Assessing Engineer Transformational Concepts

A Monograph

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Abstract

ASSESSING ENGINEER TRANSFORMATIONAL CONCEPTS by MAJ Michael C. Derosier, United States Army, 59 pages.

The purpose of this monograph is to study past and present engineer organizations and operations to answer the question: What is the deficiency between engineering requirements of the Brigade Combat Team (BCT) in the Contemporary Operational Environment (COE) and the actual engineer capabilities embedded in the BCT? A study of past engineer organizations, beginning with the lessons of World War I, shows that engineers habitually provide embedded engineer capability within plus additional augmentation to the Army's primary unit of action; from WWI to the present this primary unit of action has been the division. Lessons learned from past and ongoing engineer operations reveal the engineer capabilities commonly required in the COE. An analysis of the BCT and its embedded engineer organization indicates a deficiency in engineer requirements versus engineer capability. To compensate for this, engineers (through the engineer force pool) continue the habitual provision of augmentation from echelons above the unit of action. The result is a low-density/low-usage doctrine for employment of engineer assets in an operating environment that demands high-usage of these same assets. This organizational concept fails to correct command and support deficiencies in the current force structure. It further degrades the training, readiness, and post-deployment recovery of engineer force pool units. The monograph recommends a balanced embedded engineer battalion in the BCT that includes combat, construction, bridging, and geospatial capabilities. Since the Army and Training and Doctrine Command (TRADOC) do not consider this affordable, recommendations are offered on integrating engineer assets with the maneuver enhancement brigades, the UEx, and the UEy. Specific focus is given to command and support and to immediate DOTMLPF concerns. Further recommendations are given on refining conceptual wargaming in order to better contribute to the force development process. Finally, measures of effectiveness are suggested for monitoring the progress of engineer transformation and for structuring the study and reporting of future engineer operations.

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INTRODUCTION

The United States Army, in dealing with a post-Cold War security environment, is transforming to take advantage of improved and emerging technologies and to capitalize on successful business trendlines, especially the flattening of hierarchical organizations.[1] As a manifestation of this, the Army is moving to a new command structure centered on maneuver Brigade Combat Teams (BCT) with four distinct designs: armor, light, Stryker, and Future Combat System (FCS). These BCTs are augmented by Support Units of Action (SUA) with command and control provided by Units of Employment (UEx and UEy). Current and future requirements for rapidly providing forces to Regional Combatant Commanders (RCC) guide this process.

In response, the Engineer Regiment is transforming to provide modular, scalable, mission-tailored, and multi-functional capabilities to Army and joint force commanders. The foundation for the future engineer force is a small embedded capability within the BCT. Engineers provide additional capability through an engineer force pool consisting of baseline forces, effects modules, and engineer command and control. The purpose of this monograph is to study past and present engineer organizations and operations to answer the question: What is the difference between engineering requirements of the BCT in the Contemporary Operational Environment (COE) and actual engineer capabilities embedded in the BCT?

The first chapter summarizes the history of Army and engineer reorganizations, beginning with the lessons of World War I, in order to illustrate factors that have influenced engineer force structure. Trends are: 1) the embedded engineer capability is usually larger and more versatile when the unit of action it supports is expected to operate more independently; 2) the habitual augmentation of the division with echelon-above-division engineer assets; 3) the command and control challenges at the operational level resulting from augmentation; and 4)

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[1] Douglas A. Macgregor, *Breaking the Phalanx: A Design for Landpower in the 21st Century* (Westport, Connecticut: Praeger Publishers, 1997), see introduction.

increased administrative, logistical, and transportation requirements for non-embedded engineer units.

Chapter Two describes transformation as a function of national security strategy, battlefield requirements, technology, and budget. Since the end of the Cold War, the Army has functioned with less strategic guidance and in a more abstract operating environment (described by the Joint and Contemporary Operational Environments). Technology is a major concern as both a way to enhance capabilities and because of the budgetary demands of research, development, experimentation, and fielding of new equipment. The Army budget provides little focus on enhancement to engineer mobility, countermobility, survivability, general engineering, and topographic support capabilities.

Chapter Three examines the transformed BCT as the Army's warfighting unit of action and the specific role of the COE in shaping engineer force structure. Studies of Army operations in Somalia, Haiti, and the Balkans, as well as French and British peacekeeping experiences, demonstrate the engineering requirements of the COE. These operations are particularly relevant to current transformational efforts because they involve mostly one, sometimes two, BCTs operating independently under a division headquarters. The study indicates that engineers typically provide support in a proportion of one-tenth the size of the deployed force. In addition, the COE demands a full range of engineer mission sets: sapper, bridging, construction, and topographic.

Chapter Four examines the status of Army and engineer transformation. A comparison of COE requirements to actual BCT capabilities identifies a requirement versus capabilities gap in BCT force structure. Historical unit of action sizing trends and an assessment of the COE indicate that an engineer battalion is the appropriate size organization to match BCT requirements with full spectrum engineer capabilities. Since the Army and Training and Doctrine Command (TRADOC) do not consider this affordable, engineers will continue the habitual practice of augmenting the unit of action with units from the engineer force pool. This risks degradation of engineer force pool readiness and responsiveness because units are structured as low-density/low-usage but will actually be deployed in high demand. This also fails to correct command and support deficiencies in the current force structure, and there are some conceptual gaps regarding United States Army Corps of Engineers (USACE) integration along with material and contract support. The Caspian scenario[2] is presented as an example of how conceptual wargaming adds value to the process of proportioning embedded to force pool units. This scenario, however, does not replicate the COE and it, and others like it, needs to be refined.

Chapter Five introduces a series of related recommendations that contribute to the debate on Army and engineer transformation. The first set of recommendations is on designing the requisite engineer capability into the BCT and defining the line between embedded engineer units and force pool assets. The second set is command and control recommendations at the RCC, UEy, and UEx levels. The third are Doctrine, Organization, Training, Materiel, Leadership, Personnel, Facilities (DOTMLPF) considerations that need immediate attention. The final set is a list of possible measurements for monitoring engineer performance in future conceptual wargaming. These may also serve as a possible outline for studying future engineer operations, writing after action reports, and compiling lessons learned in a manner that is constructive to future Army improvements. All sets of recommendations are influenced by 1) a demonstrated capabilities gap in the BCT, 2) lack of incorporation of certain past lessons learned, and 3) deliberations on how to proportion baseline forces to module forces to engineer command and control.

CHAPTER ONE – Historical Trends

As a result of a Revolution in Military Affairs (RMA), the division will no longer be the Army's warfighting centerpiece. The Maneuver Brigade Combat Team (BCT) is replacing it as

[2] This is a current scenario being used to facilitate force development decisions regarding the support units of action.

the Army's central warfighting unit of action. There are four variants of the BCT – Heavy, Light, Stryker, and Future Combat System (FCS). This chapter studies the evolution of the division and engineers in order to illustrate factors that have historically influenced engineer force structure.

Beginning with World War I, the Army has produced four primary division organizations and has incorporated four additional improvements. The four primary division organizations are Square, triangular, pentomic, and Reorganization Objectives Army Division (ROAD)/modern heavy. Four additional modification concepts based on the ROAD design are light infantry, air mobile, TRICAP, and the digitized division. The division as a unit of action has evolved as a result of national security strategy, battlefield requirements, technology, and budget. More specific factors influencing division design are operational flexibility, firepower, mobility, deployability, sustainability, human capabilities, and advances in information systems, transportation, and protection.[3]

World War I – Square Division

In response to the evolving division structure, engineers have also undertaken substantial reorganization efforts. The Square division was assigned an engineer regiment consisting of 1,634 personnel in a division of 28,334.[4] Major capabilities included bridging, constructing fortifications, performing road work, and serving as the divisional reserve. The need for additional engineering effort was quickly realized, and engineers augmented the Square division with separate battalions. Additional specialty units (railway, port construction, forestry, mechanical, electrical, and depot units) typically supported a corps or an army. Early on the need for additional engineer capability in the division was realized and the conditions set for engineer command and control complications across tactical and operational levels of effort.

[3] Richard W. Kedzior, *Evolution and Endurance: The U.S. Army Division in the Twentieth Century* (Santa Monica, California: RAND, 2000), summary ix.
[4] Ibid., Appendix A.

World War II – Triangular Division

In the interwar period, 1919-1939, the Army cut most of the combat support and combat service support capability out of the division, and eventually settled on a triangular division structure. Under the assumptions of greater tactical mobility, firepower, and armored protection the divisional engineer capability was cut in half to 800 men and constituted as a battalion. However, to offset this reduced capability in the division, each corps was authorized two engineer regiments consisting of 1,250 men each. At the Army level were three general service regiments, six separate battalions and a number of special units, such as maintenance and supply companies. In 1942, the War Department directed non-divisional engineer regiments to redesignate as engineer groups and function as a scalable command-and-control headquarters. Corps engineer battalions lost their regimental affiliation and became separate numbered battalions. A negative effect of this was the requirement for sufficient administrative, logistical, and transportation capability to allow each battalion to function independently. "Providing these resources for battalions created a larger personnel bill and equipment bill than was required under the regimental organization."[5]

The number of engineers in both the infantry and armored divisional engineer battalion increased to over 1,600 in World War II. Corps commanders continued the practice of habitually reinforcing the division with an additional engineer battalion. This organizational design attempted to capitalize on concepts of modularity and scalability, which were offset by degradation of administrative efficiency, esprit de corps, and a reliance on echelon above division engineer augmentation.

[5] Larry Roberts, "The Evolution of the Engineer Force," *Engineer*, 6. *Engineer* published this in two parts. The pages cited are from a compiled copy provided by Dr. Roberts.

Pentomic Division

In the 1950s, in response to survivability concerns of the nuclear battlefield plus greatly reduced budgets and force structure, the Army reorganized to the pentomic division. Conceptually, this division was sized at 8,600 personnel, but later grew to 13,000. The pentomic division consisted of five battalion-sized battle groups, each of which could operate independently. Each of the battle groups was organized with an organic engineer platoon. The divisional engineer battalion was organized into five engineer companies with added bridging and equipment capabilities organic to the division. Although the engineer battalion mirrored the division structure, doctrine did not specify a routine command and support relationship of one engineer company per battle group. Because of the requirement for battle groups to operate independently, engineers embedded multifunctional engineer capability within the unit of action. The pentomic design was largely considered transitional and proved to be unwieldy, unmanageable, and incapable of performing on the battlefield.[6] As a result, the Army quickly reorganized to ROAD.

Reorganization Objectives/Army Division (ROAD)

The ROAD concept returned to a triangular organization that essentially provided baseline combat support and combat service support units with combat units tailored to the tactical situation. Brigades "did not possess subordinate battalions as in the past but were really highly flexible headquarters that would coordinate the actions of maneuver battalions and other support units of the division that were attached in accordance with a particular mission."[7] While engineers had attempted modularity as early as World War II, ROAD was the predecessor to maneuver modular design with nearly identical and interchangeable combat units. This redesign occurred simultaneously with the war in Vietnam and the Army missed an opportunity to tailor

[6] Kedzior, 27.
[7] Ibid., 30.

force structure for fighting low intensity or counterinsurgency operations.[8] Embedded engineers in the division did not change substantially with the exception of enhanced bridging capability to accommodate heavier maneuver forces. At the corps and army levels, force structure was added while at the same time the number of engineer command and control headquarters was reduced.[9]

Trends

The progression of engineer support to the division indicates that the process has been more evolutionary than revolutionary. When maneuver elements have been expected to operate with a high degree of independence, such as the pentomic division, greater engineer capability has been embedded at lower echelons. With a more rigid organizational structure, such as the World War II triangular division, embedded engineer capability has been reduced resulting in a reliance on a modular approach for providing engineer forces. A consistent trend is the habitual reinforcement of the division with echelon above division combat engineering capability. The division has never been organized with requisite engineer capability; this is not expected to change in the transformation to BCTs. The result has been increasing complexity of engineer command and control relationships and increased administrative, logistical, and transportation requirements for non-embedded engineers. These challenges will be exacerbated by the non-linear, non-contiguous battlefield requirements.

The past also indicates that conventional warfighting doctrinal requirements are a primary independent variable of division and engineer evolution. Vietnam proved that the division was not optimally structured to fight using an unconventional or counterinsurgent doctrine. Similarly, engineers today are moving to decrease engineer capability in the unit of action while the operating environment favors a more flexible organizational structure. The next

[8] Andrew F Krepinevich, Jr., *The Army and Vietnam* (Baltimore, Maryland: The Johns Hopkins University Press, 1986), 275.

[9] The discussion throughout this chapter on past engineer organizations is based on Larry Roberts, *The Evolution of the Engineer Force*.

chapter describes today's environment in terms of the primary determinants of force structure: national security strategy, battlefield requirements, technology and budget.[10]

CHAPTER TWO – Transformational Determinants

Desert Storm was a culminating event that proved the Cold War Army, rooted in the ROAD organization, was deployable and capable of accomplishing national security requirements.[11] Since achieving that victory, the international strategic environment has changed considerably. In response to this shift and in anticipation of the future, "a central objective of the [2001 Quadrennial Defense] Review was to shift the basis of defense planning from a threat-based model that had dominated thinking in the past to a capabilities-based model for the future."[12] To manage this objective, the Secretary of Defense created the Office of Force Transformation and issued Transformation Planning Guidance: In order to prepare for the future, the nation "must think differently and develop the kinds of forces and capabilities that can adapt quickly to new challenges and to unexpected circumstances. We must transform not only the capabilities at our disposal, but also the way we think, the way we train, the way we exercise, and the way we fight."[13] The Army's response is to move towards more agile thinking and greater versatility and flexibility in responding to contingencies.[14]

The Army Chief of Staff, in the Army's Transformation Roadmap Campaign Plan, calls for meeting "the needs of future Joint Force Commanders by providing a campaign quality Army

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[10] The discussion on division reorganizations and the primary factors determining the division structure is based on Richard W. Kedzior's *Evolution and Endurance*.

[11] Macgregor. *Breaking the Phalanx*, 6.

[12] Department of Defense, *Quadrennial Defense Review Report* [on-line] (Washington, D.C., 30 September 2001, accessed 1 November 2004); available from http://www.oft.osd.mil/library/library_files/documents_125_QDR_2001.pdf, iv.

[13] Department of Defense, *Transformation Planning Guidance April 2003* [on-line] (Washington, D.C., April 2003, accessed 1 November 2004); available from http://www.oft.osd.mil/library/library_files/document_129_Transformation_Planning_Guidance_April_2003_1.pdf, 1.

[14] Suggested to the author by MAJ David Culkin during a monograph review on 29 Nov 2004.

with a joint and expeditionary mindset."[15] This involves "building more strategically responsive organizations"[16] with engineers that are "modular and tailorable…including facilities repair and construction, power generation, road construction, and debris clean-up and removal."[17] With reorganization as a main effort of Army transformation this chapter provides context to the process vis-à-vis the four primary determinants of force structure presented in Chapter One: national security strategy, battlefield requirements, technology, and budget. The following chapter examines one determinant, battlefield requirements, in more detail as a method for articulating Army, BCT, and engineer requirements.

The German Example 1919-1939

The German Army of World War II offers an example of how these determinants interact as a dynamic system. During the interwar period, 1919-1939, German political and military leaders resolved to reverse the loss of Germany's power, influence, and reputation resulting from the conditions of the Versailles Treaty.[18] A strategy that sought the gain of additional territory precipitated the renewal of land combat on the European continent. The German Army Chief of Staff, General Hans von Seeckt, provided a vision that demanded incorporation of rapidly developing technologies to satisfy anticipated battlefield requirements: "the whole future of warfare appears to…lie in the employment of mobile armies, relatively small but of high quality and rendered distinctly more effective by the addition of aircraft."[19] Doctrinal and organizational concepts matured based on the lessons of World War I, field exercises, and the study of foreign

[15] United States Department of the Army, "Army 2003 Transformation Road Map," [on-line] (Washington, D.C., 1 November 2003, accessed 1 November 2004); available from http://www.oft.osd.mil/library/library_files/document_334_2003ArmyRoadmapFull.pdf, Foreword.
[16] Ibid., xi.
[17] Ibid., 4-5.
[18] Williamson Murray and Allan Millet, *Military Innovation in the Interwar Period* (Cambridge, United Kingdom: Cambridge University Press, 1996), 312.
[19] James S. Corum, *Hans von Seeckt and German Military Reform: The Roots of Blitzkrieg* (Lawrence, Kansas: University Press of Kansas, 1992), 50.

militaries.[20] The application of these technologies was slowed by military budget restraints that were an intended consequence of the Versailles Treaty. Once Hitler ordered and financed remilitarization of the German military, the determinants of force structure were aligned in such a manner that the *Wermacht* rapidly transformed into the most powerful and capable ground force in the world. Its eventual defeat would result from a lack of balance among these same factors. Hitler's national strategy demanded more of the Army than it was capable. Additionally, within the *Wermacht* too much emphasis had been placed on the expectation of *Blitzkrieg* to deliver rapid and decisive victory through maneuver at the cost of neglecting logistical force structure requirements. Contemporary U.S. political and military leadership must learn from these German mistakes.

United States National Security Strategy

Since the end of the Cold War the United States has shifted focus away from Europe which has resulted in a trend of decreased strategic guidance. What first emerged was the Weinberger Doctrine for the application of military force: "involvement of vital national interests, clear intention of winning, clearly defined political and military objectives, constant reassessment of objectives and forces, reasonable assurance of public and congressional support prior to commitment, and use of force as a last resort."[21] At the time, the Soviet Union provided a nearly singular focus of national security.

In 1992, President Clinton inherited an Army that had been downsized considerably following Desert Storm. Lacking a peer military competitor, he employed the Army in a range of humanitarian and peacekeeping missions that included stopping ethnic wars in Bosnia and Kosovo, working to bring about a regime change in Iraq, fostering democracy in the Western

[20] Murray and Millet, 142.

[21] Colin Powell with Joseph E. Persico, *My American Journey* (New York, New York: Random House, 1995), 303.

Hemisphere, helping Colombia defeat drug traffickers, and restraining North Korea's and Iran's missile programs.[22] The Soviet Threat, against which ROAD had been designed, was no longer the focus of national defense; replacing it were threats classified as regional or state-centered, transnational (terrorism, drugs, arms trafficking, organized crime, refugees, and the environment), and weapons of mass destruction.[23] President Clinton's national security strategy was based on response to crises while always retaining the capability to win two major wars in Iraq and North Korea: "Our tools of foreign policy must be able to shape the international environment, respond to the full spectrum of potential crises, and prepare against future threats. Our military forces will have the ability to respond to challenges short of war, and in concert with regional friends and allies, to win two overlapping major theater wars."[24] In what largely became known as a "do more with less" era, the military was required to maintain sufficient forces to conduct simultaneous military action against multiple adversaries.[25]

In 2002, President George W. Bush, facing the demands of a Global War on Terror and ongoing international stability commitments, specifically recognized military efforts to transform as vital to global interests and a requirement to counter global threats. The nation must "continue to transform our military forces to ensure our ability to conduct rapid and precise operations to achieve decisive results." These results include assurance of allies and friends, dissuasion of future military competition, deterrence of threats against U.S interests as well as those of allies and friends, and decisive defeat of any adversary should deterrence fail. To do so, the military "must prepare for…deployments by developing assets such as remote sensing, long-range

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[22] President Clinton, National Security Strategy, "A National Security Strategy for a Global Age," [on-line] (Washington, D.C., December 1999, accessed 9 January 2005); available from http://clinton4-nara.gov/media/pdf/nssr-1299.pdf; Internet.

[23] Ibid.

[24] Ibid.

[25] David Jablonsky, "Army Transformation: A Tale of Two Doctrines," *Parameters,* Autumn 2001, 43.

precision strike capabilities, and transformed maneuver and expeditionary forces."[26] Confirming the trend, the 2002 National Security Strategy lacks specific guidance on potential threats or desired capabilities resulting from transformation.

Battlefield Requirements

The 2002 National Security Strategy contributed directly to the Joint Operational Environment (JOE), a document published in 2004 which broadly defines potential threats, adversaries, and battlefield requirements. The JOE is a document published by United States Joint Forces Command (USJFCOM) that describes the threat and environment in which a capabilities-based military must be prepared to operate. The JOE's content is very broad and serves to: "describe processes, procedures, and relationships being used within the USJFCOM training, experimentation, and doctrinal development communities; to establish a framework for thinking about threat capabilities and environmental influences on modern conflict; and to identify points of reference necessary for guiding the capabilities-based model for force development."[27]

The JOE is not specific enough to be used in a practical sense for organizational design. Appendix A does suggest four generic planning scenarios along the range of military options for investigating future concepts: major combat operations against an adversary with WMD and regional anti-access capability; urban environment; non-state actor with regional combat capability, access to WMD, and ties to a global terrorist network; failing state with WMD capability.[28] Alarmingly, the JOE does not include homeland defense as a scenario.

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[26] President Bush, National Security Strategy, "The National Security Strategy of the United States of America," [on-line] (Washington, D.C., September 2002, accessed 9 January 2005); available from www.whitehouse.gov/nsc/nss.html; Internet.

[27] United States Joint Forces Command, "The Joint Operational Environment – Into the Future," (Norfolk, VA, coordinating draft 05 March 2004), 6.

[28] Ibid., 169-175.

The JOE does reinforce the relevancy of engineers within the joint force structure especially with respect to the physical environment, and specifically the JOE considers terrain an essential element of the physical environment. Until this paradigm changes, the engineer core functions of mobility, countermobility, survivability, general engineering and topographic support retain lasting legitimacy.[29] Combat engineers alter terrain, usually temporarily, to enhance mobility, countermobility, and survivability. Construction engineers permanently alter terrain through general engineering in ways that enhance sustainment of the force. Topographic experts also provide commanders with an understanding of terrain through the management, analysis, and distribution of geospatial data.

The three core engineer functions also cut across all five joint functional concepts: command and control, battlespace awareness, force application, protection, and focused logistics. The result is a JOE that demands organizational flexibility but offers very little for defining the engineer capabilities required of the joint force.[30] Of relevance to engineers are some of the force capabilities articulated throughout the document: combat in complex and urban terrain, maritime operations in littorals, power projection at APODs/SPODs, force protection, and mine warfare.

Derived from the JOE, the Army's defines the potential types and places of conflict and the kinds of threats as the Contemporary Operational Environment (COE) in Field Manual 7-100, *Opposing Force Doctrinal Framework and Strategy*. The eleven critical variables of the COE are: nature and stability of the state, regional and global relationships, economics, sociological demographics, information, physical environment, technology, external organizations, national will, time, and military capabilities.[31] The COE nests perfectly with the JOE and engineers are

[29] Ibid., 79.
[30] Ibid., 151.
[31] United States Department of the Army, Army Field Manual 7-100 *Opposing Force Doctrinal Framework and Strategy* (Washington, D.C.: Government Printing Office, May 2003), v.

vital with respect to the physical environment. The COE adds use of IEDs, environmental damage, and area inundation as particular concerns of ground forces.[32]

Technology and Budget

Technology and budget act to keep force structure development in tension. Fielding new equipment and technologies is constantly weighed against recapitalization of the current force and manpower costs. As a matter of policy, the Department of Defense will limit investment in science and technology to three percent of the budget in FYs 03-07.[33] At the same time, the Army is counting on emerging technologies as enablers of FCS. The intent is that FCS will be more independently mobile and survivable. However, the risk to armored, light, and Stryker BCTs rises if current organizations are designed around yet to be fielded technologies.[34]

The Army bases the FY 05 $98.5 million budget on three pillars: current readiness, people, and future force. Critical to transformation are research and development of FCS, continued purchase of Stryker, and accelerated procurement to improve strategic responsiveness, increase lethality of light forces, and recapitalize legacy systems. Over $10.4 million is planned for research, development, testing, and evaluation with the goal of fielding an FCS unit of action in 2012.[35] For the Engineer Regiment, future capabilities depend heavily on yet to be developed technologies that receive low priority in the Army budget.[36] Of particular concern is that the Army budget gives little visibility to engineer related systems or budget items.

[32] United States Department of the Army, Army Field Manual 3-34 *Engineer Operations* (Washington, D.C.: Government Printing Office, 2 January 2004), Chapters 2 and 3.

[33] *Quadrennial Defense Review Report*, 63.

[34] Suggested to the author by MAJ Todd Plotner during a monograph review on 29 Nov 2004.

[35] Department of Defense, Assistant Secretary of the Army for Financial Management and Comptroller, *FY05 President's Budget Highlights,* [on-line] (Washington, D.C., February 2004, accessed 5 November 2004); available from http://www.asafm.army.mil/budget/fybm/FY05.pbhi.pdf; Internet.

[36] United States Army Engineer School, *TRADOC Pamphlet 525-3-34: The United States Army Future Engineer Force Operational and Organizational Concept (Initial Coordinating Draft),* (Fort Leonard Wood, Missouri, 9 July 2004), 113.

Summary

In conclusion, national security strategy, the JOE/COE, emerging technologies and budgetary concerns largely shape the current transformational environment. Engineers are inextricably linked to transformed and expeditionary forces articulated in the 2002 National Security Strategy, and remain directly relevant to the physical environment element of the JOE/COE. There are new engineer systems and emerging technologies available to enhance force capabilities (i.e. Wolverine assault bridge to replace the armored vehicle launched bridge, armored D9 bulldozer, Bradley Fighting Vehicle to replace the M113 Armored Personnel Carrier, and contemporary electric tool kits). These have all been fielded in small quantities, but they and other engineer related enhancements, are not prioritized high enough in the Army budgetary process to be considered integral to transformation. Building on this as a foundation, Chapter Three examines operations spanning the past twelve years as a tangible representation of the COE in order to provide evidence on the types of BCT and engineer specific tasks.

CHAPTER THREE – The Contemporary Operating Environment

This chapter examines the BCT as the Army's primary warfighting unit of action and the role of the COE in determining engineer force structure. The method is to study U.S. Army operations spanning the past twelve years (operations RESTORE HOPE, UPHOLD DEMOCRACY, ABLE SENTRY, JOINT ENDEAVOR/GUARD, JOINT GUARDIAN), as well as that of French and British peacekeeping missions, and provide evidence on the types of engineer tasks required in the COE. These operations are selected based on availability of after action reviews and lessons learned published by the Center for Army Lessons Learned (CALL) and the Center for Engineer Lessons Learned (CELL). Though mostly peacekeeping operations, they are extremely relevant to the study of BCT force composition because each involves one or two BCTs operating independently thereby demonstrating what BCTs typically demand in terms of engineer capabilities.

Each review documents engineer missions completed, engineer lessons learned, and the size of the deployed engineer force. An analysis suggests that the size and composition of embedded engineer units in the BCT is inadequate. This means BCTs will constantly require outside support which may itself be limited by high demand.[37] Indicative of historical trends, negative consequences for augmenting engineer units include degradation in readiness, combined arms training, and responsiveness. Great care must be taken to construct a versatile BCT in a manner that also considers affordability, deployability, sustainability, and agility.

Transformational Designs

Coinciding roughly with President Clinton's 1997 National Security Strategy, Colonel (Retired) Douglas Macgregor seized an opportunity to present a transformation concept for the Army in his book *Breaking the Phalanx*. Macgregor's model is presented for examination for two reasons. First, the model is relevant because of current Army transformation efforts to organize with the brigade combat team as the basic unit of action. Second, his model is incomplete because it does not adequately address the combat and combat support engineer requirements of the force.

For the Army component of a future joint task force (JTF) Macgregor recommends one that is "smaller in size and more numerous in quantity than the existing division organization" with part of the force rapidly deployable, modular, operationally and tactically mobile, and capable of sustaining itself for extended periods.[38] He presents specific designs for a Heavy Combat Group, an Airborne-Air Assault Combat Group, a Heavy Recon-Strike Combat Group, and a Light Recon-Strike Group. An engineer company would be assigned to the Heavy Combat Group and an engineer battalion to the Light Recon-Strike Group, mainly for mobility purposes.

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[37] United States Army Combined Arms Command, "News From the Front – Regimental Engineer Company in Iraq," [on-line] (Fort Leavenworth, Kansas: Center for Army Lessons Learned); Internet; accessed 5 December 2004.

[38] Macgregor, *Breaking the Phalanx*, 74.

Finally, additional battalions could be attached to the group based on the mission, to include operational level combat and construction capability.[39] Based on RMA trendlines, Macgregor recommended 4,000-5,000 soldier self-contained combat groups as the Army's primary unit of action. He based this on the assumption that future combat operations will be "rapid and intense, and that they will take place over extended frontages and depths."[40] In contrast to Macgregor's model the approved transformational BCT is smaller than Macgregor's proposed combat group.

Macgregor's inclusion of engineer mobility capability in the Heavy Combat Group and the Light Recon-Strike Group is wholly inadequate with respect to the requirements of the COE. Further, he does not offer analysis on inconsistencies in size, mission, and support requirements of organic engineer units. For example, why is mobility the primary engineer mission set? Why is an engineer battalion organic to the Light Recon-Strike Group whereas the Heavy Combat Group only has a company? Why did he elect to leave engineers out of the design for the Heavy Recon-Strike Group and the Airborne-Air Assault Combat Group?

Perhaps a larger inconsistency with both the combat group and BCT designs is that they create organizations best suited for high intensity conflict. This is at odds with the President's National Security Strategy of expected employment for full spectrum missions to deter, assure, and dissuade. While identifying this inconsistency is critical of the general approach towards combat support elements, especially by Macgregor, it also presents an opportunity to study the engineer requirements of a BCT in the COE. Recent and ongoing operations provide concrete examples of the COE as a way to articulate the engineering capabilities required to operate across the range of military operations.

[39] Macgregor, *Breaking the Phalanx*, 68 and 82.
[40] Macgregor, *Breaking the Phalanx*, 227.

Operation RESTORE HOPE (Somalia)

In the absence of a central government and against a background of civil war, United Nations Operation in Somalia (UNOSOM) was established in April 1992. The size of the mission grew throughout 1992, but remained largely ineffective due to a general lack of security in the country. In December 1992, the United States initiated Operation RESTORE HOPE to secure the area for humanitarian relief efforts and to return control to UN forces. The operation was planned in four phases. In phase I, forces deployed to secure the port and airfields in Mogadishu and Baledogle. In phase II, forces secured humanitarian relief sectors to provide security for relief distribution sites. In phase III, forces expanded presence in the relief sectors and began looking for weapons in search and seizure operations. In Phase IV, completed on 4 May 1993, forces returned control of the operation to the United Nations. CINCENT formed a JTF under the command of CG, 1st Marine Expeditionary Force. 10th Mountain Division provided the Army Forces Headquarters for the operation and committed a "heavy" brigade to phase I and a "light" brigade to phases II and III.

In theater, engineers functioned as a joint team under the JTF J-4. "Engineer contributions were substantial. Engineers, working Jointly, provided standard maps and imagery products, detected and cleared hundreds of land mines and pieces of unexploded ordnance, built base camps and drilled wells. They constructed and improved over 2,000 km of roads, built and repaired several bridges, upgraded and maintained airfields, and participated in local civic action projects."[41] Additional missions included engineer reconnaissance, port construction, diving, real estate management, prime power and firefighting capability. Contracts were executed for well drilling, facilities management, power generation, and electrical wiring.

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[41] United States Army Combined Arms Command, "Operation RESTORE HOPE Lessons Learned Report," (Fort Leavenworth, Kansas: Center for Army Lessons Learned, November 1993), 14.

10th Mountain Division deployed 2nd Brigade with its habitually associated engineer company B/41st EN, and augmented the brigade with an additional light engineer company. The 36th Engineer Group was assigned to TF MOUNTAIN to command and control additional engineer units which included the 43rd Engineer Battalion (Combat Heavy) and two combat support equipment companies. Engineers represented about one third of the total Army troop strength in theater. "Limitations on engineer support in theater included a lack of standard map coverage, lack of…mine detection equipment, and a shortage of Class IV materials."[42]

Operation UPHOLD DEMOCRACY (Haiti)

On 19 September 1994, 10th Mountain Division deployed as JTF 190 into Port-au-Prince and Cap Haitien. The mission was to "conduct military operations to restore and preserve civil order, protect U.S. citizens and interests and designated Haitians and third-country nationals; create a secure environment for the restoration of the legitimate government of Haiti; and provide technical assistance to the government of Haiti."[43] The operation was envisioned in five phases spanning 180 days. Phase I was a two week preparation period. In Phase II forces deployed and conducted initial security operations with 1st BCT seizing and securing the port and airfield in Port-au-Prince and 2nd BCT seizing and securing the port and airfield in Cap Haitien. In Phase III the brigades increased combat strength in outlying areas of Haiti. Phase IV entailed an expansion of civil-military operations designed to ensure security and stability throughout the country. Phase V involved the mission's transfer to the United Nations.

In addition to the division's organic engineer battalion, the JTF deployed with three terrain detachments, a port construction company, a diving detachment, two combat heavy construction battalions, two combat engineer battalions, a combat support equipment engineer

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[42] Ibid., Ch VII.

[43] Walter E. Kretchik, Robert F. Baumann, and John T. Fishel, *Invasion, Intervention, "Intervaision": A Concise History of the U.S. Army in Operation Uphold Democracy* (Fort Leavenworth, Kansas: U.S. Army Command and General Staff College, 1998), 78.

company, two bridging companies, and three fire fighting detachments. The over 2,500 engineers deployed as part of Operation UPHOLD DEMOCRACY represented over 10 percent of the total force deployed. Various missions performed included force protection, base camp development, and support to civil-military operations. Documented accomplishments are the construction of 500 latrines, erection of 1,000 tents with plywood floors, and various projects requiring 7,000 rolls of concertina, 10 tons of nails, 14,600 sheets of plywood, and 60,000 tons of gravel. Major observations include that 1) the JTF engineer staff functions best as a separate staff organization, 2) engineer involvement in the planning process was inadequate, 3) real estate management was a critical task (this involved two real estate teams with missions covering facility engineer operations, real property maintenance activities, real estate activities, contracting, and supervising indigenous labor), 4) material was not available to provide force bed-down, and 5) terrain support to the JSOTF was ad hoc. [44]

Operation ABLE SENTRY (Macedonia)

On 21 May 1993, the National Command Authority informed United States Army Europe (USAREUR) to send ground forces to Macedonia as part of a UN peacekeeping mission. On 28 May 1993, CINC USAREUR decided to send elements of the Berlin Brigade. Although the level of commitment was much smaller than in Somalia and Haiti, force protection, real estate, and engineer equipment were capabilities required for execution of the mission. Specifically engineers constructed wire obstacles and arranged for other countermobility obstacles around the camp perimeter and at the camp entrance. The task force employed engineer equipment to clear obstacles around the camp perimeter, improve roads, and construct the ASP, latrines and drainage ditches. Sustainment engineering proved critical to overall quality of life.

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[44] United States Army Combined Arms Command, "Initial Impressions Operation UPHOLD DEMOCRACY: Haiti D-20 to D+40," (Fort Leavenworth, Kansas: Center for Army Lessons Learned, December 1994), Chapter 9.

Eleven engineers deployed with a task force of 315 soldiers, and the Berlin Brigade considered itself short engineer capability and equipment necessary to complete all of their requirements.[45]

French and British Peacekeeping

CALL compiled a report on French lessons learned in Somalia, Yugoslavia, and Cambodia and on British lessons learned in Bosnia. Engineer requirements included infrastructure development, base camp construction, route maintenance, bridge repair, as well as combat engineering tasks such as mine and explosive ordnance clearance. In Somalia the French provided engineer support to the local population, but indicate no desire to redesign forces with this mission set. Support to local population remains a mission of opportunity rather than a critical mission for achieving operational and strategic goals. The task organization chart indicates that the total engineer force deployed for these operations was approximately 10 percent of the total force.[46]

Operation JOINT ENDEAVOR/GUARD (Bosnia)

In 1995, three warring factions in Bosnia-Herzegovina agreed to a cease-fire and endorsed the Dayton Peace Accord which paved the way for deployment of a multinational Implementation Force (IFOR). In December 1996, IFOR transferred authority for the mission to Stabilization Force (SFOR) with the mission to ensure continued implementation of the Dayton Peace Accord provisions. The U.S. committed two BCTs to IFOR and reduced to one BCT for SFOR. Through September 2002 the Army provided a division headquarters while maintaining a BCT (+) in the MND-N sector. Beginning in September 2002, National Guard brigade headquarters replaced active army divisions. Original troop strength for IFOR was 32,000. As of

[45] United States Army Combined Arms Command, "Lessons Learned Report: Former Yugoslav Republic of Macedonia (Operation ABLE SENTRY)," (Fort Leavenworth, Kansas: Center for Army Lessons Learned, October 1994), 76.

[46] United States Army Combined Arms Command, "Initial Impressions Report: French and British Peace Operations," (Fort Leavenworth, Kansas: Center for Army Lessons Learned, January 1995), B-2.

14 November 2004, SFOR is currently in its fifteenth rotation (SFOR-15) and total troop strength is down to 7,000.[47] U.S. commitment began at 18,500 troops with IFOR, stabilized between 6,000-7,000 soldiers during 1997-1999 and currently stands at 1,800 personnel.

"In the words of Major General Ellis, Bosnia is an Engineer playground. Engineers played a major role in Bosnia since the beginning in December 1995, when they bridged the swollen Sava River for the entry of the Implementation Force. They also attacked the greatest threat to American and United Nations' forces – landmines. Since then, engineers completed hundreds of other missions spanning the full range of the Engineer Battlefield Operating System (BOS) which includes countermobility, mobility, survivability, sustainment, and topographic operations."[48]

Stability and support operations are normally lower spectrum conflicts characterized by relatively stationary maneuver units requiring engineer mobility, countermine, and construction tasks. In Bosnia, divisional engineers adapted to the environment by conducting such tasks as bridging operations, countermobility operations, and facilities engineering.[49]

Various unit after action reports from SFOR-2, SFOR-3, SFOR-5, and SFOR-7 summarize the scope of engineer requirements in Bosnia. "The engineer task force supporting Task Force Eagle in 1997-1998 [SFOR-2 and SFOR-3] consisted of the following type units: a mechanized combat engineer battalion (minus one company), a wheeled engineer company, a Navy Sea Bee company, an Explosive Ordnance Disposal Company, and fire fighting

[47] SFOR Stabalization Force [on-line]; available at http://www.nato.int/sfor/index.htm; Internet; accessed 14 November 2004.

[48] United States Army Combined Arms Command, "Conduct Engineer Operations," (Fort Leavenworth, Kansas: Center for Army Lessons Learned) [on-line]; available at https://call2.army.mil/products/IIR/BOSNIA/BHCAAT13/html/ch6.asp; Internet; accessed 14 November 2004.

[49]United States Army Combined Arms Command, "Engineer Operations in Stability and Support Operations (SASO)," (Fort Leavenworth, Kansas: Center for Army Lessons Learned) [on-line]; available at https://call2.army.mil/products/IIR/BOSNIA/BHCAAT16/html/ch3.asp; Internet; accessed 14 November 2004.

detachment." The 1st Armored Division Terrain Team also provided topographic support.[50] This represented more than 5 percent of the total force on the ground. "Companies were task organized with a mix of heavy and light combat engineers to diversify their capabilities."[51] The task force experienced shortages of draftsmen, supply personnel, and engineer technicians. The D7 MCAP dozer was in high demand.[52] "The engineer task force functioned in a very decentralized manner, being responsive to the needs of immediate commanders and the overall task force."[53] The engineer battalion staff required reorganization in order to track the range of engineer missions and included a mine action center (MAC), construction management section (CMS), and base camp coordination agency (BCCA).[54]

A/62nd EN BN (SFOR-5) missions included SEA hut construction, road repair and upgrade, FARP and concrete helipad construction, and area mine clearance. Issues involved poor maintenance of construction equipment and difficulty in parts management, Class IV ordering procedures, and lack of forklift and crane assets.[55]

The 49th Armored Division (SFOR-7) task organized with a mechanized combat engineer company, a construction platoon, and EOD support. The division engineer brigade provided command and control to include a MAC and BCCA. Substantial international augmentation was provided bringing the organization roughly to battalion size. U.S. engineer personnel totaled 174 and international personnel are estimated at 250 for a total of 425 engineers in MND-N. Engineers represented about 10 percent of the force in the U.S. sector. Major equipment included earthmoving, lift, haul, bridging, and countermine vehicles. Major tasks included MSR

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[50] "Conduct Engineer Operations," [on-line].

[51] Ibid.

[52] United States Army Combined Arms Command, "Compendium of Observations," (Fort Leavenworth, Kansas: Center for Army Lessons Learned) [on-line]; available at https://call2.army.mil/products/IIR/BOSNIA/BHCAAT11/html/appa.asp; Internet; accessed 14 November 2004..

[53] "Conduct Engineer Operations," [on-line].

[54] Ibid.

[55] United States Army Engineer School, "A/62nd Engineer Battalion SFOR 5 AAR," (Fort Leonard Wood Missouri: [e-mail file provided by] Center for Engineer Lessons Learned).

maintenance and construction, mechanical mine proofing and other demining missions, bridge reconnaissance and construction, force protection, engineer reconnaissance, sustainment engineering, environmental cleanup, snow removal, and EOD.[56]

Operation JOINT GUARDIAN (Kosovo)

In June 1999, Task Force Falcon (built around 2nd Brigade, 1st Infantry Division) deployed to Kosovo as part of Operation Joint Guardian. In June 2001, 1st Armored Division accepted responsibility for the mission. Major accomplishments included encouraging increased integration of Serbs and Albanians, removal of 80 percent of the mines in their area of responsibility, and oversight of successful elections in October 2000. KFOR engineers repaired numerous power stations, roads, bridges, and railroads.

Engineers in Kosovo in the summer of 1999 consisted of more than 1,700 personnel under the command and control of the 1st Engineer Brigade: 9th Engineer Battalion (organic to the 2nd BCT), 94th Engineer Battalion (CBT HVY), 535th CSE Company, Naval Mobile Construction Battalion 3, A/864th EN BN (CBT HVY) and the 568th CSE Company. Additional attachments included EOD and a USACE construction management section. The brigade staffed a mine action center. Missions included security fencing, road and bridge reconnaissance, patrolling, mine and ordnance clearing, and force-protection related construction.

Base camp construction involved building renovation, electrical and water utility work, erection of SEA huts, construction of a 30,000 square foot headquarters building, ammunition holding areas, motorpools, wastewater treatment, earth moving, haul, road construction, concrete pads, and a helicopter airport. In the winter, engineers provided snow removal. Also involved was a Facilities Engineering Team (FET) which managed over $30 million in construction and

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[56] United States Army Engineer School, "Stability and Support Operations SFOR AAR: DIVENG 49th Armored Division," (Fort Leonard Wood, Missouri: [e-mail file provided by] Center for Engineer Lessons, Learned, 22 January 2001).

base camp planning. Total troop strength in Kosovo was about 7,000. Over 1,100 U.S. contractors and 7,000 local Albanian hires provided additional engineer effort, implying substantial contracting oversight. Uniformed engineers represented 25 percent of the deployed force, although the effort was substantially greater due to contracted construction.

Lessons learned from Kosovo focus on command and control, engineer equipment, and the size of engineer units. These lessons include the following: the engineer brigade headquarters was essential for effectively coordinating the engineer effort, much of the equipment used was outdated and parts receipt was often a difficult process, sapper companies were too small, and terrain products are much more valuable and timely when the terrain team is represented at the BCT level. Though the engineer requirements did not diminish, in the absence of other requirements, engineer units (especially combat engineer units) can perform infantry related tasks such a presence patrolling, observation, and security.[57]

Analysis

The review ends with Kosovo because these operations share a commonality that differs greatly from Operation ENDURING FREEDOM (Afghanistan) and Operation IRAQI FREEDOM (Iraq). The reviewed deployments all involve one or two BCTs operating independently under a division headquarters. All these operations required capabilities across two or more engineer mission sets. They also provide concrete examples of the COE. By considering the engineering requirements in these operations, it is possible to make three inferences about the size, scalability, engineer mission sets required to support a BCT. Where possible, initial lessons from Operations ENDURING FREEDOM and IRAQI FREEDOM are incorporated.

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[57] Robert L. McClure, "The Engineer Regiment in Kosovo," *Engineer Professional Bulletin*, April 2000 [on-line]; available from https://call2.army.mil/products/TRNGQTR/tq3-oo/mcclure.asp; Internet; accessed 23 September 2004.

The size of the engineer force most often stabilized at 10 percent of the deployed force. The size of the deployed engineer force ranged from less than 1 percent of the task force in Operation ABLE SENTRY to over 30 percent in Operation RESTORE HOPE. French and British engineers represented about 10 percent of total forces committed to operations. Engineers in Haiti represented 10 percent of the force. The initial engineer effort in Bosnia was 15-20 percent.[58] During SFOR-2 and SFOR-3 the proportion of engineers to deployed forces dropped to 5 percent; this proportion rose to a stable 10 percent over the course of SFOR rotations.[59] Mission requirements in Kosovo demanded a substantially higher number of engineers in theater, about 25 percent of total forces. In Iraq, engineer support to 3rd Infantry Division totaled at least 15 percent.[60] Considering all operations, if the COE requires an engineer force roughly 10 percent the size of a deployed BCT why not embed this capability? Embedding a smaller capability and relying on augmentation assumes that, when needed, augmentation will be available and ready.

The concept of scalability is validated because requirements are shown to vary over time. For example, in Bosnia the engineer effort increased over time though not exceeding 10 percent, especially the construction effort as the number of base camps increased. In Kosovo, a substantial engineer effort was front-loaded for base camp construction. This should be considered as important decision point in future course of action development – when does the commander want base camp construction to begin, and when do construction assets need to arrive to satisfy this requirement?

The operational requirements also indicate that multiple engineer mission sets are required in the COE. In Somalia, the mission sets were mobility (in urban terrain,

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[58] Suggested to the author by COL Peter Tabacchi during a monograph review on 29 Nov 2004.

[59] MAJ John Buck offered the primary reason for this is that the engineer mission remained constant, while the overall security situation improved thereby requiring less combat force on the ground.

[60] 3,000 engineers (source 3rd ID AAR) divided by 17,000 in the division (source WorldTribune.com).

roads/bridges/airfields, and countermine), general engineering (base camp construction), topographic support, and a combination of countermobility and survivability effort for force protection. The requirements in Haiti and Macedonia were the same except for the absence of a countermine requirement. In Macedonia, the mobility focus on roads and bridges was less, but the operational risk was increased due to lack of engineer equipment.[61] French and British requirements are also the same except their after action reviews do not mention terrain support. Operations in Bosnia and Kosovo similarly involve mobility (bridging, roads, and countermine), general engineering (base camp and airfields), topographic support and force protection. Additional functions such as engineer reconnaissance, real estate support, prime power, fire fighting, and snow removal are recurring requirements.

Operations in Afghanistan and Iraq reinforce the demand for multiple engineer mission sets. In Afghanistan, engineer units often performed missions outside the normal mission essential task list (METL).[62] Critical mission sets included base camp construction, runway repair, and countermine while noting MTOE equipment deficiencies and poor training in unexploded ordnance identification and disposal. In Iraq, a regimental engineer company conducted bridge and route reconnaissance, ammunition removal and disposal, improvised explosive device (IED) response, base camp construction and force protection improvements. The commander noted a lack of construction and engineer equipment, and suggested that construction engineers are needed at the maneuver brigade level.[63] The 3rd Infantry Division augmented the divisional engineer brigade with an engineer group headquarters, a corps mechanized battalion, a combat heavy battalion, four multi-role bridge companies, a combat

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[61] "ABLE SENTRY", 60

[62] Dennis J. Mcnulty, "Engineer Operations in Afghanistan," *Engineer*, October-December 2002 [on-line]; available from https://call2.army.mil/products/trngqtr/tq4-02/germann.asp; Internet; accessed 11 December 2004.

[63] "News From the Front."

support equipment company, a terrain detachment, and an explosive ordnance disposal company. Mission sets spanned combat, construction, bridging, terrain, and force protection.[64]

Summary

In summary, the embedded engineer unit in a BCT should be about 10 percent of the total force and possess a range of capabilities based on the requirements of the COE: countermine, bridging, road repair/construction, reconnaissance, force protection, base camp/airfield construction, topographic support, and sappers for combined arms tasks. The size of a deployed force should be scalable and real estate support, prime power, fire fighting, and operational bridging should be rapidly available. Serious consideration should be given to front loading construction requirements in undeveloped theaters as a combined effort between Army, joint, and contracted engineers. The next chapter examines the status of current Army and engineer transformation in relation to these conclusions. A comparison of the COE engineering requirements demonstrated in this chapter to the actual engineering capabilities of the BCT identifies a requirement versus capabilities gap in the BCT combat support structure.

CHAPTER FOUR – Engineer Capabilities Gap in the BCT

This chapter examines the embedded engineer force structure within each of the BCTs and compares the capabilities contained in each against the requirements of the COE. A comparison of engineer task-frequency to embedded assets in the BCT illustrates deficiency in the ability to conduct some high demand and combined arms tasks. After identifying this as a gap between requirements and capabilities, a recommendation is made that the embedded engineer force in the maneuver BCT should be a multifunctional battalion. Because this gap will cause

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[64] United States Department of the Army, "Third Infantry Division (Mechanized) After Action Report, Operation Iraqi Freedom," [on-line]; available from www.globalsecurity.org/military/library/report/2003/3id-aar-jul03.pdf; Internet; accessed 11 December 2004.

BCTs to rely on the engineer force pool, this chapter also addresses how force pool units will integrate with maneuver forces and commands.

Recognizing that a full spectrum engineer capability will not be adopted, the Engineer Regiment is developing a force augmentation capability of engineer baseline forces, effects modules, and command and control. Drawing the line between embedded and force pool assets has serious implications on engineer command and support relationships as well as training and readiness. There are also transformation conceptual gaps concerning the integration of USACE capabilities and oversight of material and contracting support. Conceptual wargaming is introduced as a valuable tool for deliberating the correct ratio of baseline forces to effects modules to command and control headquarters, but the scenario selection needs review.

Brigade Combat Teams

"The nation depends upon [the Army] to be able to fight across the whole spectrum of conflict, from long campaigns that…go toe-to-toe with symmetrical foes, all the way across to stability and support operations."[65] To accomplish this, the Army is moving to a BCT structure based on the "tendency for habitual relationships between combat brigades and their supporting units which led to defacto fixed brigade combat teams."[66] Largely following Macgregor's concept the Army is reorganizing from three levels of command to two and increasing combat power through innovations in surveillance, fire control, precision munitions, analysis and fusion of information, and moving/sharing/tracking data.[67]

The Army Chief of Staff has set three primary objectives for transformation: 1) increase the number of combat brigades available to the Army while maintaining combat effectiveness

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[65] James Kittfield, "Army Chief Struggles to Transform Service During War," *The National Journal,* October 29, 2004 [on-line]; available from http://www.govexec.com/dailyfed/1004/10290njl.htm; Internet; accessed 11 November 2004.

[66] United States Army Combined Arms Command, "Draft Modularity O&O Plan Part I," (Fort Leavenworth, Kansas: 3 April 2004) [CD-ROM], 13.

[67] "Draft Modularity O&O Plan Part II," [CD-ROM], 9.

that is equal to or better than that of current divisional brigade combat teams, 2) create smaller standardized modules to meet the varied demands of Regional Combatant Commanders and to reduce joint planning and execution complexities, and 3) redesign brigades to perform as part of the joint team.[68] Derivative measures of success and effectiveness for the new BCT structure include 1) how much more rapidly BCT commanders see, understand and share tactical information, 2) range of out of contact engagements, 3) quickness in concluding close combat, 4) performance along the spectrum of military operations, 5) and ability to operate in distributed AOs.

Based on an analysis of the Contemporary Operating Environment, the Army is restructuring BCTs as armor, infantry, and Stryker with the purpose of complementing each other along the range of anticipated combat environments.[69] A fourth design, Future Combat System (FCS), is projected for FY 08 fielding or beyond. "Current experience and future forecasts also indicate that units and personnel that have a dual military-civil application (e.g. military police, civil affairs, psychological operations, engineers, aviation, and all forms of logistical support) will be in high demand."[70] Although similar in design to Macgregor's proposed combat groups there are distinct differences; a primary difference being that BCTs are considerably smaller than the combat group. The transformation blueprint, TRADOC's Modularity Operational and Organization (O&O) Concept, also provides specific consideration for designing the engineer force.

Force design in this transformational period involves both building and iterative processes. The build starts with the modular BCT as the Army's centerpiece warfighting unit of action. Adopting this new design gives "the Army more brigades, creates greater standardization

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[68] "Draft Modularity O&O Plan Part III," [CD-ROM], 4.

[69] Ibid., 10. The dominant expected environments are open and mixed terrain, urban terrain, and close terrain.

[70] William T. Johnsen, "Force Planning Considerations for Army XXI," (Carlisle, Pennsylvania: Strategic Studies Institute, 18 February 1998), 27 [on-line]; available at http://www.carlisle.army.mil/ssi/pdffiles/00252.pdf; Internet; accessed 11 November 2004.

among those brigades and accelerates the speed of employment of land combat forces".[71] This new design must also make the brigade more "effective in combat missions, more capable of stability operations and far better at interacting with other service tactical elements of the Joint Force."[72]

To simplify force packaging and improve combined arms operations three modular designs are approved: armor, infantry, and Stryker[73]. The armor BCT consists of two balanced (two armored/two mechanized infantry) combined arms battalions, a RSTA squadron, a strike battalion, a support battalion, and a brigade troops battalion (BTB). Total troop strength is 3,735. The infantry BCT is identical in structure except that two infantry battalions substitute for the combined arms battalions. Total troop strength is 3,369. The Stryker Brigade is organized with three Stryker battalions, a RSTA squadron, an AT company, a 155 IAV battalion, and a brigade support battalion. Total troop strength is 3,893.[74]

Engineer Transformation

Two complimentary processes contribute to determining the embedded engineer force within and the augmenting engineer force above these brigade units of action. The first is frequency of task analysis. The second is experimentation and conceptual wargaming.

Frequency of Task Analysis

The *Future Engineer Force White Paper* identifies the Joint Engineer Capability Elements followed by a frequency of task assessment off the Army Universal Task List (AUTL). Frequency is broken into three categories (high, moderate, low) and assessed in three separate phases (pre-combat, combat, post-combat). The following matches up the Joint Engineering

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[71] *TRADOC Pamphlet 525-3-34*, 13
[72] Ibid.
[73] Ibid., 14.
[74] United States Army Engineer School, "Future Engineer Force White Paper," (Fort Leonard Wood, Missouri: 12 April 2004), Appendix A.

Capability Elements to AUTL tasks: detect and neutralize explosive hazards (ART 5.3.4 Provide explosive ordnance disposal support), provide gap crossing (ART 5.1.1.3 Conduct river crossing operations), enhance mobility through urban terrain (ART 5.1.1.1 Conduct breaching operations), attack enemy freedom of maneuver (ART 5.2 Conduct countermobility operations), provide mobility assessments (ART 1.3.3.4 Conduct a route reconnaissance, ART 1.3.3.2 Conduct an area reconnaissance), provide rapid deployable earthmoving (ART 5.1.2.1 Construct/maintain combat roads and trails), repair/construct air and ground LOCs (ART 5.1.2.2 Construct/maintain forward airfields and landing zones, ART 6.10.2.1 Construct and maintain roads and highways), repair and restore infrastructure (ART 6.10.5.4 Construct, manage, and maintain bases and installations, ART 6.10.4 Supply mobile electric power), enhance force protection (ART 5.3.1.3 Prepare protective positions, ART 5.3.1.2 Prepare fighting positions) enhance infrastructure protection (ART 6.10.5.1 Provide waste management), and generate, manage, analyze, distribute geospatial data (ART 1.1.1.5 Conduct geospatial engineering operations and functions).[75] The relationships indicate that force protection, infrastructure, geospatial, and countermine capabilities are most critical to the force.[76]

Embedded Engineers

Theoretically, the embedded engineer unit within the BCT is based on combined arms necessity and demand for high frequency and high risk tasks.[77] The AUTL frequency task analysis identified four tasks required full time by maneuver battalions: prepare protective positions, conduct breaching operations, conduct a route reconnaissance, and conduct geospatial engineering operations and functions. In the heavy organization, to satisfy this requirement, two engineer companies support the BCT with one organic to each combined arms battalion. Each

[75] Ibid., 13.
[76] *TRADOC Pamphlet 525-3-34*, 28, Fig 3-7.
[77] *TRADOC Pamphlet 525-3-34*, 35.

engineer company consists of 76 personnel (representing 4 percent[78] of the BCT), six combat engineer squads, nine engineer squad vehicles, two Volcano mine dispensers, two SEEs, and three ACEs.[79] The light BCT is supported with one engineer company under the brigade troops battalion. This company consists of 76 personnel (2.5 percent[80] of the BCT), four SEEs, haul/troop transport, and some earthmoving capability with two bulldozers and one bucket loader.[81] The Stryker BCT is task organized with one engineer company of 120 personnel (just over 3 percent[82] of the BCT), nine engineer squad vehicles, one medium girder bridge, three Volcano mine dispensers, six MICLICs, six SEEs, and six DEUCEs.[83] All BCTs contain a GI&S cell.

These embedded units represent a foundation of mobility and geospatial capability that BCTs require at all times.[84] However, based on the engineering demands of the COE[85], this focused mission set fails to maintain or improve the combat effectiveness of today's divisional brigade combat team – one of the goals established by the Army Chief of Staff for transformation. To demonstrate this, return to the AUTL frequency task analysis. All except four tasks are high and moderate frequency in two or more phases: conduct breaching operations, prepare fighting positions, conduct countermobility operations, and conduct area clearance. Four additional tasks are specified as combined arms tasks: conduct breaching operations, conduct route clearance, conduct countermobility operations, and conduct geospatial engineering operations and functions. This does not support the decision to leave countermobility and survivability capability out of the BCT. The BCT is also short assets necessary for selected high frequency requirements and for execution of combined arms tasks (especially prepare protective

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78 (76*2)/3735=4.1
79 *TRADOC Pamphlet 525-3-34*, 70.
80 76/3369=2.3
81 *TRADOC Pamphlet 525-3-34*, 71.
82 120/3893=3.1
83 "Future Engineer Force White Paper," 32.
84 *TRADOC Pamphlet 525-3-34*, pg 32.
85 Refer to Chapter III of this monograph.

positions and conduct breaching operations). In addition, with reduced engineer assets, the BCT loses rather than gains capability for performing stability operations.

Historical unit of action sizing trends and an assessment of the COE indicate that an engineer representation of about 10 percent is the appropriate size organization to match BCT requirements with full spectrum engineer capabilities: sapper, construction, equipment, and topographic. "At the tactical level of the brigade, uncertainty and friction must still be dealt with. An organic combined arms capability is the answer."[86] Specific mission sets should include countermine, road repair/construction, tactical bridging (i.e. Wolverine and fixed bridging), force protection, base camp/airfield construction, topographic support, and sappers capable of combined arms mobility and countermobility tasks plus reconnaissance.

Addressing command and control of the unit is a complex issue. It is certainly beyond the capability of a company commander. With additional engineer positions on the staff, the BTB could command and control this numerically strong and diverse set of engineer capabilities. However, this would favor assigning the command as an engineer billet. Since a significant portion of the Engineer Regiment would be embedded in BCTs, the best solution is to include an engineer battalion in each BCT. Knowing that a certain amount of engineer augmentation would still be required, an experienced engineer commander in the BCT becomes the receiver of additional engineer units. This emphasizes the combat support role of engineers, provides definitive leader development positions for the branch, and mitigates command and control complications that are addressed later in this chapter.

Since the Army and TRADOC consider this unaffordable, the embedded engineer company should at least be expanded. Doubling the size of the embedded company would be a good starting point. To accomplish all high frequency tasks, every BCT needs heavy equipment to prepare protective positions along with MICLICs and rollers/plows for breaching. Only when

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[86] David Fastabend, "An Appraisal of The Brigade-Based New Army," *Parameters,* Autumn 2001, 73.

FCS negates the requirement for some or all of these assets should they be cut from the BCT; cutting these capabilities before technology replaces them increases operational risk. Meanwhile, through experimentation and wargaming, the Army and the Engineer Regiment should continue to try different combinations to see what works best.[87]

UEy AND UEx

It is necessary to summarize the Engineer Regiment's concept for providing modular, scalable, mission-tailored, and multi-functional capabilities to Army and Joint Force Commanders at the UEy and UEx levels of command. Since BCTs will not contain the requisite embedded engineer capabilities to dominate along the full spectrum of operations, engineers must continue the habitual practice of augmenting the unit of action. Engineers provide this additional capability through an engineer force pool consisting of baseline forces, mission modules forces, and engineer command and control.[88]

A framework of the UEy and UEx commands shows where engineers interface in the new structure. The Army is replacing service component commands, numbered armies, corps and division headquarters with Units of Employment (UE). The UEy will direct theater support and land component operations. The UEx will provide tactical and low level operational battle command. The UEx is designed to control up to six BCTs of any type (possibly more in stability operations) in addition to SUAs (Fires, RSTA, Aviation, Maneuver Enhancement, Sustainment) required for the mission.

Engineer Force Pool

Engineers provide support within this force structure with baseline forces, engineer modules, and command and control. Engineer baseline forces are high frequency tactical

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[87] Macgregor, *Breaking the Phalanx*, 15.
[88] *TRADOC Pamphlet 525-3-34*, 33-35.

mobility[89] and construction[90] capabilities typically demanded by BCTs to perform full spectrum operations. The engineer mission module forces are specialized low-density/low-demand type capabilities typically required at theater level. The modules are arranged in five general categories[91] plus battalion headquarters for command and control.

With respect to command and control, engineer command (ENCOM) headquarters and engineer brigades are notionally aligned at the UEy and UEx levels respectively. Depending on the scope of a mission an engineer brigade may be assigned at the BCT or SUA level.[92] Finally, Early Deployment Detachments (EDD) are a command and control force pool asset designed to provide "forward eyes-on" assessment to ENCOMs and engineer brigades, early technical assistance and reachback capability.

If the mission of a UEx dictates, an engineer brigade will be OPCON to provide 24-hour planning, design, QA/QC, and battle command capability for 5-7 battalions. Engineers are represented throughout the UEx command nodes: a UEx engineer, engineer plans cell, and GI&S capability at the Main; an engineer operations cell and GI&S capability at TAC1; an engineer operations cell at TAC2. If required, engineers will draw from these three nodes to staff the mobile command group.

If no engineer brigade is present, the maneuver enhancement brigade is the primary node for receiving and employing force pool engineers. However, because much of this capability is likely needed at the BCT level and because the ME brigade is responsible for its own area which may not be contiguous with BCT AOs, the BTB seems a more appropriate command level for assigning engineer force pool units. Assigning units to the ME brigade complicates command

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[89]The mobility capabilities are: battalion headquarters, sapper, assault bridging, assault breaching, route clearance, area clearance.

[90]The construction capabilities are: battalion headquarters, rapid deployable earthmoving, horizontal construction, vertical construction, haul, concrete

[91]The five general categories are: bridging, explosive hazard, construction support, infrastructure, and geospatial.

[92] "Future Engineer Force White Paper," 15-16.

and support relationships between the UEx, BCT commanders, BTB commanders, the ME brigade, and any OPCON engineer brigade or battalions at the UEx or BCT level. For example, how does the ME brigade provide forces to a BCT in a non-contiguous AO? What commander is responsible for assets traversing "white space" between AOs? How does the engineer work line concept translate into non-linear, non-contiguous battle space? Further, the ME brigade is the first level of command with enough depth in the staff to integrate joint engineer assets. This appears to be a flaw in organizational design and is a repeat of command and control confusion found in the current force design. If task organized to the BTB, augmenting elements must be prepared to provide their own planning and liaison capability to the BTB or else the BTB risks exceeding prudent span of control measures.

The type of unit will determine the readiness and deployability requirements for that unit. Major combat formations (i.e. BCTs) use an assemble-train-employ-rebuild model over a three year period. Embedded engineer capability within the BCT and engineer brigades with assigned battalions (combat and construction) will use this same employment model. Lower density units such as the effects modules will use a sustain-employ-sustain model to maximize availability for shorter deployments.[93]

With respect to support, the Future Engineer Force concept lacks the detail to determine if support will be effective or not. Engineer force developers assume that one forward support company is required with the attachment of 5-7 engineer companies.[94] Does this mean the attachment of four additional companies requires no additional logistics support? Four companies arriving in a BCT AO without support would be a significant strain, and engineers are only one BOS that can impact the BCT in this way. Also, there are no details provided about the ownership and organizational placement of organizational and direct support level maintenance.

[93] *TRADOC Pamphlet 525-3-34*, pg 41.
[94] United States Army Engineer School, "Maneuver Enhancement Brigade," (Fort Leonard Wood, Missouri: briefing presented on 18 October 2004 at the ME Commandant's ICT).

Is this capability located within the engineer force pool, or will it reside with the brigade support battalions or sustainment brigades? Are any of the support units being designed to match the engineer maintenance requirements? Finally, based on the lessons of past operations, construction materials and contractors ought to be treated with the equivalence of pacing items and engineers must have full time integration with supply and contracting functions of the supported command.

As an example of command and support deficiencies, consider the light combat engineer platoon MTOE. Light engineer platoons habitually are attached to infantry battalion/task force commanders. The platoon leader has dual responsibility as the task force engineer. The platoon MTOE does not provide for an operations, planning, liaison, logistics, medical, or maintenance capability. To compensate for this, the engineer platoon leader decreases his combat strength in order to provide 24-hour engineer operations and planning capability in the task force TOC and the task force absorbs the support requirements of the platoon. In this sense, the platoon is a "module" that gets "plugged" into the maneuver task force. Future engineer MTOEs should account for this imbalance in command and support capability; the smaller the force or the module, the more difficult it is for that unit to provide continuous planning, execution, and liaison capability. The future concept requires the staff to perform these functions, but the staff is small and at some threshold[95] will require augmentation.

A strongpoint of the future engineer force concept is in determining specific engineer effects and in creating modular forces to provide those capabilities. In accomplishing this, the number of engineer TOEs is reduced from 98 to 31. Operation IRAQI FREEDOM validates this. Commanders stated that the sheer number of missions demanded that engineers task-organize by capabilities packages.[96] However, there are conceptual gaps: the integration of USACE capabilities, shortfalls in command structure in the BTB and modules, plus maintenance, material

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[95] This threshold is dependent upon the numbers and types of augmenting modules supported.
[96] Suggested to the author by MAJ Todd Plotner during a monograph review on 29 Nov 2004.

and contracting support. The primary work ahead in the Total Army Analysis process is to determine the appropriate number of baseline forces, modules, and headquarters to create in the active and reserve components, along with associated basing and peacetime command and control decisions. The most likely risk is that much of the engineer force pool will be structured as low-density/low-usage when the demand for these units will actually be high. Conceptual wargaming has the potential to add a great deal of value to this process.

Conceptual Wargaming and Experimentation

Conceptual wargaming is being used to refine the BCTs and in shaping the maneuver enhancement brigade and the engineer force pool. Even though "the development of a future force structure is not the primary object of the annual AAN wargame process…the technologies, manpower, logistics, and training needed to support a future force directly affect near-term as well as future budgets. Consequently, the force structures used in the wargames play a direct role in fulfilling the CSA's goal to connect the Army's long-term vision to the research and development process."[97]

The potential value to the process is large, but a recent presentation of the Caspian scenario (to facilitate the organization of the maneuver enhancement brigade) exposes some flaws. First is that the COE is not adequately represented by the scenario. The scenario assumes short-term offensive oriented objectives and does not explore campaign length requirements which are typical of the COE. Second, it assumes availability of echelons-above-BCT required units. The scenario assumes an additional ten sapper companies (910 personnel) are attached to various BCTs so that each possesses the requisite engineer capability to accomplish its mission.

With four armor BCTs and two Stryker BCTs assigned to a UEx for the scenario, BCT strength on the ground is about 22,500 personnel. Organic engineers represent fewer than 4

[97] Walt L. Perry and Marc Dean Millot, "*Issues from the 1997 Army After Next Winter Wargame*," (Santa Monica, California: RAND, 1998), 41.

percent of this force.[98] With the addition of ten sapper companies and assuming no additional BOS augmentation to the BCTs, the ratio of engineers to the deployed force is raised to 7.5 percent.[99] This analysis should not be construed as an argument that number of personnel is an appropriate measure for determining BCT and UEx task organization. Rather it is offered as one possible benchmark alongside more important factors (such as capabilities demanded by the environment) in determining the proper force structure.

With capabilities in mind, the Caspian scenario augmentation does not even address potential bridging, countermine, general engineering, and topographic capabilities that BCTs typically require in order to operate in the COE. Because much of the engineer capability has been stripped from the BCT, force pool augmentation becomes a requirement for BCT and UEx versatility in the COE. In addition to the BCT augmentation, the Caspian scenario task organizes to the UEx three sapper companies, three clearance companies, three engineer support companies, three multi-role bridge companies, three vertical construction companies, and three horizontal construction companies. This adds an additional 2,280 engineers to the task organization, which taken as a proportion of combat forces now represents over 15 percent of the force and adds significant diversity in capability. The UEy controls additional diving, real estate, utilities, well drilling, mine dog, and topographic prime power companies. Fire fighting and USACE capabilities are not represented in the scenario. An engineer battalion headquarters commands and controls engineer capabilities in the maneuver enhancement brigade; considering the size and number of engineer units in the AO this is simply inadequate. Two engineer brigades command and control engineers in theater.

An inherent weakness to this scenario is that it assumes all required capabilities are available for deployment. With force designers focusing on a narrow scenario there is no exploration of what happens if other national commitments or if force size constraints limit the

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[98] (76*8) + (120*2) =848. 848/22500=3.77.
[99] (848+910)/(22500+910)=7.5

amount of augmentation available. Lack of available augmentation exacerbates the lack of certain capabilities in the BCTs. If the BCT design is indeed fixed, as it appears to be, then a global war on terrorism wargame involving multiple and extended engagements across two or more regional combatant commands might give insights on the proper ratio of engineer force pool units to echelon of supported command. A satisfactory approach to conceptual wargaming is beyond the scope of this monograph; however it is clear that a sixty day offensive oriented scenario in the Caspian region is not sufficient for making force composition decisions.

Summary

In summary, this chapter demonstrates the deficiency between engineering requirements of the BCT in the COE and actual engineer capabilities embedded in the BCT. The optimal recommendation to close this gap is to embed within the BCT an engineer battalion with multifunctional capabilities: sapper, construction, equipment, and topographic. If this is not feasible, the embedded engineer company should be substantially increased in size and include additional breaching and heavy equipment in order to provide the BCT basic capabilities to perform all high frequency, high risk combined arms tasks. A discussion of conceptual wargaming as a contributing process to force development demonstrates that the future engineer force concept repeats many of the command and support mistakes in past operations. With some adjustment, however, conceptual wargaming offers great potential to the process. This chapter includes recommendations on scenario selection. The next chapter presents overall conclusions and recommendations to include specific recommendations on measuring engineer effectiveness.

CHAPTER FIVE – Conclusion and Recommendations

The debate on the shape of the future force is far from over. Colonel (Ret.) Macgregor has recently testified before the House Armed Services Committee criticizing the assumptions on which Army transformation is based. He suggests that Stryker is the wrong technology, especially for urban or complex terrain, and recommends that acquisition of additional Stryker vehicles be terminated. Further, the modular two-battalion brigades do not possess the combat power, C4ISR plugs, armed helicopters, and adequate organic support for sustained independent operations. He recommends larger BCTs (e.g. the combat groups presented in *Breaking the Phalanx*) in order to achieve independent capabilities and scaling back research and development on FCS in order to field technologies that are currently available for immediate incorporation and subsequent testing in the current force.

Macgregor does not agree that the UEy and UEx architecture transforms the Army's command and control structure and enables joint capabilities. He challenges the Army's top leadership when he states "the formations that would have emerged in the wake of OIF would have resembled those outlined in…*Breaking the Phalanx,* not the ones [divisions and brigades] are currently compelled to establish.[100] Criticism, however, at this stage of the debate, should be considered a healthy part of the process; Macgregor's recommendations in particular should be heeded as he has studied the matter in depth. This is especially true since some bold assertions in the Modularity O&O Plan have not yet been demonstrated: transformed BCTs will be as or more capable than existing divisional BCTs; BCTs will be more capable in stability operations; joint engineers are seamlessly interoperable. This monograph has attempted to bridge the engineer gap in Macgregor's proposal, and by doing so also contribute to the ongoing transformation debate.

This chapter presents four sets of engineer specific recommendations derived from the process of writing this monograph. The first set of recommendations is a restatement from Chapter Four based on the analysis of COE requirements and BCT capabilities. In answering the monograph's hypothesis - What is the difference between engineering requirements of the BCT in the COE and actual engineer capabilities embedded in the BCT? – the assertion is that BCTs are short some high-demand assets. The optimal solution is to redesign the BCT with these

[100] Macgregor, "Army Transformation: Implications for the Future," (Washington, D.C.: House Armed Services Committee Schedules and Transcripts, 15 July 2004) [on-line]; available at http://www.house.gov/hasc/openingstatementsandpressreleases/108thcongress/04-07-15Macgregor/pdf; Internet; accessed 23 September 2004.

capabilities included. Assuming that the Army will not modify the BCT to incorporate all of the requisite engineer capabilities, this chapter recommends both incremental changes to the embedded engineer design and conceptual changes regarding the augmenting engineer force pool. The second set are C2 and support recommendations at the RCC, UEy, and UEx levels in order to leverage engineer capability at the proper point of application. The third are DOTMLPF considerations that need immediate attention. The final set of recommendations is on refining conceptual wargaming in order to better facilitate force structure decisions and processes. All sets of recommendations are influenced by 1) a demonstrated capabilities gap in the BCT, 2) lack of incorporation of certain past lessons learned, and 3) deliberations on how to proportion baseline forces to module forces to engineer command and control.

Embedded Engineers in the BCT

As demonstrated in Chapter Four, BCTs should have a battalion size engineer element with full spectrum capabilities: sapper, construction, equipment, and topographic. Specific tasks required include countermine, road repair/construction, tactical bridging, force protection, base camp/airfield construction, topographic support, and sappers capable of combined arms mobility and countermobility tasks plus reconnaissance. This battalion should also have its own organic forward support element. Low density/low usage units should be available for operational level requirements: operational bridging, real estate, USACE, pipeline, facilities and construction management, mine dog, contracting, diving, well drilling, prime power, and fire fighting. This arranges forces in accordance with employment demands. The assumption must be made, however, that the Army will not adopt this recommendation because it is too costly.

If only incremental changes are possible, BCTs need additional heavy equipment for force protection, assets for combined arms breaching (i.e. MICLIC, rollers/plows, Panther, miniflail), and assault bridging.[101] The embedded engineer company in the Stryker BCT offers the most versatile of the three BCT designs. Though it is too small to provide the necessary capabilities identified in Chapters Three and Four, armor and infantry BCTs should adopt this as the minimal engineer force design. If implemented, the lack of an engineer battalion still posses a problem.[102] If no immediate changes are made to the embedded engineer force design, commanders should be given the latitude in future training and experimentation to try a lot of different combinations to see what works.[103]

The future engineer force organizational concept should also better address USACE, maintenance, materiel support, and contracting. For example: What is the proper command and control arrangement for ENCOMs, engineer brigades, and deployed USACE division or district commanders? Should there be a USACE Forward Engineer Support Team (FEST) effects module? Should there be a formal alignment of USACE divisions with RCCs? Is the BCT capable of maintaining its engineer equipment? How much engineer augmentation can the BCT absorb without additional support augmentation? What organization is responsible for providing support augmentation – engineers or logisticians? Is the BCT staffed and equipped for materiel management, especially that of construction? Is there an unstated assumption that LOGCAP and local hire contracts will replace a substantial portion of engineering requirements such as construction and materiel management? If so, what should the BCT anticipate it will have to contract for, and should the BCT be staffed for contract oversight? These questions indicate a number of assumptions that may or may not have been incorporated into the force design concept. Unfortunately, the TRADOC Pamphlet 525-3-34 contains the word "assumption" only once and does not go into any details as to what those assumptions are. An underlying deficiency to the force development process is that assumptions are not documented.

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[101] Refer to frequency of task analysis in Chapter IV of this monograph as justification for this recommendation.

[102] "News from the Front."

[103] Macgregor, *Breaking the Phalanx*, 15.

Engineer C2 and Support

As introduced in Chapter Four, a strong point of the Future Engineer Force concept is the creation of effects modules as an augmenting force pool. This reduces the number of engineer MTOE designs, and better enables the application of engineer effects. A potential disadvantage to this approach, however, is that it pools engineers as low-density and high-demand. In order to mitigate this and to best enable engineer application at the appropriate level of command (i.e. the supported BCT, UEx/ME brigade, UEy), engineer C2 and support must be designed to actively integrate engineer units strategically, operationally, and tactically.

Prioritizing the engineer element is essential to transformational concepts. Depending on the size of the deployed force, competing demands for resources across multiple operations, and the readiness status of the engineer force pool, not all maneuver commanders will receive the engineer augmentation that they request and indeed may require. The following recommendations, rooted in the lessons of past operations, create an architecture for effectively applying engineer effects where they are most needed:

- Align an ENCOM with each RCC. The size of the ENCOM should be reduced and it should be staffed with an AC/RC mix. This will offset the costs of creating additional ENCOMs and allow engineer brigades to focus on operational command and control. Because the needs of each RCC vary, an alternative is to dissolve ENCOMs altogether, shift the personnel billets to USACE, and align USACE divisions with RCCs. Each RCC could "hire" USACE on an as needed basis, with the disadvantage being that the RCC would have to pay for services rendered because USACE functions as a fully reimbursable organization.[104] This level of engineer C2 would maintain strategic visibility of engineer readiness and responsiveness across the Engineer Regiment.

[104] Krepinevich, 15.

- Create one deployable engineer brigade headquarters per UEy capable of planning and of managing deployed engineer units/assets. Its capabilities are commensurate with those shown in the Future Engineer Force O&O; it should clearly state that the headquarters be capable of initiating MAC as well as a BCCA. These are operational tasks BCTs frequently depend on and should be centrally managed.
- Align one engineer brigade headquarters as a force provider to each RCC. Responsibilities include managing an organization of battalion headquarters, combat battalions, construction battalions, and at least one set of regionally tailored modules: operational bridging, real estate, USACE technical specialties, contracting, diving, pipeline, etc. These units should be based together like the 555th Engineer Group at Fort Lewis. The brigade would also support mobilization of reserve component engineer units.[105] If an additional engineer brigade headquarters is needed in support of a UEy, the RCC can decide to deploy this force provider brigade.
- Consider aligning fire fighting assets with aviation SUAs and coordinate unit readiness requirements with the supported aviation element. This is consistent with ensuring that engineer assets are aligned with the supported unit of action needing those capabilities.
- Designate engineers as a special staff group reporting directly to RCCs and UEy commanders. This staff section is already designated at the UEx command level. Depending on the level of supported command and the degree of engineer augmentation this designated engineer commander or staff officer could come from the engineer force pool, USACE, active or reserve component, or other services. What matters is that engineers organize to represent all functional capabilities through a single voice to the supported commander. This recommendation conflicts with Army transformational efforts to align functionally at the UEy level and above. The problem with this is in

[105]Suggested to the author by COL Peter Tabacchi during a monograph review on 29 Nov 2004.

determining where engineers fit functionally: combat? combat support? combat service support? maneuver support or enhancement? force protection? sustainment? The engineer effort is relevant to all of these, and should seriously be considered as an independent function within the overall command structure.

- Design all engineer MTOEs with organic organizational level maintenance. If this is already being done, it should be clearly demonstrated in the Future Engineer Force White Paper and in TRADOC Pamphlet 525-3-34. Also, a clear concept should be outlined on whether engineers or sustainment units will be responsible for DS maintenance requirements.

Immediate DOTMLPF Concerns

Though not a primary focus of this monograph, some immediate DOTMLPF concerns relevant to BCT requirements surfaced through the research[106]:

- (D) As in Kosovo, consider front loading the construction effort if the supported commander decides to operate out of fixed base camps. Base camp construction is a complex project most effectively accomplished before a using unit occupies the facilities. In addition, this would compliment the force pooling of construction assets and allow some construction engineers to be moved out of theater quicker, which could also ease any force size constraints.
- (D and M) Revise breaching doctrine and seek a materiel replacement for the MICLIC. In OIF, the MICLIC proved ineffective against blast resistant mines, yet combined arms doctrine assumes that the engineer equipment "will always get through."[107] While not necessarily apparent, this is consistent with the earlier recommendation to add or increase

[106] "Third Infantry Division (Mechanized) After Action Report, Operation Iraqi Freedom," Chapter 15.

[107] Ibid. The phrase "will always get through" is a reference based on the World War II assumption for air power force development that the bomber would always get through.

MICLICs in the BCT design because partial capability today is better than no capability at all. Whatever the replacement for the MICLIC, the BCT needs an effective breaching tool and doctrine for employment.

- (T) EOD is a classic example of how low-density force structure and high-demand employment results in poor responsiveness. Because EOD is closely related to the engineer countermine tasks, combat engineers should train on explosive ordnance response and disposal.[108]
- (M) Ensure that engineers are fielded with the same family of vehicles as the supported maneuver force. A current gap exists with M113 engineer vehicles supporting M1 and M2 based maneuver units.[109] This gap must be closed with the fielding of the FCS engineer vehicle.
- (M) Field the Wolverine to replace the AVLB.[110] Each BCT should have some organic assault bridging.
- (M) Create armored D9 dozer effects modules. These are a necessary asset for mobility in urban terrain, and also provide tremendous survivability and general engineering capability. This capability would enhance the BCT but is most likely too expensive and is not strategically mobile enough to be embedded in the BCT.
- (M) Outfit construction engineer units with power generation and power tool capabilities commensurate with joint engineering capabilities. This is the starting condition necessary for joint interoperability of engineer units.

[108] McNulty, 13.
[109] Ibid., Chapter 1.
[110] Ibid., Chapter 15.

Conceptual Wargaming Refinement

As addressed in Chapter Four, the Caspian scenario is not robust enough for designing forces that are independently capable across the range of military operations. In order to effectively contribute to the force development process, multiple and long term military engagements should be modeled. The most beneficial scenario would select operations from contingency planning guidance based on expected or anticipated execution. At least one third to one half of the active component BCTs should be deployed in the scenario with some reserve component augmentation. The operations should span two or more AOs, preferably located in separate RCCs. The time period studied should be lengthy enough to allow for a relief in place. This process would certainly add contributing information on transforming force structure.

A benefit of conceptual wargaming is the ability to take an iterative approach with varying combinations of C2 structure, the numbers and types of BCTs, and combat support and combat service support requirements, to include engineer force pool augmentation. In order for conceptual wargaming to be effective, there must be measures of effectiveness to compare various outcomes. This last set of recommendations proposes a set of engineer measures of effectiveness to serve this purpose. These measures potentially serve a dual purpose as a structure for studying future engineer operations, writing after action reports, and compiling lessons learned. A more methodical approach to studying engineer contributions and areas of improvement could help the Engineer Regiment communicate both relevance to the Army and capability shortfalls in budgeting and force development processes.

Measures of Effectiveness

- Communication. Does the engineer unit posses the organic capability to communicate with higher headquarters, subordinate units, and supported units across non-contiguous AOs? What is the ratio of vehicle mounted radios to vehicles? Based on number of vehicles and the commander's convoy procedures, how many missions can be executed simultaneously? What communication deficiencies degraded mission performance?

- Maintenance and support. What is the organic maintenance organization supporting the engineer unit? What is the ratio of organic contact teams to pieces of equipment (this could be analyzed separately for pacing and non-pacing items)? Which organization and level of command provides direct support maintenance? What distances are traveled to receive supply support, organizational maintenance, and direct support maintenance? Are the maintenance units capable of supporting all embedded and force pool (especially effects modules) units? Is support available within the same AO as the engineer unit? How often do the support relationships change?
- Contracting. What is the supported commander's contracting plan? Did additional unexpected requirements occur that required contracting capability? What contracts (service, support, construction, etc.) are being executed? Who provides contract oversight? Are these individuals qualified as Contracting Officer Representatives (COR)? How accessible is the Administrative Contracting Officer (ACO) and the Contracting Officer (CO)? Which of the supported commander's engineering requirements were not met through organic, assigned, or contracted capability?
- Materiel responsiveness. This applies to Class IX parts, construction materiel, and other engineer specific supply requirements. How long does it take to receive requested supplies? What construction materiel is locally purchased? What construction materiel competes for strategic air and sea shipment priority? To what degree does lack of materiel degrade project progress? What organization manages these supplies? How

responsive is that organization to engineer requests? How do force pool units integrate with supported units?[111]

- Command and support arrangements. What is the task organization (include BCT, SUA, engineer battalion, engineer brigade, ENCOM, UEx, UEy, and RCC)?[112] How often does the task organization change?[113] Do engineers maintain a special staff section or command relationship directly with the supported commander? Are engineers required to break up organic forces (squads, platoons, equipment, etc.) to support various commands?
- Readiness. Following engineer force pool employment , what is the recovery time granted in relation to time deployed? When was the unit ready to deploy again? Were there any significant issues that hindered readiness? Were any ad hoc arrangements taken to improve the readiness of one unit over another (i.e. reassignment of personnel or equipment)?
- Engineer reconnaissance. Are any elements designated as engineer reconnaissance units? At what level of supported command? What engineer reconnaissance missions are executed?
- Project management. Does the BCT have a construction or project management requirement? What engineer unit provides this capability to the supported commander? Was the unit designed to provide that support? What are the planned project(s) cost and schedule? What are the completed project(s) cost and time required? Are there any factors which contributed significantly to cost or time growth?

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[111] David Maraniss, *They Marched Into Sunlight*, (New York, New York: Simon & Schuster, 2003), 220. See discussion on LT Welch calling in artillery fire periodically during patrols. By doing that he knew that when he needed fire support, the supporting artillery units would be ready to provide it. A system is more responsive if parts are periodically exercised.

[112] The task organization should include command and support relationships of units as well as number of personnel and significant equipment.

[113] More permanent command and support relationships suggest that the capability should be embedded.

- Liaison. What liaison requirements were identified? Were engineer units able to provide liaison within their prescribed MTOEs, or was individual augmentation required?

All future AARs should address requirements demanded by supported commanders and any capability shortfalls as a method to document capabilities deficiencies.

Closing

In closing, the fact that the Army is transforming while continuing to fight Operation IRAQI FREEDOM and the Global War on Terror makes this both a challenging and exciting endeavor. This transformation is indeed necessary to adapt to an ever changing international security environment. This environment will continue to shift even as the Army finishes the current Total Army Analysis and settles on BCT, UEx, and UEy force designs. The intent of this monograph is to contribute to this ongoing process. In doing so, it also demonstrates the challenges of integrating interdependent combat, combat support, and combat service support functions across the Army. The ultimate recommendation is to strengthen engineer capabilities in the BCT in order to strengthen overall BCT effectiveness.

LIST OF ACRONYMS

AAN	Army After Next
AAR	After Action Review
ACE	Armored Combat Earthmover
ACO	Administrative Contracting Officer
AC/RC	Active Component/Reserve Component
AO	Area of Operation
APOD	Ariel Port of Debarkation
ART	Army Task
ASP	Ammunition Supply Point
AT	Anti-tank
AUTL	Army Universal Task List
AVLB	Armored Vehicle Launched Bridge
BCCA	Base Camp Coordination Activity
BCT	Brigade Combat Team
BN	Battalion
BOS	Battlefield Operating System
BTB	Brigade Troops Battalion
C2	Command and Control
C4ISR	Command, Control, Communication, Computers, Intelligence, Surveillance, Reconnaissance
CALL	Center for Army Lessons Learned
CBT HVY	Combat Heavy
CELL	Center for Engineer Lessons Learned
CENT	Central Command
CG	Commanding General
CINC	Commander in Chief (now Combatant Commander)
CO	Contracting Officer
COE	Contemporary Operational Environment
COR	Contracting Officer Representative
CSA	Chief of Staff, Army
CSE	Combat Support Equipment
DEUCE	Deployable Universal Combat Earthmover
DOTMLPF	Doctrine, Organization, Training, Materiel, Logistics, Personnel, Facilities
EDD	Early Deployment Detachment
EN	Engineer
ENCOM	Engineer Command
EOD	Explosive Ordnance Detachment
FARP	Forward Arming and Refueling Point
FCS	Future Combat System
FET	Facilities Engineer Team
FEST	Forward Engineer Support Team
FY	Fiscal Year
GI&S	Geospatial Information & Services
IAV	Interim Armored Vehicle
IED	Improvised Explosive Device
IFOR	Implementation Force

JOE	Joint Operational Environment
JSOTF	Joint Special Operations Task Force
JTF	Joint Task Force
KFOR	Kosovo Force
LOC	Line of Communication
LOGCAP	Logistics Civil Augmentation Program
MAC	Mine Action Center
ME	Maneuver Enhancement
METL	Mission Essential Task List
MICLIC	Mine Clearing Line Charge
MND-N	Multi-National Division North
MTOE	Modified Table of Organization and Equipment
MSR	Main Supply Route
OEF	Operation Enduring Freedom
OIF	Operation Iraqi Freedom
O&O	Operational and Organizational
OPCON	Operational Control
QA/QC	Quality Assurance/Quality Control
RCC	Regional Combatant Commander
ROAD	Reorganization Objectives, Army Division
RMA	Revolution in Military Affairs
RSTA	Reconnaissance, Surveillance, and Target Acquisition
SEA	Southeast Asia
SEE	Small Excavation Equipment
SFOR	Stabilization Force
SPOD	Sea Port of Debarkation
SUA	Support Unit of Action
TAC	Tactical Command Post
TF	Task Force
TOC	Tactical Operations Center
TRADOC	Training and Doctrine Command
TRICAP	Triple Capability
UEx	Unit of Employment X
UEy	Unit of Employment Y
UN	United Nations
UNOSOM	United Nations Operations Somalia
USACE	United States Army Corps of Engineers
USJFCOM	United States Joint Forces Command
WMD	Weapons of Mass Destruction

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