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**NAVAL WAR COLLEGE
Newport, R.I.**

**OPERATIONAL ENGINEERING:
Unity of Effort to Meet Operational Requirements**

by

Shawn Follum, PE

LCDR, CEC, USN

A paper submitted to the Faculty of the Naval War College in partial satisfaction of the requirements of the Department of Joint Military Operations.

The contents of this paper reflect my own personal views and are not necessarily endorsed by the Naval War College or the Department of the Navy.

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10 October 2006

Abstract

OPERATIONAL ENGINEERING: Unity of Effort to Meet Operational Requirements

The Joint Force Commander must make the most effective use of the limited forces available to meet the commander's objectives. Engineering forces are a critical force multiplier and help shape the conditions in which other forces will operate in. Unity of effort is essential in order to efficiently orchestrate the multiple types of engineering forces from all of the Services. Unity of effort for these high demand, low density forces will ensure the commander's priorities for the wide variety of engineering functions are met in the most expeditious manner.

This paper explores the many different organizational structures that can be used for employing engineering forces in order to maximize the effectiveness of the available forces. This paper also discusses the basic capabilities of each of the Services' engineering forces and the historical command and control (C2) structures used. By reviewing what organizations have worked or not worked in the past, this paper discusses the effectiveness of several C2 alternatives in organizing both the forces and the engineering staff, and recommends which structures should be used to most effectively maintain unity of effort among the engineering forces.

Table of Contents

Introduction	1
Background	2
Service Capabilities	3
Historical C2 of Engineering Forces	5
The Gulf War	5
Other Operations in the 1990's	6
OIF and OEF	7
Courses of Action	10
Engineering Forces	11
Service Component Command	11
Functional Component Command	12
Subordinate Joint Task Force	12
Engineering Staff	13
Special Staff	14
Operations Directorate Staff	15
Logistics Directorate Staff	16
Recommended Course of Action	17
Conclusion	18
Bibliography	20
Appendix A - Figures	

List of Illustrations

Figure	Title	Page
1.	Figure 1: Engineering Battlespace Functions	A-1
2.	Figure 2: I MEG Organization	A-2

INTRODUCTION

The effective employment of engineering forces will shape the conditions that other military units must operate in. By shaping the environment to enhance operations, engineering forces become a significant force multiplier to the Joint Force Commander (JFC). As shown in figure 1 in Appendix A¹, Engineer Battlespace Functions, engineering operations assist the JFC at the operational level in three primary areas, combat engineering, general engineering and topographical engineering. Combat engineering enhances mobility by helping the JFC maneuver freely, reducing the enemy's ability to maneuver (countermobility), and supports force protection measures. General engineering constructs and supports the facilities and infrastructure needed to shape the battlespace and is key to force projection. Topographical engineering provides the geospatial information and services necessary to create the common operational picture (COP) for the JFC.²

Engineering units are typically a scarce commodity with a high demand for priority support among the component commanders. **The thesis of this paper is that to better utilize the available engineering forces in the operational area, the JFC requires a single point of contact for engineering operations to ensure unity of effort and successfully shape the conditions needed to allow military units to meet the JFC's objectives.**

Historical employment of engineering forces has proven that the creation of a functional command or separate joint task force significantly enhances unity of command and mission accomplishment. However, for either a loss of the previous lessons learned or just a preference of the JFC to reduce the numbers of subordinate commanders, JFC continue to go into combat with minimal engineering staff, usually within the J4 directorate, and leave the engineering functions to the services. As the combat effort progresses, the command

relationship for engineering forces are often changed to make corrections to the poor unity of effort stemming from a lack of central control and coordination over this force multiplier.

BACKGROUND

Contributing to the failures in unity of effort is the peacetime planning effort. As defined by JP 4-0, Doctrine for Logistic Support of Joint Operations, and the new JP 3-0, Joint Operations, general engineering is one of seven broad functional areas for logistics.³ As a logistics functional area, each service is responsible for providing civil engineering support to their forces. Of special note is the newly released JP 3-0 only references general engineering vs. the more broad term of civil engineering in JP 4-0.⁴ As depicted by Figure 1, general engineering is only a portion of the overall engineering functions. However, no attempt will be made in this paper to segregate the engineering functions into separate structures. Other engineering functions are planned by and provided by the same forces as those providing the general engineering support so it is not practical to try and separate them as it would only add to problems in achieving any semblance of unity of effort among the engineering forces.

As one of seven logistics functional areas, the Civil Engineering Support Plan (CESP) is a sub-part to the overall logistic plan developed to support each course of action being considered by the JFC. Being a subpart to a supporting plan rarely brings together a well coordinated engineering effort among all the Services who are primarily focused on their piece of mission. As a briefer to several Joint Task Force Commanders, I saw the logistics plan as a whole routinely narrowed down to supportable or not supportable, so more briefing

time could be applied to the teeth of the mission. As long as they had some of “it” they were happy, even though they had no idea what the coordinating details behind “it” were.

Another important aspect of civil engineering being a functional area of logistics is the Combatant Commander ability to exercise his directive authority for logistics. This authority may be used to ensure: “effective execution of approved OPLANs; effectiveness and economy of operation; and prevention or elimination of unnecessary duplication of facilities and overlapping of functions among the Service component commands.”⁵ The Combatant Commander may also delegate directive authority for common engineering support capabilities. Having operational control along with this authority allows the Combatant Commander to combine the civil engineering function under a single coordinator to support all theatre components if deemed beneficial.⁶

SERVICE CAPABILITIES

Civil engineering operations span all scales of military operations and across the full range of military operations. To effectively plan for civil engineering operations, the Joint Force Commander (JFC) must understand the capabilities that can be provided by each of the Services engineer forces. While a complete listing of the types of engineering units and force capabilities may be found in Joint Pub 4-04, Appendixes A-D, the following paragraphs outline the basic capabilities of each of the Services.

The Army engineer units have a robust capability to provide combat, civil and topographical engineering support to the JFC. Army units can also provide complete planning and coordination support for assigned engineering operations. They also have the ability “to construct, maintain, and repair facilities, MSR, heliports, ports, railroads, bridges,

and lines of communications; conduct quarry operations; drill water well; and perform real estate, environmental, and facility engineering functions.”⁷

Navy civil engineer units are typically organized as construction engineer units (SEABEE) and have a wide array of basic to specialized construction capabilities in all environments. These skills include vertical construction, bridging, and heavy earthmoving to construct MSRs, supply distribution points for all classes, expeditionary airfields and HLZs, rapid runway repair, damage assessments, and expedient to permanent force beddown and logistic facilities. SEABEE C2 structure allows these units to readily deploy in task-organized detachments from very small to multiple battalions. This flexibility provides the JFC the ability to apply the right level of force at the optimum time and location.⁸

Air Force engineer units are organized as Rapid Engineer Deployable Heavy Operations Repair Squadron Engineer (RED HORSE) units or as Prime Base Engineer Emergency Force (PRIME BEEF) units. These engineer units can perform a wide array of operations including: “extensive vertical and horizontal construction; facility and infrastructure maintenance and repair; aircraft fire, crash, and rescue support; airfield systems support; nuclear, biological, and chemical defense support; force protection support; explosive ordinance disposal; and base denial.”⁹ Additionally, RED HORSE units provide the flexibility to operate independently in austere environments.

Marine Corps engineer units are an expeditionary force-in-readiness structured to provide combat engineering and civil engineering support Marine Corps operations. This span of this support can range from a Marine expeditionary force to a smaller task-organized Marine air-ground task force.¹⁰

In addition to the military engineer units, the Army, Navy and Air Force also provide construction contracting, technical engineering support, and civil augmentation programs to the JFC. These civil augmentation programs allow the JFC to focus the military forces on missions in higher threat areas and contract support to more secure areas. The three primary civil augmentation programs that can provide significant civil engineering and logistic support to the JFC are the Army's Logistics Civilian Augmentation Program (LOGCAP), the Navy's Construction Capabilities Contract (CONCAP), and the Air Force Contract Augmentation Program (AFCAP).¹¹

HISTORICAL C2 OF ENGINEERING UNITS

The Gulf War

History has shown that even within the same geographic area, lessons learned in the effective command and control of engineering units are sometimes lost. During Operation DESERT SHIELD each service provided separate engineering support for its own forces.¹² After three months of working without any unity of effort, the JFC corrected the command and control issues for engineering units by establishing the 416th Engineer Command to be the functional commander for all engineer forces in theatre. Following the Gulf War, throughout Operation PROVIDE COMFORT, the JFC maintained a similar structure by giving OPCON of all Service engineering units in theatre to the Commander of the 20th Engineer Brigade. The C4 retained a small engineer staff for planning but did not have any directive authority over these units. The Commander of the 20th Engineer Brigade established liaisons with other key staffs and provided the unity of command needed to prioritize missions and assign the right engineering force to the task ensuring mission

success.¹³ A critical lesson learned from the I MEF during DESERT STORM was a “need for increased battlefield coordination and synchronization among the engineers of different Services.”¹⁴

Other Operations in the 1990s

In 1993, Operation RESTORE HOPE in Somalia saw a return of the Service oriented controlled engineering forces coordinated by the engineering staff within the J4. The inevitable failure of unity of effort led to the after action report recommending that for large operations the task force engineer should fall under a special staff element (functional command) and under the J3 for smaller operations.¹⁵ During the follow on operation, Operation CONTINUE HOPE, the United Nations and JTF had separate staff elements coordinating the engineering efforts. Ad hoc agreements between the engineering units on the ground grew out of frustration over command and control problems. While the engineers on the ground were able to regularly meet with each other to work out the coordination problems to get the job done, the command and control problems at the operational level were not resolved.

As in any combat operation, unity of command during disaster relief is also essential. In October 1998, Central America was severely impacted by Hurricane Mitch. High winds and heavy rains caused extensive damage to the infrastructure, isolating large sections of the population from all access except via helicopters. In response, USCINCSOUTH established two task organized joint task forces to support disaster relief and humanitarian relief (DR/HA) operations. The already established JTF Bravo was to support operations in

Honduras and JTF Aguila was responsible for operations in El Salvador, Nicaragua, and Guatemala.¹⁶

Due to the nature of the operation, large numbers of engineering forces quickly flowed into Honduras. JTF Bravo had a small engineering staff element organized under the J7 which was unable to coordinate this massive effort. US Southern Command responded to the request for an augment to the J7 staff or a separate C2 element by deploying the 22nd Naval Construction Regiment to command and control all engineering efforts in Central America until JTF Aguila was stood up. The 22nd NCR continued to successfully provide a unified command and control structure to JTF Bravo after the establishment of JTF Aguila.¹⁷

During the planning for JTF Aguila, a similar functional command was envisioned to provide this same unity of command over the engineering forces. However, the JTF Commander opted to change this structure and split the engineering forces up into subordinate task forces aligned by geography in lieu of task. While this fractured command structure succeeded in meeting the mission, coordination of the overall effort was more difficult and proved to be less flexible than the JTF Bravo model.¹⁸

OIF and OEF

Several years later when OIF started, a wide variety of Service supported engineering support was sent to Iraq. There was no functional commander directing the effort for all engineering units. However, there was some effort at lower levels to unify the engineering effort. The I MEF fully implemented General Anthony Zinni's 1995 concept for centralization of all the engineering forces attached to the Marine air-ground task force under a single functional command, I Marine Expeditionary Force Engineer Group (I MEG).¹⁹

Additionally, this was not an ad-hoc command relationship unlike many that were thrown together in previous conflicts to address the unity of effort problems. Throughout the 1990's the I MEG concept was put together through a series of plans and exercises in support of Korea and Southwest Asia. This concept was embraced by I MEF Commanders as it solved the problem on how to effectively employ a division sized engineering force that was made up of forces from multiple Services.²⁰

The I MEG concept in OIF used a flexible, task organized command structure to combine Active and Reserve forces from the Navy, Marine Corps, Army, and coalition forces to more efficiently execute all engineering functions. I MEG was organized into three regimental task forces: Task Force Mobility (TF Mike), Task Force Construction (TF Charlie) and Task Force Endurance (TF Echo).²¹ This naming convention reflected the primary tasking of each engineering task force but did not limit the task forces' ability to perform other engineering functions. Figure 2 in Appendix A depicts the I MEG structure as it was employed in OIF.²² The resounding success of the I MEG concept during operations is reflected by the comments of I MEF Commander, Lieutenant General James Conway, when he spoke to the SEABEES and stated, "You joined forces with us in Operation Iraqi Freedom and, through your landmark mobility and construction engineering efforts, enabled I MEF to move farther and faster than any MAGTF in history."²³

While the I MEG model worked well for the Marines in OIF, other forces did not organize as efficiently. The Army model provided an engineering brigade to each regional division commander. The engineering brigade commander was OPCON to the division commander (regional commander) and ADCON to the 420th Engineer Commander, who was the Engineer in Charge of all engineering operations and CJTF-7 Deputy C7. This command

arrangement did provide for some coordination of effort to react to changes like a surge of construction work in one part of the theatre and redirection of key assets such as bridging. However, as OPCON of the engineering units had been given to the regional commanders, any force movement had to be coordinated through the various regional commanders.²⁴ While this may have worked operationally, the less flexible structure also created a lot of confusion and unnecessary effort to get scarce resources moved from one region to another. As noted by a member of the 458th Engineer Battalion, “They used us, we traveled a lot, from Kuwait almost up to the Turkish border and back.”²⁵ However, this same unit was attached to six different commands during this same time period, March 21 to August 24.

The Air Force organized their engineering forces as a more pure logistical function deploying engineers (PRIME BEEF) as part of the AEF. Additional RED HORSE units augmented these forces to provide specialized functions like airfield repair. These units were dedicated to support the Air Force mission at each forward deployed location. Efforts by the CJFT-7 C7 to redirect the Air Force engineering effort or change the priorities of these assets were strongly resisted by the Air Force.²⁶ The Air Force was also organized in this manner for OEF and in both cases the structure was effective in meeting the CFACC mission but failed to fully support the JTF at a higher operational level of support.

The reconstruction effort by the Provincial Reconstruction Teams (PRT) in Afghanistan was another example of how not to attempt engineering operations without unity of effort. By July 2005 there were thirteen United States led coalition PRTs and 9 ISAF led PRTs operating in Afghanistan. Each PRT developed its own personality but all followed a basic model based on either American, British or German structures. The command relationships and prioritization of objectives among the PRTs were unclear and

were only complicated by the continued addition of PRTs from other countries. The U.S. PRTs stated objective of providing quick impact development projects to influence the Afghanistan populations matured into a series of wells, schools, clinics and other community development projects. However, these teams lacked the necessary centralized control, had frequent turnover of key personnel and significant pressure to get results as soon as possible. This soon led to a series of hasty, poorly built buildings that were not coordinated with other NGOs, the government of Afghanistan or the Afghan ability to provide teachers and doctors to support these new facilities.²⁷

Changes have been made to the U.S. PRT model to help coordinate activities amongst the PRTs. This has led to a change in focus for the reconstruction effort. PRTs are now working on supportable infrastructure projects such as road and bridge construction, and the construction of public facilities such as police stations and courthouses.²⁸ While this new approach is having success, the initial efforts of the PRTs clearly show how ad hoc command relationships result in the loss of unity of effort and can negatively impact the JTF mission success.

COURSES OF ACTION

Lessons learned from these operations indicate that engineering operations work best when engineering forces are controlled by a centralized command structure that reports directly to the JFC. The JFC must determine how to best organize joint forces to meet the assigned mission. As stated by JP 3-34:

The JFC's engineer organization must consider how best to achieve unity of effort, centralized planning, and decentralized execution for assigned engineer forces. Simplicity and clarity of command relationships of the engineer organization are paramount to the effective and efficient use of engineer forces due to the varied nature of engineer tasks, units, and capabilities.²⁹

The following paragraphs will discuss several different options available to the JFC on how engineering forces and engineering staffs may be organized to support the objectives of the commander, and the advantages and disadvantages each option creates.

ENGINEERING FORCES

Service Component Command

Under this concept, the Service component commanders maintain control (OPCON) over the engineering forces from their service. This structure maintains the more traditional forces structure. This command relationship may be effective when the JFC executes the missions through the Service component commands and the engineering forces are dedicated solely to supporting the individual Service component missions. There is some flexibility in this structure with the ability to delegate tactical control of the engineering forces to another Service Component. The temporary attachment of forces allows for the transfer of engineering forces from one Service to support another Service when required.³⁰ An obvious drawback to this concept is the inherent lack of “jointness” in the structure when future operations are expected to rely on the integration of all forces to accomplish the mission. Another significant disadvantage is the speed and level of effort needed to flex forces to another Service when needed. This coordination effort can be exasperated even more if there is some disagreement between the Service components on which Service has the higher priority for the engineering units in question. This priority issue was clearly evident in OIF by the Air Force’s reluctance to assign their forces to non-Air Force missions.

Functional Component Command

Similar to the Service Component Command, the JFC may organize to accomplish the mission using one or more functional commands. Using this concept, engineering forces are attached to the various functional commands based on the mission requirements of the functional command. This structure provides a joint approach by allowing forces from any Service to be assigned to the functional commander to carry out engineering tasks required by that commander. Common logistic support to the joint force, such as base camp construction, will not normally be assigned to the functional component.³¹ While this structure does create the necessary joint environment, the debate over whose mission is more significant still remains when engineering forces are needed to be attached to another functional commander. Additionally, some functional commands such as the joint force special operations component may not have a significant engineering force attached and will have to coordinate with other functional commands to provide this support.

Subordinate Joint Task Force

The JFC may consolidate the engineering forces and establish a joint task force to command and control then engineering mission. Doctrinally, this type of structure is only used when there is a significant amount of engineering effort needed to accomplish the mission. By consolidating the engineering forces under one JTF, the JTF commander can effectively control the extensive amount of engineering operations required to complete the mission.³² Some advantages to this structure are the unity of command resulting from the coordinated tasking of engineering activities and the improved access to the JFC by the senior engineer. The joint task force is also inherently joint by its very nature and may also

provide common support capability to the other commanders in the theatre if this responsibility is delegated by the combatant commander. This structure is designed to provide priority support to all the functional commands in accordance with the JFC priorities. Engineering forces are needed throughout all phases of conflict which creates another advantage of the JTF structure due to its ability to easily transition from one phase of operations to the next without having to reorganize the engineering command structure as other combat forces enter/leave the theatre during the transitions. One significant disadvantage is the introduction of another complete command structure under the JFC increasing the span of control for the JFC and introduces additional support requirements to the overall joint force.

ENGINEERING STAFF

The creation of the right structure for the engineering forces is only half the equation in effectively employing engineering forces. While the engineering staff may not have authority over the engineering forces, this staff can still ensure unity of effort through effective planning and coordination. The JFC must be able to provide clear and concise guidance with respect to the engineering mission and how to achieve it. To assure success the JFC must also take care to establish an effective joint force engineering staff to coordinate all engineering functions.

The joint force engineer must have access to the JFC for a thorough understanding of the commander's intent and the staff must have representation from each of the Services conducting engineering operations. Additionally, coalition representatives may be necessary when specialized coalition engineering forces are combined with the joint task force. The

engineering staff must have constant communication with the engineering forces, and liaison and coordination capability throughout the joint force staff.³³ The following paragraphs will discuss the benefits and disadvantages of creating this joint force engineering staff as a special staff, an operations directorate staff, or a logistics directorate staff.

Special Staff

The first option to the JFC is to establish a special staff that reports directly to the JFC. Creation of a special staff, such as the C7 organization created for CJTF-7, allows the joint force engineer direct access to the JFC. The organization is typically a much more robust staff that can manage the large planning and coordination effort. In OIF, the CJTF-7 C7 organization included a plans branch that worked with the C3 and C5 to incorporate the engineering effort into future operations, a facilities branch to manage current planning and management of the multiple base camps, a branch dedicated to locating and tracking IEDs, and an operations cell that worked directly in the Combat Operations Center.³⁴ With the robust structure and immediate access to the JFC, this structure provides excellent capability to coordinate a wide array of engineering operations; and the greatest visibility of engineering capacity, capabilities, new requirements and coordination responsibilities within the staff.³⁵ While this type of organization may be established for any task force, it is of even greater utility when the primary effort of the joint task force is has a significant engineering focus. Disaster assistance operations, similar to what was done after Hurricane Mitch hit Central America, in which engineering forces make up the majority of the force is a good example of this type of focus.

The most significant drawback is the creation of another directorate. As seen with a subordinate task force, another directorate would create additional administrative overhead and increase the JFC span of control. Additionally, this may be criticized as an unnecessary attempt by the engineering community to garner more influence in the decision making process. However, it is not unusual to create special staffs that affect numerous other staffs within the organization, such as training, to help coordinate efforts across the staffs.

Referring back to the engineering battlefield functions in figure 1, engineers support the efforts of the other staffs by providing topographic engineering to the J2, combat engineering (mobility, countermobility, and survivability) to the J3, general engineering to both the J4 and J3, and a combination of functional planning to the J5 within the civil engineer support plan. Establishing a special engineering staff gives the joint force engineer an equal voice and therefore helps prioritize this support across the other special staffs in accordance with the JFC's intent.

Operations Directorate Staff

The next option explored for organizing the engineering staff is to create an engineering plans and operations cell within the J3 Operations Directorate. Placing the engineering cell within the J3 will provide for a rapid exchange of information during crisis action planning and effective use of the available engineering forces. This structure provides for better integration of the civil engineering support plan into the overall operations plan and will be most effective when supporting combat operations such as maneuver, fires and force protection. This also counters the disadvantages of increased overhead and a greater span of control for the JFC seen in the previous structure.

An obvious disadvantage to this structure is the reduced access the joint force engineer has to the JFC. Additionally, this type of structure is typically small and limits the ability to provide specialized focus for the different engineering functions. Although small, this cell should contain Service representation for all of the engineering forces attached or assigned to the joint task force. Other missions, such as general engineering in support of logistics, may suffer as a result of this structure. Due to the reduced flexibility and coordination capacity of this staff, creating an engineering cell under the operations directorate should be limited to small contingencies, primarily combat engineering operations, or peacetime operations. This type of structure may also provide adequate staff support for large operations or engineering intensive missions if the JFC also establishes an engineering joint task force at the same echelon as other functional component commands. In this case, the engineering JTF could assume the bulk of the planning and coordination effort.

Logistics Directorate Staff

The final option is to create an engineering plans and operations cell under the J4, Logistics Directorate. Due to engineering falling under the general scope of logistics this is a common structure for many organizations. This structure has similar advantages and disadvantages as placing the engineering staff under the J3. However, the primary difference is the change in focus of effort to predominately force sustainment in which the bulk of engineering operations support logistic operations.³⁶ Like the previous structure, the reduced flexibility and coordination capacity of this staff, limit the effective of the status quo structure to small contingencies, primarily general engineering operations, or peacetime

operations. However, as noted in the J3 section, the J4 engineering cell could also leverage the capabilities within a tier one engineering JTF.

RECOMMENDED COURSE OF ACTION

To organize the engineering forces in the most optimal manner to assure unity of effort the subordinate joint task force provides the most flexible and effective structure. This force may be organized either directly under the JFC or two echelons down. As a second tier echelon, each component command under the JFC with a multi-Service engineering mission should establish a subordinate engineering joint task force. The determination on whether to create the joint engineering task force as a tier one or tier two command should be based on the engineering mission. If the JFC mission has a preponderance of engineering related missions, as typically seen in disaster relief operations, the joint task force should report directly to the JFC to optimize operations. When the engineering mission is primarily to support the mission of other functional components, then tier two joint task forces should be established to optimize the support to the functional component commander.

With the direct access to the JFC, or component commander, this type of force structure also encourages innovation as seen in the I MEF example in OIF. The I MEG, working closely with the I MEF commander, realized the MEF's need for improvements in mobility operations. This led to the employment of a newly developed SEABEE Engineer Reconnaissance Team (SERT) to meet the need for real-time engineer intelligence and assessments on critical infrastructure ahead of the force to maintain the high mobility rate.³⁷

By leveraging a tier one engineering joint task force, all three engineering staff options could provide adequate coordination to meet the overall mission. However, the most

effective alternative in almost all situations is to create a special staff function. I will refer to this as the J9 to avoid confusion with other commands that have utilized the J7 code for other functions. The J9 may be too large a structure for peace time planning and exercises, however, making this a permanent special staff directorate will ensure that this optimal coordinating and planning structure is not lost in the haste of building a JTF when responding to a crisis. Additionally, this will reinforce the “train as you would fight” concept by keeping the peacetime structure similar to the contingency structure. By including a significant individual augmentation capability from each of the Services, the J9 can be reduced during peacetime to improve efficiency.

CONCLUSION

The original thesis of this paper focused on the creation of a single point of contact for engineering operations to successfully shape the conditions needed to allow military units to optimize the JFC’s ability to meet mission objectives. Due to diversity of military operations both in scale and type, there is no single concept that fits all of these possibilities. However, as shown throughout history, the best solution still revolves around the JFC’s ability to directly control the engineering effort through a dedicated engineering staff, a functional engineering joint task force, or a combination of both concepts. Key to all these solutions is the commander’s direct link to the joint force engineer and the joint force engineer’s ability to coordinate all engineering operations ensuring unity of effort is maintained at all levels.

NOTE

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- ² U.S. Joint Chiefs of Staff. Engineer Doctrine for Joint Operations. Joint Pub 3-34, v.
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- ⁵ U.S. Joint Chiefs of Staff. Joint Doctrine for Civil Engineering Support. Joint Pub 4-04, (Washington D.C.: 27 September 2001) II-4 – II-5.
- ⁶ U.S. Joint Chiefs of Staff. Doctrine for Logistic Support of Joint Operations. Joint Pub 4-0, I-7.
- ⁷ U.S. Joint Chiefs of Staff. Joint Doctrine for Civil Engineering Support. Joint Pub 4-04, pp. X-XI.
- ⁸ Ibid, XI.
- ⁹ Ibid.
- ¹⁰ Ibid.
- ¹¹ U.S. Joint Chiefs of Staff. Joint Doctrine for Civil Engineering Support. Joint Pub 4-04, pp. XI-XII.
- ¹² Tufts, Dean A., “Military Engineers with Unity of Command: Why is this so Hard?,” (Unpublished Research Paper, U.S. Naval War College, Newport, RI: 2002), 5.
- ¹³ Ibid.
- ¹⁴ Howard, Michael C. and Flynn, Stephen J., “‘MEG’ My Day.” Marine Corps Gazette. (March 2004): 23.
- ¹⁵ Tufts, 5-6.
- ¹⁶ U.S. Joint Chiefs of Staff. Engineer Doctrine for Joint Operations. Joint Pub 3-34, II-3.
- ¹⁷ Ibid, II-4.
- ¹⁸ Ibid, II-5.
- ¹⁹ Howard and Flynn, 23.
- ²⁰ Ibid. 2.
- ²¹ Ibid. 3.
- ²² Howard and Flynn, 25.
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- ³⁰ Ibid, II-1.
- ³¹ Ibid, II-2.
- ³² Ibid, II-3 – II-4.
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- ³⁶ Ibid, II-10.
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Appendix A – Figures

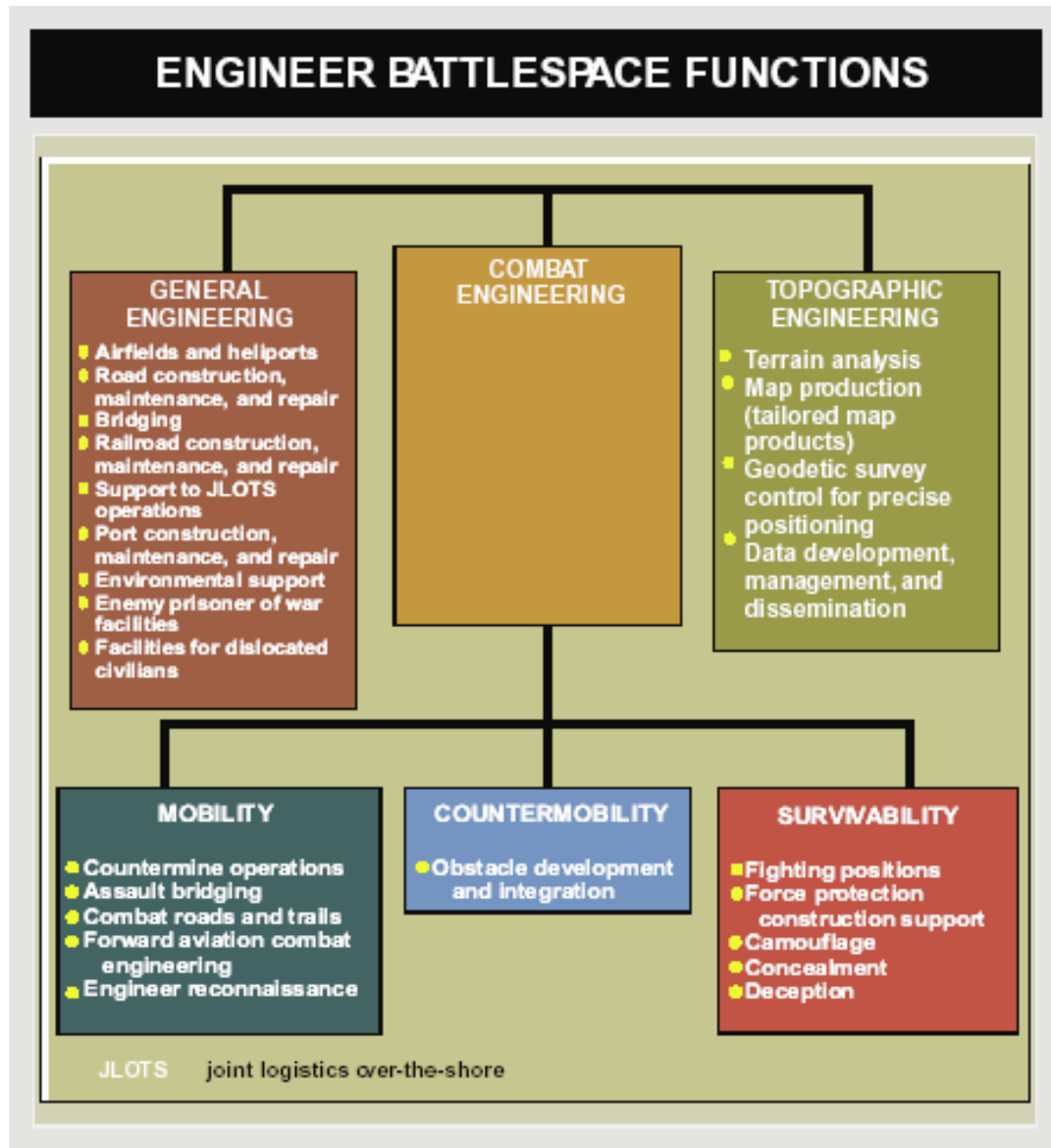


Figure 1: Engineer Battlespace Functions from JP 3-34¹

I MEG Task Force Organization

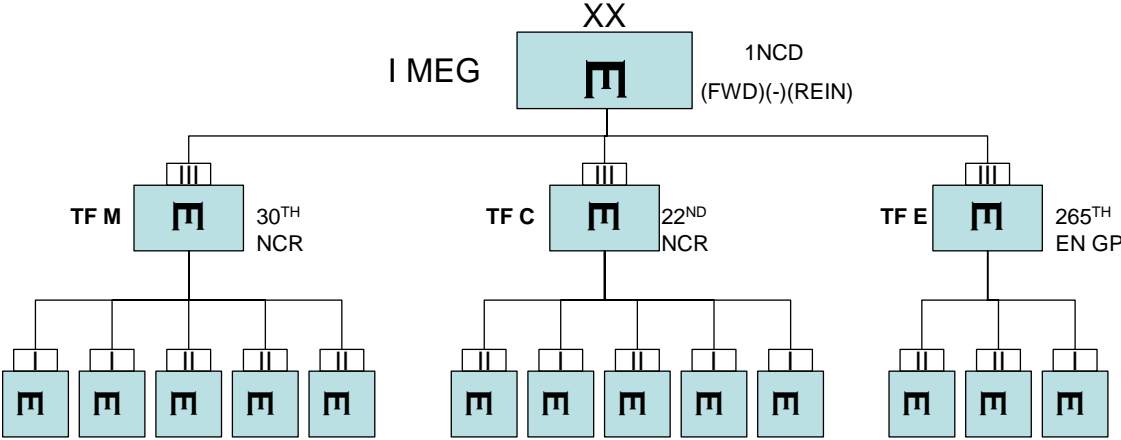


Figure 2: I MEG Organization²²