviation and large scale maneuver planning using 1:250,000 scale maps, but not for tactical operations where the distances were often measured in kilometers requiring detailed 1:50,000 scale maps. These maps were also not suitable for engineers who would need terrain information to conduct base camp and road design and create construction plans from them. "…to remedy these deficiencies a new map [was] produced for the Vietnam War."[18] This new map called PICTOMAP, (Photographic Image Conversion by TOnal MAsking Procedures), was actually a picture image that was combined with other products and overlaid with a grid reference system. These maps were able to provide a solution to the shortfall of mapping products for the combat units. The topographic needs of the army in Vietnam were similar to the requirements that exist today. The initial deployment of forces into an austere environment usually finds the military wanting for terrain products. Often times terrain detachments will take existing maps designed for other purposes like tourism or city planning and utilize them as a base map to produce tactical ones. This process still exists today and when the US first entered Afghanistan it found itself using older Soviet maps for some of their original planning and operations. This monograph will later cover the evolution of geospatial products and technologies in use as the Afghanistan Theater matured.

General Engineering in Vietnam

Shortly after the initial build up of forces was announced in 1965, the need to upgrade the logistics infrastructure at the ports and along the coast to facilitate the arrival of all the expected American forces became the primary engineer mission. Additionally, the need to extend the lines of communication inward from these ports to the western borders with Laos and Cambodia was becoming a pressing need. The Viet Cong guerrillas could move easily in and around the jungles

[18] Ibid.

of South Vietnam and quickly disappear across the western borders. According to MG Ploger, "The most immediate need for combat and support engineers existed in northern II Corps where enemy forces were making a concerted effort to cut the country in two along the Pleiku-An Khe-Qui Nhon axis."[19] Following the arrival of the original construction units to expand these port facilities the engineer "force-flow shifted" to additional non-divisional combat units, the first of which were the 70th Engineer Battalion (Combat) and the 937th Engineer Group headquarters on 16 August 1965. These two units were to be the primary elements that would expand the lines of communication westward into the jungles of Vietnam.[20] Additionally, they would begin the construction of base camps inland for the arriving units to eliminate the accumulation of combat forces along the coastal ports. The 70th Engineer battalion supported by elements of the 1st Brigade of the 101st moved inland 40 kilometers and linked up with the 1st Cavalry Division's 8th Engineer Battalion.[21] By the end of 1965 four additional combat engineer battalions had arrived to help assist the divisional engineers' westward expansion into the jungles and prepare for additional combat forces. The 159th Engineer Group, arriving in October of 1965, provided both combat and general engineering support to the maneuver forces. The combat battalions supported tactical units with an engineer company per brigade and the construction battalions provided support at the logistical base camps.[22]

The command and control relationships established between the non-divisional engineers in the 18th Engineer Brigade and the combat forces were best described as general supporting. The units would move into the maneuver brigade's area and provide them with the additional

---

[19] Ploger, 75.

[20] Ibid., 76.

[21] Ibid., 77

[22] COL J.H. Hottenroth, "Army Troop Construction," *The Military Engineer*, 57 (September-October 1966): 320-322.

combat or general engineering support for a certain mission and then when that project or mission was complete they would be reallocated to other assets who needed them. The commander of the 18th Engineer Brigade, Major General Robert P. Ploger, encouraged his subordinate units to establish direct coordination between the field forces and divisional engineers that the engineer groups were supporting.[23] These relationships helped the engineer forces to be flexible and responsive to the maneuver commanders on the ground by facilitating parallel planning in support of upcoming operations. The relationships further assisted in eliminating the potential for engineers to be either underemployed or used for non engineering missions. MG Ploger knew that by task organizing the engineers to the maneuver forces he would lose the ability to remain flexible to the whole theater. As most engineer commanders have experienced at some point in their career, MG Ploger knew that if he retained strict control of his units he would quickly overwhelm his staff and their span of control, while simultaneously hindering the maneuver commanders from accomplishing their missions or limiting them to only their organic engineer capabilities. This is often a battle that an engineer staff officer faces when they are trying to remain relevant by supporting their maneuver commander and at the same time meeting their engineer commander's intent of efficiently using his assigned engineer forces.

Most of the first year of build up, from the summer of 1965 to the summer of 1966, focused on the construction of logistical support infrastructure, base camps and the lines of communication between them. The majority of this was initially performed by the engineer units on a "first come first served" basis as they arrived into theater. Eventually, once the engineer force structure matured enough, the divisional engineers were able to focus mostly on the combat

[23] Ploger, 86.

engineer support to their maneuver forces as the non-divisional engineers picked up the bulk of the general engineering tasks.[24]

Combat Engineering in Vietnam

The primary reason for engineers is and has always been to support the maneuver forces in the accomplishment of their mission. The main engineer forces tasked with this mission are the organic divisional and brigade engineers. As MG Ploger stated in his *Vietnam Studies of US Army Engineers*, "The doctrinal mission of an engineer battalion organic to a division is to increase the combat effectiveness of the division by performing various engineer tasks and, when necessary, fighting as infantry."[25] The primary mission of these engineers was to conduct mobility and survivability operations for their brigades and counter-mobility against the enemy. Additionally, with the assets available they also provided the initial general engineering support, albeit with a very limited capability. One of the primary tasks of the combat engineer in Vietnam was the demolition of "enemy base camps, material, and tunnels."[26] The practice of task organizing the divisional engineer battalion subordinate units further down into their habitual infantry and armor company teams was very effective in providing responsive combat engineer support across the division. The newly developed airmobile concept the Army was working with posed new challenges to the engineers who were able to provide opportunistic support to their infantry units because of this task organization. By being present with the combat team they could immediately conduct clearance, demolition and minesweeping operations without requiring the maneuver elements to stop movement and wait for the additional support to arrive. Additionally, these engineers were able to "[develop] new expedients for preparing landing

---

[24] Ibid., 89.

[25] Ibid., 90. A similar mission statement is in the current BCT engineer company MTO&Es, listed later in the monograph.

[26] Ibid.

sites."[27] Two of these expedients were: being flown into a jungle via helicopter, with chain saws and demolitions, and literally creating a helicopter Landing Zone and the creation of land clearing teams of "tractors with special tree cutting blades…[who could clear] the jungle in a matter of hours."[28] Other operations engineers performed in direct support of combat units were the constructing of forward fire bases and sweeping hundreds of kilometers of road each day for land mines and booby traps. Additionally, engineers "moved more than 20 million tons of earth, built more than 150 miles of road; …mapped the country to provide precise information to support Army artillery, hydrography and navigation."[29]

As the logistical ports and hubs matured along the coast and the airfields inland were upgraded, the focus of engineer efforts shifted to the lines of communication which connected them. Operation ROLLING STONE serves as an example of a combined arms operation that supported this shift. The mission was to provide security to the 1st Engineer Battalion of the 1st Infantry Division, as it constructed an all-weather road connecting Highway 13 with route 16 north of Saigon. Here 1st Brigade 1st Infantry Division provided security with three battalions, one securing the road crew while the other two conducted patrols nearby to prevent the enemy from massing along the road. [30] The project took a little over a week to complete and required the full engineer battalion along with the maneuver brigade.

Cedar Falls & Junction City

By November of 1967 the US Army Engineer Command, Vietnam (Provisional) had been fully established with the 18th and 20th Engineer Brigades subordinate with three Engineer

---

[27] Ibid., 91.

[28] Robert G. McClintic, "Clearing the Way", *The Engineer*, 1 (Fall 1971): 14.

[29] Ibid.

[30] Carland, 179-181.

Groups each to control the entire non-divisional engineer forces in theater.[31] This organization was able to shift assets as needed to the various Corps Areas in Vietnam to augment the divisional engineers. In January of 1967 LTG Jonathan O. Seamen, commander of II Field Forces, Vietnam, decided to move into a Viet Cong stronghold near Ben Cat, known as the Iron Triangle, 35 kilometers north of Saigon.[32] The operation was known as Cedar Falls and was originally a battalion level operation that quickly grew into a two division plus mission over the course of a month.[33] The organic 1st Engineer Battalion of the 1st Infantry Division was the primary engineer effort but needed augmentation by the 79th Engineer Combat Group. Here they developed a "dozer-infantry team" concept where bulldozers, including the new Rome Plow[34] worked in conjunction with infantry units to clear over 2,000 acres of jungle area and construct landing zones for future combat operations.[35] Additionally, the 1st Engineer Battalion emplaced a Bailey Bridge over the Thi Tink River west of the town to permit elements of the 11th Armored Cavalry regiment access to the area. Following the completion of the bridge and the construction of numerous Landing Zones, the engineer forces were called upon to conduct unorthodox clearance operations, including the clearing, searching and destruction of enemy tunnel

---

[31] Ploger, 135.

[32] George L. MacGarrigle, *Combat Operations Taking the Offensive: October 1966 to October 1967,* (Washington, D.C., United States Army Center of Military History, 1998), 96.

[33] Ploger, 139.

[34] "A tankdozer is an M-48 medium tank with a bulldozer blade. The heavy armor provides protection from most mines, booby traps, and snipers; the tankdozer is a favored leading vehicle during jungle clearing operations. The Rome Plow is a large tractor with a specially configured dozer-type blade developed specifically for heavy-duty land clearing operations, civilian and military, by the Rome Caterpillar Company of Rome, Georgia. The blade is more curved than the usual bulldozer blade and has a protruding, sharply honed lower edge. The lower edge curves out on one side to form a spike used to split trees too large to cut with the blade alone, but the blade itself can slice a tree of three feet in diameter. Bars are added to the top of the blade to force trees away from the tractor, and there is a safety feature-a "headache bar"-over the operator's position to protect him from falling debris. Some Rome Plows were also modified to include light armor for the operator." Lieutenant General Bernard William Rogers, *Vietnam Studies Cedar Falls- Junction City: A Turning Point* (Washington, D. C., Department of The Army, 1989), 63.

[35] Ploger, 140.

complexes that were discovered around the area of Ben Suc. As the dozer teams began leveling the buildings, they uncovered a vast underground tunnel complex stocked with thousands of pounds of rice. The complex was so vast that the 1st Infantry Division engineers used acetylene gas to ignite and destroy the tunnels along with conventional explosives.[36] It was these operations that led to the creation of the infamous "tunnel-rats" who proved to be an invaluable engineer asset throughout the remainder of the war.[37]

Shortly after the success at CEDAR FALLS, the II Field Force commenced Operation JUNCTION CITY into War Zone C in Tay Ninh Province. The operation was to involve the equivalent of two US divisions along with South Vietnamese battalions executing an airborne assault into an area believed to be the headquarters of the Central Office of South Vietnam, the Communist headquarters. In addition to the airborne operations to locate and destroy the enemy forces, the mission called for the construction of three airfields, two Special Forces base camps and the upgrade, clearance, and maintenance of the main highway into the area.[38] The 168th Engineer Battalion co-located with an infantry battalion and two artillery batteries at the Special Forces Camp near Prek Klok with the task of completing the base camp and a nearby airstrip.[39] The 65th Engineer Battalion of the 25th Infantry Division and the 1st Engineer Battalion of the 1st Infantry Division were the primary engineer assets who conducted mobility support operations to their respective divisions. In just about a month these three battalions constructed three C-130 capable airfields, emplaced three armored vehicle launch bridges, and constructed, upgraded, and maintained 66 kilometers of roadway including the clearance of 75 yards on either side.[40]

---

[36] MacGarrigle, 107-108.

[37] Rogers, 61.

[38] Ibid., 84.

[39] MacGarrigle, 124.

[40] Ibid., 103-107.

Both the operations in CEDAR FALLS and JUNCTION CITY demonstrated that maneuver forces deployed to an austere environment will rely heavily on their engineers to provide the bare minimum for mobility support and could quickly overcome that capability. Both operations used their organic engineers; however, CEDAR FALLS, the larger mission, required significant augmentation when the general engineering tasks required extra horizontal construction capability. Though it was a new concept, the unorthodox task of tunnel demolition and clearance fit well into the combat engineering capability of the organic divisional engineers.

In this brief study of initial engineer operations in Vietnam it is clearly evident that the organic engineer forces assigned to divisional units could only provide limited combat and minimal general engineering support to their maneuver brigades. The greatest need was for general engineering support to assist in the construction of base camps and logistical facilities as the build-up of combat forces occurred over the first twelve months in Vietnam. This was primarily due to the immature theater of Vietnam lacking any infrastructure to support the build-up of forces prior to the commencement of large scale major combat operations. The solution for this was to send echelons above brigade and division engineer battalions to assist. The majority of these forces were assigned to engineer combat or construction groups under a separate theater engineer brigade. Eventually the requirements for external engineer support grew large enough to merit two engineer brigades under a Provisional Engineer Command for all of Vietnam.

The initial brigade combat teams in Vietnam were light units comparable to today's Infantry BCTs and brought with them their organic light engineer companies and battalions. The austere environment and severely limited infrastructure required significant augmentation for both combat and construction capabilities. Additionally, the geospatial information for Vietnam, unpredictably, was limited and required innovative ways to overcome the mapping requirements of the maneuver forces. It was over a year before any major offensive capability was established in theater that could be successfully sustained during major combat operations. The initial engineer units stepped-up to the challenge and provided what limited engineering support they

could as they arrived in theater. Eventually, they fell back into their traditional roles of combat, general, and geospatial engineering as more forces arrived and the logistical situation matured. It is clearly evident that the engineer companies assigned to each brigade were not enough and the successes of the brigade required augmentation from external engineer assets to provide a more robust general and combat engineering capability.

The forces that initially deployed to Vietnam in 1965 were limited in their ability to conduct offensive operations as they had limited operational reach. The lack of developed infrastructure required significant effort to establish base camps, logistical nodes, and routes between them. This caused the maneuver forces to have to focus on defensive operations to secure these areas until they could be constructed which further prevented them from moving inland into Vietnam to engage the enemy forces until an adequate sustainment base was established. It was not until almost a year later that the operational reach of the forces in Vietnam was capable of conducting offensive missions in the interior of Vietnam and along the Cambodian-Laos borders. It was the construction of base camps and fire bases inland from the shores of Vietnam, their ability to be defended, and the construction of the lines of communication to sustain them that permitted this.

Engineers in the Global War on Terrorism (GWOT)

OEF - Engineer Operations in Afghanistan

In October 2001 a platoon from the 41st Engineer Battalion, Fort Drum, NY accompanied its habitual infantry battalion Task Force, 1-87 Infantry to Uzbekistan to prepare for future operations in Afghanistan.[41] This light combat engineer platoon would provide the initial combat engineering capability for its infantry battalion and a company from the 326th Engineer

[41] Philip J. Dacunto and Bo Arnold, "Light Engineer Lessons Learned in the Contemporary Operational Environment," *Engineer*, 33 (January-March 2003): 11.

Battalion would provide support to the remainder of 3rd Brigade 101st Infantry.[42] The platoon from Alpha Company 41st Engineer Battalion deployed with little notice, minimal mission focused training and equipment, and would spend the majority of their tour in Afghanistan with only the equipment they brought with them. Due to the undisclosed deployment location executed under the auspices of an emergency readiness deployment exercise (EDRE), and the fact that their vehicles would be a low priority for movement, the platoon was forced to repack its equipment resulting in severe equipment shortages later. Upon arrival into theater at Uzbekistan the platoon went about conducting initial countermobility and survivability operations around the airfield by hand emplacing wire obstacles and constructing fighting positions. Their engineer equipment of a small emplacement excavator (SEE) and a dozer were so low on the force flow priority list they would need to rely on their resourcefulness and the assistance of other engineer units to provide their supporting battalion with anything other than basic combat engineering support. Despite the lack of equipment the platoon was able to install 8500 meters of perimeter wire and construct over 40 fighting positions. Additionally, they would provide limited general engineering support by construction of command posts, guard towers, and temporary detainee facilities using their pioneer and carpenter tool kits.

After the initial 30 days in Uzbekistan the battalion task force moved into Afghanistan and the sapper squads went along with their habitual infantry companies. Their primary missions were combat engineering focused on mobility operations, primarily using their demolition and mine detection equipment capabilities. [43] The secrecy of their deployment from Fort Drum, and little notice prior to deployment prohibited their higher headquarters from properly resourcing

---

[42] MAJ Mark Quander, Interview by Operational Leadership Experiences Project Team with Combat Studies Institute, transcript, 7 March2007, Fort Leavenworth, Kansas. [Online version at Combined Arms Research Library, Fort Leavenworth, Kansas], 3.

[43] Ibid., 12.

them for the missions they would be asked to accomplish.[44] The battalion task force eventually established its base of operations at Bagram Airbase where the sapper platoon focused its efforts on unexploded ordnance and minefield clearance operations. Again, due to the lack of engineering equipment, they relied on the Bravo Company 92d Engineer Battalion's (Combat Heavy) armored bulldozer and a coalition engineer unit's Aardvark flail to conduct the major area clearance operations.[45] In March of 2002 the sapper platoon would provide combat engineer support to the Infantry Task Force as they participated in Operation Anaconda. Here the sapper squads were task organized again to their respective companies and provided primarily mobility and countermobility support. Due to the rough terrain and elevations, the squads carried limited equipment: C4 demolition and ignition systems.[46] Even though the combat engineer platoon lacked the training and equipment to conduct little more than dismounted mobility and limited countermobility support, they were able to fully support their light infantry task force with limited equipment augmentation from other engineer units in-country.

Charlie Company from the 326th Engineer Battalion had a different experience with their early deployment to Afghanistan. They were able to bring the whole company plus an attached equipment platoon. One of their combat engineer platoons would deploy earlier to Pakistan to support their habitual Infantry Battalion Task Force while the rest of the company would support part of 3rd Brigade, 101st Airborne Division (Task Force Rakkasan).[47] The engineer missions they executed provided combat engineer support to the infantry battalions. MAJ Quander, then Commander of Charlie Company, also had the responsibility to provide area clearance and

---

[44] MAJ Philip Dacunto, Interview by Operational Leadership Experiences Project Team with Combat Studies Institute, transcript, 27 March 2008, Fort Leavenworth, Kansas. [Online version at Combined Arms Research Library, Fort Leavenworth, Kansas], 9.

[45] Dacunto and Arnold, 12-13.

[46] Ibid., 13-14.

[47] Quander, 3.

general engineering support to operations around Kandahar airfield.[48] Another non-typical mission that C/326th Engineer Battalion provided during Operation Anaconda was the establishment and operation of a Forward Arming and Refueling Point (FARP).[49] The efforts by C Company, 326th Engineer Battalion at the FARP extended the operational reach of the 3rd Brigade 101st Infantry during operation Anaconda. Based on the attached equipment platoon they were able to both successfully provide their normal combat engineer skills to the Brigade Task Force and the general engineering skills to the airfield.

The initial forces in Afghanistan were primarily light infantry units and they were supported by their organic light engineers. Similar to the initial operations in Vietnam, it was not until after a few months that the Afghanistan Theater of Operations matured and additional combat and construction engineer battalions arrived to augment the organic divisional/brigade engineers. Two distinct differences between these simultaneous Afghanistan deployments were the size and composition of the engineer unit and the advanced notice time prior to their deployments. Even though both these recent operations experienced different levels of success and the units were able to accomplish their assigned missions, the second one provided a much more capable engineer support package. This demonstrates that by having both combat and general engineering capabilities in the same unit and an already established habitual relationship, an engineer unit can better provide support to their organic maneuver element.

The 66th Engineer Detachment (Terrain) of the 10th Mountain Division provided geospatial planning and product support to the division headquarters in Afghanistan starting in December of 2001. Its primary means of data management, production, and terrain visualization was through the use of the Digital Topographic Support System (DTSS)Deployable. The terrain

---

[48] Ibid., 4.

[49] Ibid., 9.

team was led by a geospatial warrant officer who was pulled from the ongoing 10th Mountain Division mission in Kosovo. The team also included terrain analysts, some of whom stayed in Kosovo, while others shifted to Afghanistan to support the planning of current operations. The team was collocated with the division G2 (Intelligence) staff section and supported the Intelligence Preparation of the Battlefield (IPB) process. Using existing data from the National Imagery and Mapping Agency (NIMA), now named National Geospatial Intelligence Agency (NGA), the team began to analyze the terrain of Afghanistan, specifically in preparation for the upcoming Operation Anaconda. Using software provided with the DTSS-D, the team could develop virtual products of the mountainous terrain to be navigated by aircraft and travelled by Soldiers on foot. The software permitted the maneuver commanders and aviators to conduct a virtual terrain walk, reconnaissance and fly through of their routes. This provided them with an opportunity to identify air avenues of approach, possible insertion points, line-of-sight profiles for various weapon systems, and possible exfiltration and infiltration routes for both friendly and enemy forces.[50]

These initial operations in Afghanistan were primarily focused on offensive missions to defeat the Taliban forces, however they still required more than just combat engineering capabilities. In order to avoid culmination, the engineer platoon with the 1-87 Battalion Task Force relied on external support to perform some of their basic combat engineering and limited general engineering missions. The platoon could not provide sufficient general engineering support if the Task Force transitioned to stability operations. Additionally, in order to reduce the risk to coalition forces in the austere environment of Afghanistan the geospatial support provided

[50] Chief Warrant Officer 3 David Kasten, "Operation Enduring Freedom: A Waypoint Toward Geospatial Engineering Transformation," *Engineer Magazine*, 32 (April-June 2003): 27-29.

by the 66th Engineer Detachment permitted the maneuver commanders to remove some uncertainty by seeing the terrain before operating on it.

OIF - Engineer Operations in Iraq

During the buildup of forces for the invasion of Iraq in March of 2003 the primary maneuver elements under V Corps had their organic engineer brigades and battalions and were further augmented with many non-divisional units. The primary maneuver units under V Corps for the initial invasion were the 3rd Infantry Division, the 101st Airborne Division and the 82d Airborne Division. Similar to Vietnam, the non-divisional engineer units fell up under the Corps Engineer Brigade, the 130th Engineer Brigade. Slightly different than the 18th Engineer Brigade in Vietnam, the 130th Engineer Brigade task organized many of the non-divisional units to the maneuver forces, equating to almost every division having twice the amount of their normal engineer effort. COL Gregg F. Martin commander of the 130th Engineer Brigade, had retained an engineer group with four battalions and two additional battalion headquarters under his direct control. Within a month of the invasion "the V Corps engineer force grew to more than 19,000 soldiers in 3 brigades, 5 groups, 30-plus battalions, and numerous separate companies and detachments."[51] The missions executed by the divisional units were once again focused on combat engineering, primarily mobility support ones.

The first engineer mobility mission was the reduction of the Kuwaiti-Iraq berm. This had been an ongoing operation by Kuwaiti forces under the auspices of border maintenance. On the night of 20 March 2003 the 937th Engineer Group, serving as the crossing area engineer under the control of 3rd Infantry Division, completed the breach of the berm permitting the 3rd Infantry Division, and the 1st Marine Expeditionary Force to begin the invasion into Iraq. As the 3rd

---

[51] Colonel Gregg F. Martin and Captain David E. Johnson, "Victory Sappers: V Corps Engineers in Operation Iraqi Freedom Part 1: The Attack to Baghdad and Beyond . . .," *Engineer Magazine*, 33 (July-September 2003): 4-6.

Infantry Division moved forward into Iraq toward its next objectives the crossing of the berm was passed back to the 84th Engineer Battalion, a non-divisional unit under the control of 130th Engineer Brigade.[52] The next forward objective in Iraq for the 3d Infantry Division was the seizure of Tallil Airbase which was quickly accomplished by elements of the 3d BCT with a company from their organic 317th Engineer Battalion. Upon seizure of the runway they noticed that it had mines and unexploded ordrnance around and on it in order to prevent it from being used. This was quickly rectified by elements of both the 54th Engineer Battalion (Combat Mechanized) and the 94th Engineer Battalion (Combat Heavy) using their mine clearance Panther Tanks and construction equipment respectively.[53] The initial engineer operations supporting the 3rd Infantry Division invasion into Iraq from Kuwait were accomplished by a mixture of both divisional and non-divisional engineer assets. As most of these operations were offensive in nature the more common engineer tasks were those of combat engineering and mobility support. A significant difference between both Vietnam and Afghanistan initial operations is that in this case the maneuver forces had more advance notice and had deployed into a well established logistics infrastructure well prior to the commencement of operations. Additionally, the maneuver elements were augmented with much more than what they would normally have in their organic engineer formations.

As suspected, the Iraqi resistance got greater as the invasion advanced further into Iraq toward Baghdad. The maneuver forces knew that as they moved quickly to seize their objectives, speed was critical to get to Baghdad and topple the regime's center of power. This not only required a robust combined arms team concept but they needed sufficient mobility assets to ensure the momentum could be maintained, bridges crossing both the Tigris and Euphrates Rivers

---

[52] Gregory Fontenot, E. J. Degen, and David Tohn *On Point: The United States Army in Operation Iraqi Freedom* (Fort Leavenworth, KS: Combat Studies Institute Press, 2004), 104.

[53] Martin, 6.

needed to be quickly secured intact and gap crossing assets needed to be nearby if they were blown or damaged. During the seizure of An Najaf the bridges crossing the Euphrates River to the North and South needed to be seized, crossed and secured so that blocking positions could be established to isolate the city from reinforcement by the north and east.[54]

As Operation Iraqi Freedom switched from offensive operations, as the main effort, following the seizure of Baghdad to one more focused on stability operations, the engineer forces would quickly transform their primary mission from one focused on mobility and combat engineering to the full spectrum of operations now requiring more survivability and general engineering support.

An additional look at another BCT in OIF is the 2nd Brigade of the 2d Infantry Division, who deployed with the 44th Engineer Battalion (Combat) from the Republic of Korea to Ramadi, Iraq in the Al Anbar province from August 2004 to July 2005. The Al Anbar province was part of the 1st Marine Divisions (MARDIV) and later the 2nd MARDIVs Area of Responsibility (AOR) which had been suffering from a strong insurgency specifically in Fallujah. The 44th Engineer Battalion was a divisional mechanized unit habitually assigned to support the 2d Brigade of the 2d Infantry Division, an infantry brigade with two air assault and one mechanized infantry battalions which had been stationed in the Republic of Korea since 1965. The engineer battalion had two mechanized engineer companies under its control as it had detached one company to one of the brigade's air assault battalions to provide them more firepower in their area of operation (AO). The typical missions the 44th found themselves conducting were route reconnaissance, rapid road & crater repair, survivability and countermobility tasks including

[54] Fontenot, 196.

checkpoint construction, concrete barrier and HESCO bastions emplacement, and reinforcing the maneuver units to fight as mechanized infantry.[55]

A major operation the 44th Engineer Battalion participated in was Al Fajr designed to take back control of the town of Fallujah. During the initial breaching operations into the city the attached engineer companies conducted minefield lane breaches using their mine clearing line charges (MICLICs) enabling the following armored task force to enter the city walls.[56] During this period of OIF, the engineer battalion was fully engaged and provided combat and limited general engineering support to its BCT and other assigned Marine units as reinforcing infantry elements. Here the combat engineer battalion was just about the right composition for the environment in which they were operating. After the successful operation in Fallujah, the 1st MARDIV conducted a relief in place with the 2nd MARDIV and the 2d BCT 2d Infantry Division boundaries were shifted to accommodate for a maneuver element to be freed-up for the upcoming elections in 2005. This boundary change included making the 44th Engineer Battalion a battle-space land owner with an AO. The AO was primarily along the main supply route (MSR) in and out of Ramadi, which the engineers were already conducting daily patrols along trying to deny the enemy from placing deadly improvised explosive devices (IEDs).[57] During the January 2005 elections, the battalion provided survivability and general engineering support to the host nation as they hardened polling stations and pre-positioned barrier material at distribution points for the election.[58]

---

[55] LTC James Raymer, Interview by Operational Leadership Experiences Project Team with Combat Studies Institute, transcript, 24 February 2006, Fort Leavenworth, Kansas, [Online version at Combined Arms Research Library, Fort Leavenworth, Kansas], 6-7.

[56] Donald P. Wright and Timothy R. Reese, *On Point II: transition to the new campaign: the United States Army in Operation Iraqi Freedom, May 2003-January 2005* (Fort Leavenworth, KS: Combat Studies Institute Press, 2008), 353.

[57] Raymer, 8.

[58] Raymer, 9.

The final engineer unit studied was the 20th Engineer Battalion supporting 1st BCT, 1st Cavalry Division during OIF II from March 2004 to March 2005 in a primarily stability support operation. The 20th actually was supposed to deploy in support of OIF I but that did not occur so they used the year to retrain and shift from an offensive focused mission to a stability and support focused mission for their OIF II rotation. The 1st BCT was rotating in to relieve a BCT from 1st Armored Division, when the Sadr City uprising occurred and forced a change in mission focused on defeating the rising insurgency and then conducting stability operations in the Sadr City area.[59] One of the major combat engineering missions the 20th Engineer Battalion was tasked with was route clearance operations along their brigade's MSRs. In order to accomplish this mission, the battalion was augmented with a reserve engineer unit equipped with the new route clearance equipment as the 20th was not equipped or trained to perform this mission. [60] Once the initial violence and unrest of Sadr City had subsided, the BCT focused on its stability operations mission with a large Civil Military Operation effort. The BCT commander, COL Robert B. Abrams, conducted weekly meetings focused on tracking the civil military operations and infrastructure repair missions primarily focused on sewer, water, electrical, and trash (SWEAT) projects. The focus was to physically clean up the city and begin to provide the basic essential services back to the people in order to prevent future violent unrest.[61] The engineer battalion did not have much capacity to actually fix these basic infrastructure systems, however, they did have access to the funds to purchase the parts needed and employ the Iraqis to repair and operate them. The BCT actually had each of its maneuver battalions follow and manage the projects in their AOs while the engineers conducted the reconnaissance, quality control and

[59] L. Barrett Holmes, LTC, USA, Interview by Contemporary Operations Studies Team with Combat Studies Institute, transcript, 6 December 2005, Fort Leavenworth, Kansas, [Online version at Combined Arms Research Library, Fort Leavenworth, Kansas], 2-4.

[60] Ibid., 7.

[61] Ibid., 8.

assessments of the facilities. One of the training events the battalion conducted prior to deployment to prepare them for the expected stability operations was with the local city planners of Killeen, TX to provide classes on operating and managing a municipality.[62]

While the stability operations were ongoing and construction projects were repairing the infrastructure, the BCT continued to conduct combat operations in order to defeat the insurgency. It was here where they could leverage the location of the construction in order to persuade the people through their District Advisory Council to take back control of the city and deny safe-havens for the insurgents. Additionally, Sadr City, a primarily Shiite neighborhood, had experienced decades of neglect under Saddam Hussein so the major sewer, water, and power facilities required large capital investment projects overseen by the US Army Corps of Engineers. Here the division engineer was able to expedite the projects in Sadr City and even helped to establish a Corps of Engineer Resident Office to facilitate these projects.[63] The BCT knew that the key to preventing future violence would be through these long term infrastructure development projects.

It is interesting to note that the 3d Infantry Division BCTs during the invasion, who already had organic engineer battalions, used additional attached engineer battalions to accomplish their two initial operations. The assumption is that this was done in order to maintain the momentum for the lead BCT and still have enough engineer support as they advanced toward Baghdad. The next two BCTs presented in the case studies above, both had their mechanized engineer battalions with them and they were able to provide the appropriate level of engineer support throughout their rotations. The 44th conducted combat engineering missions in support of its BCT and other maneuver units in their area of operations, while the 20th went about providing

---

[62] Ibid., 11.

[63] Ibid., 18.

some combat engineering support during periods of unrest but primarily provided general engineering expertise and management in support of its BCTs stability operations.

Key to the swift initial victory during the invasion of Iraq in 2003 was the tempo maintained by the maneuver forces. The speed at which they crossed the Kuwaiti berm and arrived into Baghdad was accomplished by adding robust mobility support into each lead BCT. Furthermore, by using the attached maneuver support units, the BCTs were able to retain their organic mobility assets for the future challenges they would encounter upon arrival into the city of Baghdad. After the initial phase of operations was over and the BCTs shifted efforts toward stability operations, it was with significant augmentation of engineer forces that gave them the flexibility to continue offensive operations against insurgent forces, while simultaneously conducting defensive and stability operations to compel the local populations to support the coalition and Iraqi efforts.

Current Engineer Doctrine

The Army defines full spectrum operations (FSO) as the combination of offensive, defensive, and stability or civil support operations simultaneously as part of an interdependent joint force to seize, retain, and exploit the initiative, accepting prudent risk to create opportunities to achieve decisive results. They employ synchronized action—lethal and nonlethal—proportional to the mission and informed by a thorough understanding of all variables of the operational environment.[64] Combat engineering companies in a BCT provide support to the maneuver forces primarily through assured mobility. According to FM 3-34 Engineer Operations "assured mobility is a framework of processes, actions, and capabilities that assure the ability of the joint force to deploy and maneuver where and when desired, without interruption or delay, to

[64] FM 3-0, 3-1.

achieve the mission. The assured mobility fundamentals—predict, detect, prevent, neutralize, and protect—support the implementation of the assured mobility framework."[65]

Engineer forces perform a variety of tactical enabling operations in support of full spectrum operations including mobility, counter-mobility and survivability tasks. "Engineer operations modify, maintain, provide understanding of, and protect the physical environment. In doing so they - enable the mobility of friendly forces; alter the mobility of adversaries; enhance the protection and enable the sustainment of friendly forces; contribute to a clear understanding of the physical environment; and provide support to noncombatants, other nations, and civilian authorities and agencies."[66] While supporting offensive operations, engineers conduct breaching and obstacle reduction, gap crossing, clearing of minefields and other mechanical obstacles, improvised explosive devices (IED) defeat, reconnaissance, and obstacle emplacement to protect flanks of the maneuver unit. The difficulty of these tasks increase when operations occur in restricted and complex terrain to include urban areas, jungle, mountains, desert and extremely hot areas, arctic and cold regions. "When forces are required to operate in urban areas, significant engineer augmentation is likely required."[67]

During defensive operations, engineers primarily focus their effort on counter-mobility operations to fix, disrupt, turn or block enemy formations. This includes obstacle construction and placement such as minefields, wire obstacles, tank ditches and protective berms. Additionally, engineers provide survivability support to protect and harden maneuver units' defensive battle positions, key command and control (C2) and logistical nodes.

---

[65] FM 3-34, 3-11.

[66] FM 3-34.22, 1-3.

[67] Ibid., 6-24.

"In stability operations, most engineer effort is focused on theater infrastructure repair and restoration to reconstruct or establish services that support the population."[68] Engineers organic to the BCT have limited general engineering capabilities and skill sets to complete these general engineering tasks and would require considerable augmentation from non-organic engineer units. Engineers provide similar mobility support to the BCT as they do in offensive and defensive operations. Additionally, they may provide counter-mobility support by constructing nonlethal obstacles such as fences, roadblocks, and checkpoints. Other mobility missions may include combat and general engineering efforts to construct or upgrade roads, clear, maintain or repair roads, and in some cases bridges. [69] During the simultaneous conduct of full spectrum operations or planning prior to execution of them, geospatial engineering can serve as a critical source of information. This information is critical for the planning of operations to find likely avenues of approach, possible routes to be used for movement and logistics, infrastructure assessments, urban population densities, soil, water and other necessary terrain data.

The BCT organic engineer company is equipped with minimal horizontal and vertical construction equipment. Current organization has a single 168 Soldier company with three combat engineer platoons and an equipment platoon assigned to the Heavy Brigade Combat Team (HBCT). Its mission is "to increase the combat effectiveness of the maneuver commander by accomplishing mobility, countermobility, limited survivability, and general engineering tasks."[70] The combat platoons are equipped with tracked vehicles, either Bradley or M113s and are focused on the combat engineering tasks of mobility, counter-mobility and limited survivability. Theses platoons usually move with the maneuver units and dismount from their

---

[68] Ibid., 7-3.

[69] Ibid, 7-4.

[70] 1st HBCT, 1st Cavalry Division, Brigade Special Troops Battalion, WJKZC0, Modified Table of Organization and Equipment (MTOE), accessed 7 March 2010 on the US Army Force Management Support Activity website, https://webtaads.belvoir.army.mil/ .

vehicles to conduct their combat engineering operation. They are equipped with demolition kits, mine detectors, chain saws, and mechanical mine emplacement systems. They can perform limited vertical construction tasks using assigned pioneer and carpenter tool kits but are not school trained in these tasks. The assault squads of the equipment platoon have the new assault breacher vehicles equipped with mine plows, rollers, and mine clearing line charges (MICLICs). The equipment platoons other two squads have armored combat earthmovers and High Mobility Engineer Excavators (HMEE) which provide mechanical obstacle reduction capability for mobility operations, and can construct firing positions, obstacles, and berms for counter-mobility and survivability operations. Additionally, they can be used for limited horizontal engineering operations, primarily hasty construction of combat roads or trails.

The Infantry BCT (IBCT) engineer company is about half the size of an HBCT Engineer Company with only 75 combat engineers organized into two combat platoons and one equipment platoon. Their mission is "to increase the combat effectiveness of the separate BCT by accomplishing limited mobility, countermobility, survivability, and sustainment engineering missions, or to perform infantry combat mission when required." [71] Similarly, they are also focused on mobility and counter-mobility with limited survivability capability. The two combat platoons are equipped with high mobility multi-purpose wheeled vehicles (HMMWVs), handheld mine-detection equipment, demolition kits, and conduct most of their engineer mobility and counter-mobility operations dismounted. Their equipment platoon is equipped with only two Deployable Universal Combat Earthmovers (DEUCE), two 5-ton dump trucks, and four HMEEs. They also have chain saws, pioneer and carpenter tool kits, and can provide similar survivability

[71] 173d Airborne Brigade Special Troops Battalion, WJKFA0, Modified Table of Organization and Equipment (MTOE), accessed 7 March 2010 on the US Army Force Management Support Activity website, https://webtaads.belvoir.army.mil/ .

and limited general engineering capabilities as in the HBCT; but due to their number, on a much smaller scale.

The Stryker BCT (SBCT) engineer company is similar to the HBCT Engineer Company in both size and equipment with 143 combat engineers organized into three combat mobility platoons and a mobility support platoon. However, they are task organized slightly different than the two previous engineer companies as they are not under a Special Troops Battalion. The mission of the Stryker Engineer Company is "to provide organic mobility, force protection, limited countermobility, survivability, and sustainment engineering to the brigade combat team."[72] The combat platoons are equipped with Engineer Stryker Variant vehicles with mechanical mine detection, clearance and emplacement equipment similar to the HBCT. The combat engineer squads in the mobility platoons are also similarly equipped with pioneer and carpenter tool kits, chain saws, demolition sets and mine dispensing equipment. Additionally, in the mobility support platoon the SBCT has a Rapidly Emplaced Bridge providing them with a 13meter gap crossing capability absent from the other BCT structures.[73] This is the only BCT organic engineer company that currently has a gap crossing capability.

These three organic engineer companies are all organized slightly different based on the BCT they support. However, all of them are limited in conducting operations outside the traditional combat engineering missions. All three BCTs have a maneuver support staff with engineer officers and Soldiers permanently assigned. These staffs include geospatial warrant officers and terrain analysts who provide a much more robust geospatial capability that used to

---

[72] 2d Stryker Cavalry Regiment Engineer Company, WBA4AA, Modified Table of Organization and Equipment (MTOE), accessed 7 March 2010 on the US Army Force Management Support Activity website, https://webtaads.belvoir.army.mil/ .

[73] Fm 3-34, Appendix B, 3-5.

only exist in the division or higher headquarters and separate engineer topographic organizations. These terrain teams are equipped with the Digital Topographic Support System (DTSS).[74]

Engineer Transformation

The large scale maneuvers of Corps and Divisions in single operations similar to World War I and II were last conducted by the US Army in 1991 during the Persian Gulf War. At that time the United States Army deployed about half a million Soldiers into the operational area to participate in one major combat operation against Iraqi Armed forces that had invaded Kuwait and threatened Saudi Arabia. Following the successful completion of the Gulf War, the United States Army began a long term transformation plan titled Force XXI, when on 8 March 1994, the 32d Chief of Staff of the Army (CSA), General Gordon R. Sullivan, directed the start of a major campaign plan to lead the future Army in the early years of the next century. Shortly after, General Eric K. Shinseki, the 34th CSA, continued this transformation with the Objective Force concept in October of 1999, moving toward a more modular and expeditionary force.[75] This transformation process has evolved over the last two decades and has been significantly affected by the ongoing military operations in both Iraq and Afghanistan. The most significant change to the Army is a shift from a Division centric to a Brigade centric force.

Similarly, the Army Engineer Regiment began a process of modularity shifting its force structure from 48 different engineer Modified Table of Organization & Equipment (MTOE) structures focused on providing support to a division centric army. Since transformation, the engineer regiment has reduced its number of MTOEs to 37 different types that are more focused toward supporting a brigade centric army. Previously, there were 22 types of battalion and larger structured engineer units and 26 company, and below, structures. Primarily these were focused

---

[74] Ibid., E-1.

[75] GlobalSecurity.org, "Military: Force XXI," Global Security.org, http://www.globalsecurity.org/military/agency/army/force-xxi.htm , (accessed 18 OCT 2009).

on providing dedicated engineer assets to divisions, and below, and headquarters elements that commanded and controlled additional engineer augmentation and specialized engineer units at echelons above division (EAD). Additionally, these larger forces were centered on support to Corps and Theater Army's with a strategic focus.

Currently, the engineer force structure has only four types of battalion and higher command and control structures with 34 company and below structures.[76] The largest change has been the removal of the engineer group structure, and a reduction from 14 to only two types of engineer battalions, combat or construction.[77] The largest effect on modularity has been embedding engineer companies permanently into the brigade combat teams and placing all of the other specialized assets under one of the two types of engineer battalion structures. Currently there are four categories of modular engineer units - embedded, baseline, mission modules, and engineer command and control (C2). The embedded units include the organic companies in the BCTs. The baseline units include one of seven types of engineer companies - sapper, mobility augmentation, multirole bridge, clearance, horizontal construction, vertical construction and engineer support. Mission modules consist of specialized teams, detachments, platoons, and higher not found in either the embedded or baseline companies. The engineer C2 units consist of a battalion, brigade or theater engineer command. These headquarter units are designed to provide C2 and support for any subordinate type of engineer unit.[78] Another significant change has been in reducing the various types of engineer brigades to only one theater structured brigade. These brigades are no longer dedicated to either a Division or Corps. They are geographically

---

[76] Table of Organization & Equipment Unit Reference Book, (Maneuver Support Center, Fort Leonard Wood, MO) 1 March 2008.

[77] This does not include the 249th Engineer Battalion (Prime Power) a non Forces Command (FORSCOM) unit directly assigned to the US Army Corps of Engineers.

[78] Lieutenant Colonel Steve Danner and Don Wenzel, "Engineer Modularity", *Engineer Magazine*, 39 (May-August 2009): 71-72.

stationed and assigned to a theater Army but remain eligible for worldwide deployment. Even though the numerical reduction in the types of engineer units has not been that significant, the capability and shift from a division centric force to a brigade centric force has made some significant impacts on the engineer regiment. There are now fewer engineer capabilities readily available to the maneuver commander of a BCT. Furthermore, engineer battalions and brigades have more diversity in their capabilities which requires a larger span of command and control and training.

Future Engineer Force

The engineer force missions for the future are focused around four lines of engineer effort supporting the maneuver forces in a full spectrum environment: assure mobility, enhance protection, enable expeditionary logistics and building capacity. Assured mobility focuses on the traditional mobility and countermobility tasks and geospatial engineering to help commanders and staffs to visualize the terrain. Protection tasks include the traditional survivability and some countermobility tasks. Enabling logistics would encompass all the general engineering tasks associated with lines of communication and main supply routes construction and maintenance, ports and airfields and base camp construction. Lastly, the capacity building effort would include the traditional general engineering tasks focused on the initial repair and restoration of host nation essential services and critical infrastructure reconstruction.[79]

In an interview conducted in 2006, Colonel Lou Marich, the former 1st Armored Division Engineer Brigade commander in OIF I, was asked what were the most important lessons learned from his experience. His response provides a very insightful look as to the future the engineer regiment may face.

---

[79] Bryan Watson, BG, US Army Engineer School Commandant ILE Engineer Update, Command and General Staff College, Fort Leavenworth, KS, 4 August 2009.

> The first one would be the structure piece we just talked about. Having the engineers at the brigade level who can then do all that work for the brigade commander. And, oh by the way, those engineers, not only did they just do construction, they did infantry missions as well as everybody else, things like traffic control points and cordons and searches and all that. So really in my mind you are getting twice the value for your money. You have someone who can do all the engineer stuff and then you have someone who also can do the combat missions.[80]

The research period of this monograph included the discovery of many written documents attempting to supply a definition of future warfare. They are as diverse as they are varied; however, most of them contain some element of hybrid warfare where a smaller scale conventional fight is subordinate to a protracted conflict against a less technologically equipped enemy conducting irregular warfare. The *Capstone Concept for Joint Operations* "proposes that future joint force commanders will combine and subsequently adapt some combination of four basic categories of military activity -- combat, security, engagement, and relief and reconstruction -- in accordance with the unique requirements of each operational situation." [81] The assumption drawn from this is that no matter where the US Army sends a BCT it will be required to operate simultaneously in an offensive, defensive, and stability role in both a permissive and non-permissive environment. This mission set will require a robust enough engineer force that can sustain the BCT and support it across the spectrum of conflict. The *Concept* further states that "we will need to develop new capabilities and change the capacities of existing ones and we will need to envision and create new organizations."[82] This may foreshadow the future increased requirements of engineers in a BCT.

---

[80] Colonel Lou Marich. Interview by Operational Leadership Experiences Project Team with Combat Studies Institute, transcript, 10 April 2006, Fort Leonard Wood, MO, [Online version at Combined Arms Research Library, Fort Leavenworth, Kansas], 18.

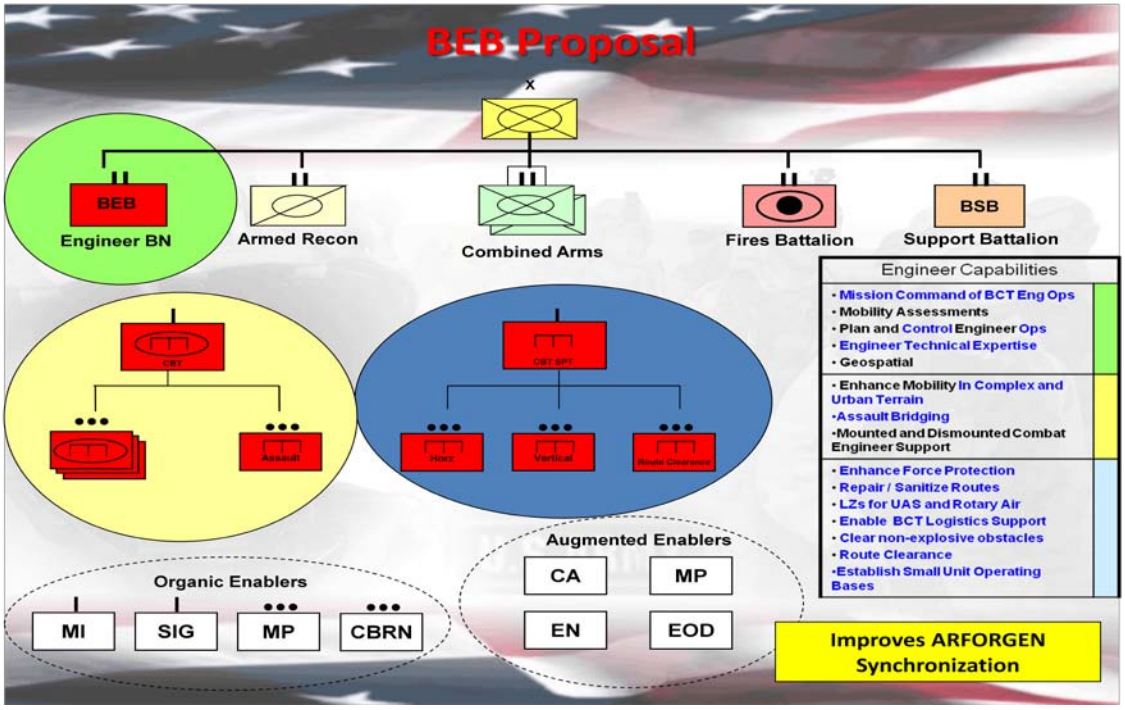
[81] U.S. Department of Defense, *Capstone Concept for Joint Operations*, Version 3.0 (Washington, DC: Department of Defense, 15 January 2009), iii.

[82] Ibid., iv.

Brigade Engineer Battalion

Recently the engineer regiment has advanced an initiative to return a battalion size engineer capability back into the BCT. The current structure would be made from the existing Brigade Special Troops Battalion (BSTB) and would need assets reassigned from the new modular combat and construction battalions outside of the brigade. The brigade engineer battalion would include an engineer headquarters with two engineer companies, one combat and one construction providing mobility, countermobility, survivability, and general engineering all in one unit. There is no recommended change to the terrain team already existing in the maneuver support cell of the BCT headquarters.

This proposal merits some significant consideration as it would provide a sufficient amount of full spectrum engineering capability in the BCT. It would have mobility, including a gap crossing capability, countermobility and survivability in one company and both vertical and horizontal construction, and route clearance in the other. This capability would insure that the BCT could sustain themselves in either permissive or non-permissive and austere environments.



*** Slide derived from ILE Engineer Update by BG Bryan Watson, US Army Engineer School Commandant on 4 August 2009. {Pre-decisional}**

Recommendations and Conclusion

After taking a look at engineer forces supporting full spectrum operations it is clear that the need for an engineer capability will continue to exist in the future to support the maneuver commanders. As the Army continues its transformation to a more modular, expeditionary force it is evident that when the modular Brigade Combat Team deploys to an environment they will need engineer assets to repair, upgrade, or build the required infrastructure to sustainment themselves immediately during the initial 90 day period. Additionally, the demand for terrain visualization products and other geospatial information is greatest during the initial planning efforts. If the expectation is to conduct full spectrum operations then there will be a need for the combat, general, and geospatial engineering assets in support of the BCT. The decision that must be made is whether or not these assets are organic to the brigade or get attached for the specific mission. Looking back in history, at initial operations in Vietnam, Afghanistan, and Iraq, the greatest need for engineer augmentation was with general engineering- type units. The organic engineer companies and battalions could provide limited mobility and countermobility support, but often needed assistance for construction, sustainment, and survivability operations.

Currently, all the BCTs have sufficient geospatial engineer capabilities assigned to their staffs, and the Stryker and Heavy BCTs have adequate mobility, countermobility and survivability assets organic to them. The Infantry BCT has limited mobility, and insufficient countermobility and survivability assets. None of the BCTs currently have sufficient general engineering capabilities. This can be mitigated with some cross-training or assignment of general engineering military occupational specialty (MOS) soldiers. Another shortfall of the modular BCT is in their gap crossing ability; only the Stryker BCT has a short gap crossing bridge. In the current engineer force structure these assets reside in either a Multi-Role-Bridge Company (MRBC) or in a Mobility Augmentation Company (MAC). The assignment of assault bridging back into the Heavy BCT should be considered in order to provide them with some limited gap crossing capability for their mechanized forces.

As with most branches in the Army, there are two basic categories of Soldiers, generalized or specialized. The Engineer Branch organizes its general engineer Soldiers into the embedded and baseline units and specialized ones into the mission modules. The biggest difference in these two types of capabilities is the training and equipment required to perform their tasks. The desire is to have a general capability in each BCT that can conduct combat, general, and geospatial engineering in support of a BCT engaged in full spectrum operations across the spectrum of conflict. The engineer regiment needs to ensure it has a balanced engineer force available to support these maneuver brigades and when necessary, augment them with the required specialized engineer modules.

The evidence presented in this monograph shows that there is a need for all three types of engineers present in the maneuver element as it deploys to a theater of operation. Two details the deploying force do not have control over are the time prior to notification of deployment and the condition of the environment they are deploying to. The challenges this presents are focused training and sustainment in the theater of operations. In order to mitigate these, it is imperative that the engineer forces are already organic in the BCT and that they are not only capable to provide combat engineering support, but they should be trained and equipped to provide the necessary general engineering support too. The analysis conducted shows that the Heavy BCT and Stryker BCT engineer companies are more capable than the Infantry BCT in providing combat engineering, but all have insufficient capability to conduct the required general engineering that is necessary when deploying to an austere environment and conducting stability operations.

The simultaneity called for in the Army's operating concept of full spectrum operations will require a robust maneuver support element with the flexibility to support offensive, defensive, and stability operations. The challenge the Army faces is that the current modular BCTs do not have the organic capability to conduct all three operations. Specifically, they do not have the ability to support stability operations without significant augmentation. In order to

successfully support the essential services and infrastructure development lines of effort in a stability operation there will need to be sufficient combat, general, and geospatial engineering capability organic to each BCT.[83]

[83] FM 3-0, fig 6-6, 6-14.

BIBLIOGRAPHY

3rd Infantry Division Operations: The Surge OIF 2007-2008. http://www.stewart.army.mil/units/docs/HistoryBookFinalRev.pdf (Accessed September 20 2008.)

Carland, John M., United States Army in Vietnam: Combat Operations Stemming the Tide: May 1965 to October 1966, Washington, D.C., United States Army Center of Military History, 2000.

CSA White Paper: The Army of the 21st Century: A Balanced Army for a Balance Strategy, 29 May 2009.

Danner, Steve, LTC, USA, and Don Wenzel, "Engineer Modularity", *Engineer Magazine*, Volume 39 (May-August 2009):71-72.

Department of the Army. *2009 Army Posture Statement*, May 7, 2009. http://www.army.mil/aps/09/index.html

Department of the Army. *The 2008 Army Modernization Strategy*, July 25, 2008. http://www.army.mil/institution/leaders/modplan/index.html

Department of the Army. *FM 3-0, Operations*, Washington, DC: U.S. Government Printing Office, February 2008.

Department of the Army. *FM 3-07, Stability Operations*, Washington, DC: U.S. Government Printing Office, October 2008.

Department of the Army. *FM 3-24, Counterinsurgency Operations*, Washington, DC: U.S. Government Printing Office, December 2006.

Department of the Army. *FM 3-34, Engineer Operations*, Washington, DC: U.S. Government Printing Office, 2004.

Department of the Army. *FM 3-34.22, Engineer Operations – Brigade Combat Team and Below*, Washington, DC: U.S. Government Printing Office, February 2009.

Department of the Army. *FM 3-90.6, The Brigade Combat Team*. Washington, DC: U.S. Government Printing Office, 2006.

Department of the Army, Maneuver Support Center: Table of Organization and Equipment, Unit Reference Book, April 2008.

Department of Defense, Capstone Concept for Joint Operations, Version 3.0 (Washington, DC: Department of Defense, 15 January 2009).

Bell, William G., *Department of the Army Historical Summary Fiscal Year 1970*. Center of Military History, United States Army, Washington, D.C., 1973.

Birtle, Andrew J., *US Army Counterinsurgency and Contingency Operations Doctrine 1942-1976*. Center of Military History, United States Army, Washington, D.C., 2006.

Dacunto, Philip J., and Bo Arnold, "Light Engineer Lessons Learned in the Contemporary Operational Environment." *Engineer* Volume 33 (Janurary-March 2003):11-15.

Dunn, Carroll H. LTG, USA, *Vietnam Studies: Base Development In South Vietnam 1965-1970*, Center of Military History, United States Army, Washington, D.C., 1972.

Feickert, Andrew , *U.S. Army's Modular Redesign: Issues for Congress*, Congressional Research Service, Library of Congress May 5, 2006. http://fpc.state.gov/documents/organization/67816.pdf, accessed 1April 2010.

Fontenot, Gregory, E. J. Degen, and David Tohn. *On Point: The United States Army in Operation Iraqi Freedom.* Fort Leavenworth, KS: Combat Studies Institute Press, 2004.

Fulton, William B., MG, USA, *Vietnam Studies: Riverine Operations, 1966-1969*, Center of Military History, United States Army, Washington, D.C., 1973.

Galloway, G. E. Jr., "*A Historical Study of United States Army Engineer Operations in the Republic of Vietnam January 1965- November 1967*" Monograph, Masters of Military Arts & Science, U.S. Army Command and General Staff College, Fort Leavenworth, KS, 1968.

Hay, John H. Jr., LTG, USA, *Vietnam Studies: Tactical and Materiel Innovations*. Center of Military History, United States Army, Washington, D.C., 1974.

Hayes, T.J., MG, USA, "A New Map for Vietnam: the PICTOMAP", *The Military Engineer*, Volume 57 (July-August 1966): 255-256.

Heiser, Joseph M. Jr., LTG, USA, *Vietnam Studies: Logistic Support.* Center of Military History, United States Army, Washington, D.C., 1974.

Holmes, L. Barrett, LTC, USA Interview by Contemporary Operations Studies Team with Combat Studies Institute, transcript, 6 December 2005, Fort Leavenworth, Kansas. [Online version at Combined Arms Research Library, Fort Leavenworth, Kansas].

Kasten, David, Chief Warrant Officer 3, "Operation Enduring Freedom: A Waypoint Toward Geospatial Engineering Transformation," *Engineer Magazine*, Volume 32 (April-June 2003).

MacGarrigle, George L., *Combat Operations Taking the Offensive: October 1966 to October 1967*, Washington, D.C., United States Army Center of Military History, 1998.

Marich, Lou, COL, USA, Interview by Operational Leadership Experiences Project Team with Combat Studies Institute, transcript, 10 April 2006, Fort Leonard Wood, Missouri. [Online version at Combined Arms Research Library, Fort Leavenworth, Kansas.]

Martin, Gregg F., COL, USA and Captain David E. Johnson, "Victory Sappers: V Corps Engineers in Operation Iraqi Freedom Part 1: The Attack to Baghdad and Beyond . . .," *Engineer Magazine*, Volume 33,(July-September 2003):4-12.

McGrath, John J., *The Brigade: A History Its organization and employment in the US Army*. Fort Leavenworth, KS: Combat Studies Institute Press, 2004.

Ploger, Robert R. MG, USA, *Vietnam Studies: U.S. Army Engineers 1965-1970*. Center of Military History, United States Army, Washington, D.C., 1974.

Quander, Mark, MAJ, USA, Interview by Operational Leadership Experiences Project Team with Combat Studies Institute, transcript, 7 March 2006, Fort Leavenworth, Kansas. [Online version at Combined Arms Research Library, Fort Leavenworth, Kansas.]

Raymer, James, LTC, USA Interview by Operational Leadership Experiences Project Team with Combat Studies Institute, transcript, 24 February2006, Fort Leavenworth, Kansas. [Online version at Combined Arms Research Library, Fort Leavenworth, Kansas].

Rogers, Bernard W. LTG, USA, *Cedar Falls- Junction City: A Turning Point.* Center of Military History, United States Army, Washington, D.C., 1974.

Schoomaker, Peter, GEN, USA, *Congressional Testimony before the Commission on National Guard and Reserves*, Dec 14, 2006, http://www.army.mil/-speeches/2006/12/14/989-statement-by-general-peter-schoomaker-chief-of-staff-united-states-army-before-the-commission-on-national-guard-and-reserves/index.html, accessed 1April 2010.

Starry, Donn A., LTG, USA, *Vietnam Studies: Mounted Combat In Vietnam*. Center of Military History, United States Army, Washington, D.C., 1979.

Turabian, Kate L. *A Manual for Writers of Research Papers, Theses, and Dissertations*. 7th ed. Chicago: University of Chicago Press, 2007.

The United States Army Corps of Engineers: A History, Headquarters, US Army Corps of Engineers (Alexandria, VA, 2007.)

Wilson, John B., *Maneuver and Firepower: The Evolution of Divisions and Separate Brigades*. Washington, DC: center of Military History, United States Army, 1998.

Wright, Donald P.; Reese, Timothy R., On Point II: transition to the new campaign: the United States Army in Operation Iraqi Freedom, May 2003-January 2005, Fort Leavenworth, KS: Combat Studies Institute Press, 2008.