ENGINEER

The Professional Bulletin of Army Engineers

September–December 2015

Headquarters, Department of the Army
PB 5-15-3 Approved for public release, distribution is unlimited.

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Engineer (ISSN 0046-1989) is published three times a year by the U.S. Army Engineer School and the Maneuver Support Center of Excellence G-37 Publications, Fort Leonard Wood, Missouri.

Articles to be considered for publication are due 1 December, 1 April, and 1 August. Send submissions by e-mail to <usarmy.leonardwood.mscoe.mbx.engineer@mail.mil>, or send an electronic copy in Microsoft® Word on a compact disk and a double-spaced copy of the manuscript to Engineer Professional Bulletin, 14010 MSCoE Loop, Building 3201, Suite 2661, Fort Leonard Wood, MO 65473-8702. Due to regulatory requirements and the limited space per issue, we normally do not print articles that have been published elsewhere.

POSTMASTER: Send address changes to Engineer Professional Bulletin, 14010 MSCoE Loop, Building 3201, Suite 2661, Fort Leonard Wood, MO 65473-8702.

CORRESPONDENCE, letters to the editor, manuscripts, photographs, official unit requests to receive copies, and unit address changes should be sent to *Engineer* at the preceding address. Telephone: (573) 563-4137, DSN 676-4137; e-mail: <usarmy.leonardwood.mscoe.mbx.engineer@mail.mil>; Web site:<http://www.wood.army.mil/engrmag/>.

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OFFICIAL DISTRIBUTION is targeted to all engineer and engineer-related units.

PERSONAL SUBSCRIPTIONS are available for $24.00 ($33.60 foreign) per year by contacting the U.S. Government Printing Office, P.O. Box 979050, St. Louis, MO 63197-9000.

ADDRESS CHANGES for personal subscriptions should be sent to the U.S. Government Printing Office at the above address.

ENGINEER

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Volume 45 PB 5-15-3 | **Headquarters, Department of the Army** | *September–December 2015*

Front cover: U.S. Soldiers and allies conduct a wet-gap crossing exercise in Gyor, Hungary, 17 September 2015. U.S. Army photo by Specialist Jacqueline Dowland

Back cover: U.S. Army photos

DEPARTMENTS

FEATURES

Clear the Way

Brigadier General James H. Raymer
Commandant, U.S. Army Engineer School

Greetings to the U.S. Army Engineer Regiment in my first "Clear the Way" column as the commandant of the U.S. Army Engineer School. Life has been fast-paced since I assumed duties on 19 June 2015. The Engineer Regiment and Engineer School lead the way for the Army in several important areas, including Soldier 2020[1] and the Credentialing Program. We'll continue these important efforts as we build a better operational engineer force that enables the Army and our joint, interagency, intergovernmental, and multinational partners to prevent conflict, shape security environments, and win wars.

The Army Vision—Strategic Advantage in a Complex World—describes eight key characteristics needed for success against future threats. It requires an Army that is—

- Agile.
- Expert.
- Innovative.
- Interoperable.
- Expeditionary.
- Scalable.
- Versatile.
- Balanced.

The Army Operating Concept—Win in a Complex World—describes an Army that must operate in a future unknown environment, against an unknown enemy in an unknown location, as part of an unknown coalition, yet must still provide multiple options to national leaders while simultaneously presenting the enemy with multiple dilemmas across multiple domains. "Force 2025 and Beyond—Setting the Course,"[2] the Army plan to achieve the capabilities required by its vision and operating concept, will enable a comprehensive modernization effort over the coming decades. It is certainly an exciting time to be in the Army and the Engineer Regiment!

Examining a daily sample of news stories, we see conflicts in multiple regions; Afghanistan, Iraq, Ukraine, Syria, Yemen, Libya, and Nigeria are just some of the more prominent ones. In several of these conflicts, we also see a very complex, 21st century way of war, a threat which combines the recruitment and manipulation of sectarian sympathies; the establishment and patient sponsoring of political and paramilitary organizations; and the engagement of these organizations in irregular and clandestine warfare, all synchronized with an external agenda supported by conventional military forces. This hybrid threat is the real challenge that the Army faces today. Let us resolve to closely study potential adversaries and identify how they use the framework of the hybrid threat; how they create and sponsor local political-military organizations among the sympathetic population inside a particular country to serve the agenda of an external agent; and how they shepherd these organizations in conjunction with the external agent's overt and clandestine power to achieve political and military influence, with each element complementing the others.

The Engineer Regiment, composed of forces in the Regular Army, the Army National Guard, the U.S. Army Reserve, and the U.S. Army Corps of Engineers, always provides trained, ready, and superbly led engineer units that can serve on a combined arms team—whether in the offense, the defense, stability operations, or support of civil authorities. It provides engineer units that can assure mobility, enhance protection, enable force protection and logistics, build partner capacity, and develop infrastructure. We do not envision significant changes to these first principles, but we do expect to apply them in currently unpredictable scenarios that will probably include technological and doctrinal surprises to our forces by a hybrid threat. To win, engineer leaders, Soldiers, and units in a balanced force across the three components and

(Continued on page 5)

"We'll continue . . . as we build a better operational engineer force that enables the Army and our . . . partners to prevent conflict, shape security environments, and win wars."

Lead the Way

Command Sergeant Major Bradley J. Houston
Regimental Command Sergeant Major

Essayons! As I write my first "Lead the Way" column, I must first say how honored and humbled I am to serve as your regimental command sergeant major. The transition into my daily duties was exciting. I am pleased to be serving among the professional Soldiers and Department of the Army Civilians of the U.S. Army Engineer School; and I am impressed every day with your commitment, knowledge, and contributions to our team. I look forward to serving with all of you over the next few years.

Of course, the summer months bring many changes. We bade farewell to Brigadier General Anthony C. Funkhouser as Brigadier General James H. Raymer and I arrived to assume our duties here at Fort Leonard Wood, Missouri. On the same day that I assumed those duties, Command Sergeant Major Butler J. Kendrick, Jr., assumed his duties in Africa as the command sergeant major of Joint Task Force Horn of Africa. I would be remiss if I didn't thank him for all that he did as the regimental command sergeant major. I hope to keep the same level of communication active across the Regiment. A new regimental chief warrant officer also assumed duties on 14 August, when Chief Warrant Officer Five John F. Fobish took over from Chief Warrant Officer Four Corey K. Hill, who admirably served as the interim regimental chief warrant officer for 90 days.

A few weeks after assuming my duties, I attended the Army Training and Leader Development Conference, where then Army Chief of Staff General Raymond T. Odierno led numerous discussions on how the Army will operate and evolve over the next few years. The Army Operating Concept, the Army Human Dimension Strategy, the sustainable readiness model, and the cost of readiness were discussed.

I highly recommend that every Soldier and leader read U.S. Army Training and Doctrine Command Pamphlet 525-3-1, *The U.S. Army Operating Concept—Win in A Complex World*,[1] "The Army Human Dimension Strategy 2015,"[2] and Field Manual 6-22, *Leader Development*,[3] to understand how the Army will prevent conflict and shape the security environment of the future. These documents give us the foundation required to establish a framework of learning that will allow us to remain more capable than our adversaries as we present the enemy with multiple dilemmas. Understanding these references will give insight into the minds of our leaders and what we must do to truly win in a complex world.

Of course, the Engineer School was excited when the Army announced that Military Occupational Specialty (MOS) 12B—combat engineer—and its seven associated additional skill identifiers were open to female Soldiers. As I write this article, the first female combat engineer is training with her male counterparts in the 1st Engineer Brigade here at Fort Leonard Wood. There are no special provisions, waivers, rules, or policies governing the integration of women into the 12B MOS. We are confident that our leaders in the field will integrate female combat engineers into our formations in a professional and seamless manner. We have led the Army effort in opening MOSs closed to women, and we will successfully complete the transition.

As we move forward, I intend to continue the Regimental Command Sergeant Major's Quarterly Forum via Defense Collaboration Services. Finally, I look forward to visiting our engineer units during my tenure and getting a firsthand look at the great things engineer Soldiers and leaders are doing every day in support of our Army.

Essayons!

Endnotes:

[1]Training and Doctrine Command Pamphlet 525-3-1, *The U.S. Army Operating Concept—Win in a Complex World*, 31 October 2014.

[2]"The Army Human Dimension Strategy 2015," [24 May 2014], <http://usacac.army.mil/sites/default/files/publications/20150524_Human_Dimension_Strategy_vr_Signature_WM_1.pdf>, accessed on 11 August 2015.

[3]Field Manual 6-22, *Leader Development*, 30 June 2015.

Show the Way

Chief Warrant Officer Five John F. Fobish
Regimental Chief Warrant Officer

Greetings to fellow construction and geospatial engineering technician warrant officers. I am honored and humbled to be chosen as your third engineer Regimental Chief Warrant Officer. I assume this office and its responsibilities with great respect and pay homage to those who have previously occupied this seat. It is my sincere intention to provide you with my very best as I execute the role of this office in honesty, transparency, and equity. As your No. 3, I will endeavor to represent you to the best of my ability.

I have joined an exceptional team with U.S. Army Engineer School Commandant Brigadier General James H. Raymer; Regimental Command Sergeant Major Bradley J. Houston; Colonel Kenneth Z. Jennings, deputy assistant commandant, U.S. Army Reserves; and Lieutenant Colonel Bryan M. Carr, deputy assistant commandant, Army National Guard. These leaders are focused on providing the Engineer Regiment with the best leadership, guidance, and direction in efforts to meet the Army's engineering requirements and position the Engineer Regiment to be successful in supporting the Army vision.

We are aware that the Army and the Engineer Regiment are in the throes of downsizing and refocusing their vision as we move into the future. This evolution affects us on every level, including personnel, training, equipment, assignments, and missions. We must evolve in such a manner that places our warrant officers in the right positions at the right time by grade, skill sets, and experience to support the engineer mission. Everyone will need to make adjustments when called upon to do so.

As I wrap my arms around the breadth of responsibilities that accompany this office, I realize that there are many initiatives in progress to support the Army and the Engineer Regiment. As the Army's construction engineers, geospatial engineers, and engineer equipment maintenance experts, our way forward in support of the Army Vision and Warrant Officer Strategy 2025 will be challenging, yet attainable.

Our challenges as cohorts. As the Army is reshaped and refined, it will seek out the best and brightest commissioned officers, warrant officers, and noncommissioned officers in a talent management effort to take the Army into Force 2025 and Beyond. This effort will challenge cohorts to reevaluate current systems, such as accessions, leader development, and professional military education. We must examine our assignments to positions that will prepare us for greater responsibilities and ensure that we remain relevant by incorporating higher-education opportunities, joint assignment opportunities, and credentialing. Cohort leaders are working to ensure that we maintain technical and tactical proficiency by getting the training and education necessary to keep pace with advancing technology and cope with future dynamic operational environments. We must expand our roles to meet Army requirements and support the Army operating concept.

Our challenges as engineer warrant officers. This evolution should challenge us to reevaluate our current values and perspectives as engineer warrant officers so that we become driven to be the best at what we do, technically and tactically. We must set the conditions for success in our respective fields, honing our skills to remain the experts, leading and training subordinates to be flexible and adaptive. In our careers, we must take on assignments that will enhance our expertise while providing an opportunity to function in a multinational, interoperable environment serving the maneuver force. We must ensure that we attend professional military education at the

"We must examine our assignments to positions that will prepare us for greater responsibilities and ensure that we remain relevant by incorporating higher education opportunities, joint assignment opportunities, and credentialing."

appropriate time, attend civilian schooling when possible, and self-educate when necessary to remain relevant so that leaders can depend on us to provide the technical advice they need to reach decisions. We must take advantage of credentialing opportunities since it helps us, the Engineer Regiment, and the Army to have certified experts within our formations. By doing these things, we will continue to be the Army's experts, while becoming leaders who understand how technicians and officers support strategic operations. As the Army and the Engineer Regiment change, we will remain the premier land force technical experts and systems integrators. We will provide a level of certainty to leaders of future joint and combined arms formations as capable, professional, and ethical warrant officers. We must be technologically agile, adaptive, innovative leaders who maintain the Army capability overmatch while reducing logistical demands for Force 2025 and Beyond—Setting the Course.

My challenge as Regimental Chief Warrant Officer. As we evolve, I will maintain the course of engineer warrant officers in support of the Engineer Regiment vision. I will educate the field on our progress as we work toward the Army and Engineer Regiment goals. I will work to review engineer professional military education to ensure that we are getting university level education for all specialties in all three components. Wherever we determine that there are gaps in our existing curriculum, we will make the necessary changes to close them. This will support cohort leader development efforts in education and training to enable warrant officers to function on a level that is commensurate to their grades and consistent with our commissioned officer brethren to ensure the success of the Army and the Engineer Regiment.

I look forward to meeting all of you in the near future and thank you in advance for your support as we move forward in supporting the Army to win in a complex world.

Essayons.

("Clear the Way," continued from page 2)

the U.S. Army Corps of Engineers must exhibit agility to respond to changing circumstances, remain expert in their craft, develop innovative solutions to challenges, maintain interoperability across components and Services, cultivate an expeditionary mind-set, remain scalable in size and capability, and possess an inherent versatility in meeting a variety of mission requirements.

I challenge you to study, reflect upon, and embrace the Army vision and operating concept as we move forward to Force 2025 and beyond. Keep your eye on conflicts around the world, and study the nature of the conflicts and those fighting in them to inform your thinking about future challenges that you may face as an engineer leader and Soldier. I look forward to serving with you as the commandant of the U.S. Army Engineer School.

Essayons!

Endnotes:

[1]Soldier 2020 is an Army-wide initiative to integrate women into previously closed military occupational specialties, <http://www.ausa.org/publications/armymagazine/archive/2013/11/Documents/Cone_Nov2013.pdf>, accessed on 11 August 2015.

[2]"Force 2015 and Beyond—Setting the Course," Army Capabilities Integration Center, <http://www.arcic.army.mil/Directorates/force-2025-beyond.aspx>, accessed on 11 August 2015.

STRONG EUROPE, STRONG ENGINEERS

By Lieutenant Colonel Thomas D. Clark

The following is the first in a series of articles concerning engineering support to the European Reassurance Initiative (ERI). It covers the strategic importance behind ERI and provides an overview for the series.

Long serving as a rich test bed for political, military, economic, scientific, and cultural thought, Europe remains a dynamic continent whose relatively small landmass belies its global impact and influence. Europe's dominance over most of the last half millennium has been underpinned by engineers who continue to play a critical role in taming the wilderness, protecting citizens, and ensuring the expedient movement of armies and goods from one location to another. Indeed, today's military engineer inherits a rich legacy from builders of fortifications, roads, bridges, and other innovators who sought to best competitors and enemies in gaining the advantage as construction methods and technology developed. Although the paradigm of European security continues to shift, engineers remain invaluable to ensuring that this vital continent remains poised to face tomorrow's challenges.

The Marshall Plan and its Soviet answer, the Molotov Plan, proved essential to rebuilding Europe following the devastation of World War II. Both plans sought to rebuild war-devastated regions and economies to ensure that Cold War allies quickly recovered to halt or advance the spread of Communism, depending on which side of the Iron Curtain a nation stood. As both sides of the Cold War readied forces and built arsenals, military commanders eagerly sought the ability to shape terrain and use it to advantage. The ability to ensure freedom of movement, deny key terrain, and harden friendly forces against the firepower of the enemy translated into the engineer tasks of mobility, countermobility, and survivability as both sides sought to maintain adequate engineering support while eliminating such assets from the adversary's formation. At the height of the Cold War, every inch of the front between the North Atlantic Treaty Organization (NATO) and the Warsaw Pact was accounted for in planning, to include the movement of forces to front lines and defense in depth. Nuclear, biological, and chemical warheads posed a real threat; and formations constantly trained to minimize their effects while national governments built hardened facilities to continue operations under such conditions.

Map depicts the NATO footprint divided into Area of Responsibility (AOR) North and AOR South.

"For military engineers in a downsizing Army, training with allies provides a unique opportunity to compare techniques, share insights, build relationships, and assess the terrain and infrastructure of far-flung lands for military operations."

Fortunately, no such war plans were executed and the fall of the Iron Curtain ushered in a new era of security cooperation with former rivals. The dissolution of the Warsaw Pact and international recognition of national borders in Europe resulted in a flourishing peace and an expanded NATO. Former Soviet republics in Central and Eastern Europe joined the alliance to insulate themselves from Russian dominance even as NATO worked with that nation on a number of security fronts as a Partner for Peace. In the face of unprecedented cooperation with Russia since the world wars, NATO priorities for common defense focused on arms reduction, nonproliferation, peace enforcement, and counterterrorism (to include eliminating al Qaida as a threat).

With the death of Osama bin Laden and a newly marginalized al Qaida, European security issues have taken a back seat to economic and social woes. As NATO right-sizes military support to the Islamic Republic of Afghanistan, allied nations are slashing defense budgets following the withdrawal of forces from Central Asia and seeking to gain efficiencies by focusing on niche capabilities and sharing costs with like-minded allies. Even the United States has continued its plan to close bases in Central Europe, although it reaffirms its commitment to NATO by rotating regionally aligned forces to the continent to train with allies.

For military engineers in a downsizing Army, training with allies provides a unique opportunity to compare techniques, share insights, build relationships, and assess the terrain and infrastructure of far-flung lands for military operations. The once-robust chain of command has been whittled to a service component command and a combatant command. These provide subordinate commanders with unprecedented flexibility and enormous responsibilities for maximizing training resources, time, and opportunities to deepen the bonds between units and nations. The relatively small footprint of these engineer units requires reachback, interdependence, and cooperation with allies and coordination with other U.S. Services.

Tactical engineers today serve as critical information gatherers—confirming the ability of host nation infrastructure to withstand the demands of U.S. equipment, supporting freedom of movement through reconnaissance, and identifying requirements that must be addressed to ensure that the alliance can meet tomorrow's security challenges. And Europe still has a number of challenges that require concerted thought and engineer contributions.

To the far south and to the east, religious extremists have created an arc of instability extending from North Africa through the Levant. Europe needs sufficient infrastructure to house and screen the exodus of refugees surging toward its relative security to weed out potential terrorist cells.

Russia's intervention into Ukrainian internal affairs has ignited fears among NATO allies of similar Russian interference in their nations. President Barack H. Obama underlined that the United States takes the mutual defense provision of the alliance seriously, and Congress released approximately one billion U.S. dollars for the ERI to fund the transportation, training, equipment, and infrastructure improvements required for U.S. troops to better train and respond to NATO contingencies.

For military engineers, the ERI goals of assuring allies and deterring Russian aggression pose many challenges to NATO's smaller military budgets and require a comprehensive look at ways to achieve cost efficiencies. Measures such as forward-positioning of materiel; revamping troop construction standards to efficiently build with locally procured, metric-standardized materials; and leveraging host nation or allied engineer capabilities are a few examples as engineers seek effective stewardship of ERI-allocated funds. Other challenges consist of infrastructure assessment with a common-standard, long-term infrastructure sustainability, effective training area management, and contingency planning with allies.

With these, military engineers must take a strategic view toward developing infrastructure, incorporating building standards into host nation plans for the efficient movement of heavy war machinery, ensuring that training areas allow for realistic maneuvers with different weapons systems and formations, and fully understanding the terrain of each nation to allow its effective allied use in times of conflict.

As NATO grapples with the changes to the European security paradigm, engineers will continue to play a critical role in ensuring that the organization is prepared to overcome future challenges. Decreased defense budgets require ingenuity, prudent fiscal stewardship of scarce resources, insightful decisions, and reinvigorated collaboration with allies. A strong Europe is kept strong through engineers.

Lieutenant Colonel Clark is the chief of plans and operations for the Office of the Deputy Chief of Staff Engineer, U.S. Army Europe. He holds a bachelor's degree from the U.S. Military Academy–West Point, New York, and a master's degree from the Catholic University of Portugal. He is a graduate of the U.S. Army Command and General Staff College–Intermediate Level Education.

STRONG EUROPE, STRONG ALLIES

By Major Brian D. Sawser

This is the second in a series of articles concerning engineering support to the European Reassurance Initiative (ERI). It details partnerships with allied nations and how they contributed significantly to the accomplishment of the engineer mission.

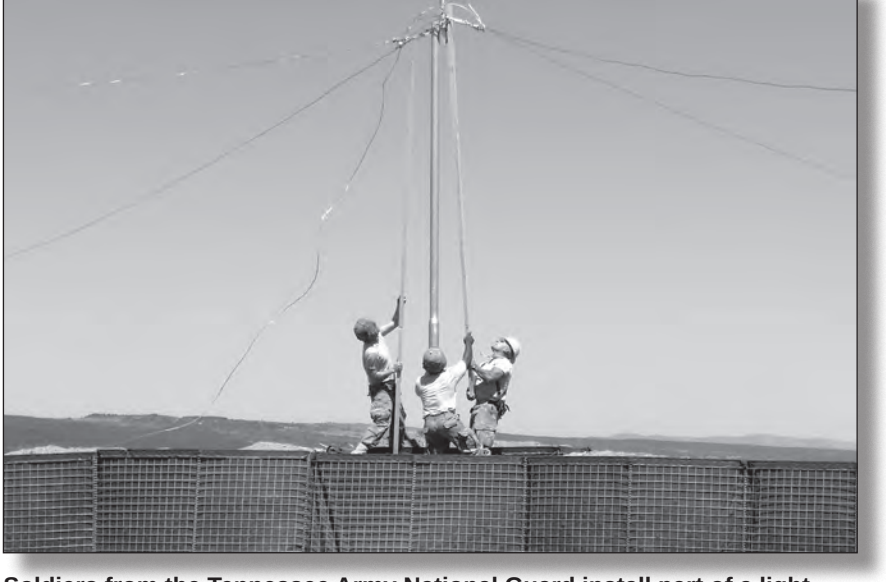
By its nature, military construction (MILCON) is complex and often includes multiple stakeholders who come to the table with divergent interests and requirements. The project engineer must often bring together all parties to achieve a commonly supported end state. Given the multiple fiscal year (FY) execution of MILCON, time usually allows stakeholder interests to be harmonized. Yet, MILCON was not the chosen mode of execution for most ERI construction projects in FY 15. Most of the projects developed and executed by the Office of the Deputy Chief of Staff Engineer (ODCSENG), U.S. Army Europe (USAREUR) were tied to Army operations and maintenance funds. USAREUR received approval and funds to execute those projects late in the construction calendar. Over the following 6 months, ODCSENG surged to define requirements for projects in six of the easternmost members of the North Atlantic Treaty Organization. U.S. stakeholders, including trainers, maintainers, communicators, and warfighters, were clear. Allied stakeholders were less clear. Since the projected training infrastructure improvement projects were planned for sites in allied countries, these host nation stakeholders became most consequential to project success. Becoming stronger with our allies became critical to the success of ERI construction.

Department of the Army civilians from the Joint Multinational Training Center, Soldiers from the Michigan Army National Guard, and members of the Latvian Defense Forces discuss projects at the Adazi Training Area, Latvia.

Building the Team

During FY 14, ODCSENG was reorganized to better support the evolving USAREUR mission set. Broken out as one of three divisions, the facilities and construction (F&C) division initially focused on supporting forward operating sites in Kosovo, Bulgaria, Romania, Turkey, and Israel. Each location presented unique challenges with numerous influential actors. F&C was further subdivided into teams that supported different forward operating sites in different countries. Much attention and effort went to the installation management of existing facilities, while constantly working to "improve the foxhole" at those locations to support distinct mission sets. This model worked well until the arrival of ERI, which included six countries and up to 200 separate construction

projects. F&C leaders decided to divide into Team South—responsible for installation management of existing forward operating sites at the previously identified locations and assuming new ERI responsibilities in Bulgaria and Romania—and Team North, which began building a new portfolio of countries, including Estonia, Latvia, Lithuania, and Poland.



Soldiers from the Tennessee Army National Guard install part of a lightning protection system at the Novo Selo Training Area, Bulgaria.

As with all military organizations, the manning of each team increased and decreased as personnel arrived and departed. The average team consisted of an officer in charge, a chief warrant officer, and two senior noncommissioned officers. Beginning in the 3d quarter FY 15, F&C procured the services of a U.S. Army Reserve officer to help manage the ERI portfolio. F&C experience with installation management in the Balkans, Turkey, and Israel demonstrated the importance of establishing host nation contacts. The normal avenue for these formal interactions ran through USAREUR country desk officers to the U.S. European Command Office of Defense Cooperation. F&C maintained numerous, informal U.S. military and civilian contacts, which kept ODCSENG in the loop with pertinent host nation happenings. By participating in formal host nation interactions such as Defense Cooperation Agreement training and real estate conferences, joint exercises, specially convened meetings with defense ministries, and informal host nation interactions, F&C personnel maintained weekly contact with critical host nation representatives.

With the arrival of ERI requirements in 2d quarter FY 15, F&C harnessed existing relationships with host nation counterparts in Bulgaria and Romania, while quickly working with desk officers and Office of Defense Cooperation representatives to establish new contacts in the Baltics and Poland. In most cases, the plans and operations division within ODCSENG had already established initial contacts during the ERI planning phase. Whether coming from internal USAREUR sources or external U.S. European Command sources, F&C immediately began reaching out to U.S. allies.

Executing the Ground Game

It was evident that executing more than $60 million across six nations in 6–7 months would not be easy. ODCSENG planners designed a list of projects supporting ranges; range support facilities; and reception, staging, onward movement, and integration facilities to enhance training at predetermined host nation training areas. While these initial lists of projects were thoroughly staffed within USAREUR, reviews by host nations and input from other interested U.S. parties such as the U.S. European Command, the U.S. State Department, and other supporting agencies, highlighted the need to conduct robust, on-site visits.

Over time, these visits became known as technical engineer surveys (TESs). These TESs brought together engineers, trainers, Office of Defense Cooperation representatives, and host nation infrastructure representatives. Beginning in February and concluding in May 2015, TESs traveled virtually nonstop to 10 training areas in six ERI countries. In football terms, USAREUR planners provided the playbook, the TESs played the game, and the host nations acted as referees. Where the planners identified the need for expeditionary motor pools with supporting facilities, the TES worked with the host nation to identify usable land within the guidelines of its master planning for that particular training area. Engineers tend to be great at scoping a project, within operational and maintenance constraints, on appropriate land that will facilitate ease of construction. This is clearly something of a science. Yet, the art of bringing these projects from paper designs to tangible facilities on mutually agreeable terrain proved to be far more consequential. Working with allies to find those beneficial locations for construction was not a passive endeavor. Projects came to life on the ground, at host nation firing ranges, with maps on the hoods of vehicles. Nothing can substitute for face-to-face interactions with allies. Since language differences were an obvious challenge, true communication was most fruitful when people were looking at pictures or maps together.

Time spent walking the terrain and negotiating in Ministry of Defense offices set conditions for success, while also building trust. It didn't take long to distinguish the host nation players who could help bring projects to life. In some countries, a well-informed major working in the Ministry of Defense infrastructure wing might be the individual who could shepherd projects through host nation approval. In other countries, we found influential civilians who filled that role. Regardless, assessing host nation personnel early in this process proved beneficial during the later stages of a project.

Each TES concluded with an outbrief, which was attended by ranking host nation officers and civilians at the host nation defense ministry. Naturally, the goal of each TES was to come into these meetings with no surprises and (if possible) complete agreement at the host nation action officer level. Our team presented simple charts, proposed

U.S. Soldiers build a multipurpose range facility in Tapa, Estonia.

locations, and brought up any special requests concerning the project, such as asking the host nation to remove trees at a specific location. At this point in the life of the project, the team was simply asking for concept approval because each of these projects still needed to be vetted and approved through the USAREUR chain of command. We took pains not to promise too much, while stressing the importance of host nation approval of the concept to keep the process moving.

An excellent example of host nation buy-in took place during our team outbriefing in Poland. Senior Polish military leaders questioned several proposed projects throughout the briefing. Yet, instead of the Americans providing the answers, the Polish counterparts who worked most closely with the U.S. team throughout the visit argued on behalf of the proposals. Watching passionate debates take place in Polish was a significant moment. Joint U.S.–Polish interests were championed not by us, but by our hosts. That is success.

Tracking While Interacting

At the conclusion of the TES, we left each country feeling good about our work. In each case, we felt that our interactions with our hosts were productive and decisive. Going into each visit with 20–30 proposed projects, we would often return with roughly the same number of concept-approved projects. Many projects were significantly modified, some were deleted as unnecessary, and others were new additions. Regardless, we returned with actionable projects. Troop construction and contracted construction were our modes of execution. Each required unique paths to final approval in each country. From the perspective of an engineer officer, the TESs were simply fun. Upon our return to USAREUR headquarters, it quickly became apparent that the remaining work would be less fun. Our team had to fight funding, legal, and approval battles to get the projects off the ground. Though these were mostly transparent to our allies (since they were primarily internal U.S. requirements), engagements with our host nation friends were only beginning. The next phase proved more difficult since engagements were generally remote, not face to face.

Weeks of telephone calls, e-mails and, in many cases, return visits followed. Our counterparts frequently inquired about moving the location of some projects (to accommodate future host nation construction plans, for example), broadening the scope of others (to increase the capacity of a wastewater treatment facility from 1,000 to 2,000 personnel, for instance), or adding more bureaucratic requirements (to include letters of intent to accompany accommodation consignment agreements, for example). For most military officers, staff work is true work. This type of staff work was especially challenging, given language barriers and distances. Since there were about 150 projects across six nations, our staff could not commit a project officer to just one country. We needed to remain engaged as a group to work these problems out with our allies.

To do this, we worked hard to develop tracking mechanisms for projects. To track the status of each project (internal and with our allies), personal interactions remained paramount. Trying to communicate solely via e-mail is a recipe for disaster, especially since our partners had varying degrees of English proficiency. The personal relationships nurtured during the in-country TESs proved extremely helpful during this period. Tracking while interacting, though unsophisticated, was our method for handling these bureaucratic hurdles.

A massive amount of planning and scoping designs for execution was successful as we awarded approximately $65 million for more than 150 projects to the end of FY 15. Any resource manager will say that waiting until the last month of the FY for project awards is a bad idea; but due to the late approval of ERI, that was where we found ourselves. Taking these projects from requirement generation to contract award in less than 7 months was a team effort by a handful of military and civilian personnel. While we pause momentarily to celebrate our contracting and troop construction successes at the end of the year, we embark on a new set of challenges as we shepherd these projects through actual construction. Execution of ERI projects to support future U.S. and allied training is an ongoing endeavor.

In spite of the difficulties encountered, the opportunity to work with eager and receptive allies proved to be most rewarding. Nothing builds interoperability with our North Atlantic Treaty Organization allies like working together to solve challenging problems.

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By Captain Christopher R. Elam

This is the third in a series of articles concerning engineering support to the European Reassurance Initiative (ERI). It details the actions of the Office of Deputy Chief of Staff, Engineer (ODCSENG), and its strategies for accomplishing ERI construction.

When Congress passed the 2015 National Defense Authorization Act in December 2014, it contained language that few in the European theater had expected: $1 billion was allocated for ERI. The measure had been announced by President Barack H. Obama in June 2014, but the U.S. military community in Europe expected Congress to balk at supporting the measure. The impact of passage of the act hit the European component commands like a shockwave, especially in the engineering community. It handed the ODCSENG a seemingly impossible task: obligate $68 million on construction projects by the end of September 2015. To make the task more difficult, the money came from Army operations and maintenance funds, which do not allow any single project to exceed $1 million. But the task required something that engineers can most effectively bring to the fight: a combination of technical expertise and energetic grit. The effort took the ODCSENG team across six countries to define, scope, and justify projects and obtain signed contracts in less than 9 months.

Applying a Reliable Technique

The team knew little about where or how to expend the resources it had been handed, except for the requirement to responsibly use taxpayer money on unit training infrastructure in Eastern Europe. Solving the problem would require the contributions of range experts; contracting specialists; civil, environmental, electrical, and mechanical engineers; host nation authorities; U.S. personnel on the ground; logisticians; planners; and staff members experienced in the practical realities that each type of supported unit faces when deployed. A tried and true engineering method—a charrette[1]—was applied in a new way to bring expertise to bear on the problem in the shortest possible time. A rapidly assembled planning charrette, dubbed a technical engineering survey (TES), was held on the site of interest for about a week. Instead of a traditional military construction charrette, which is hosted by a contractor and composed of interviews with each expert, the TES was far more rapid and expeditionary in nature.

The only practical choice for the lead coordinator of the TES was the technical engineering section of ODCSENG. The ODCSENG team was the customer representative charged with the execution of ERI and the only entity able to coordinate the distribution of projects among the following—

- U.S. Army Corps of Engineers (USACE).
- North Atlantic Treaty Organization Support Agency.
- State Partnership Program troop construction.
- Organic troop construction capabilities.

ODCSENG scoped valid requirements, determined which executing agency had the appropriate capability and capacity, and balanced work across the available options. However, ERI would not have been possible without the support of a number of agencies, especially USACE, Europe District.

During the first TES, one challenge was establishing a target storage scheme for facilities at the Novo Selo Range, Bulgaria. Range operations there are conducted with portable, battery-operated targets that need to be stored when not in use. The team developed a plan for small storage facilities on each range for use during unit rotations and a larger storage facility at the forward operating site to be used when no units were training. The team sized the facilities required, scoped each facility, and provided a detailed list of requirements to the executing agents. Troop construction was selected as the method of choice for the smaller on-site facilities, and contracted labor was selected as the executing agent for the larger facility.

Thrashing Our Way to a Solution

The range of projects developed for fiscal year 2015 execution included—

- **Life support—**Adding a wastewater treatment facility to Cincu Training Center in Romania.
- **Range support—**Constructing target storage buildings in Estonia.

- **Ammunition and fuel storage—**Constructing ammunition holding areas in Bulgaria.
- **Range construction—**Constructing a move-and-shoot vehicle range in Poland.

The first task the TES needed to complete on range projects included on-site defining and scoping, which drove all other requirements. The team then developed range support infrastructure. Once the proposed training was defined, requirements for life support, ammunition storage, and fuel storage could be identified and scoped. Once all projects were outlined, the team estimated costs to ensure feasibility. Next, the team assigned each project to one of the available execution agencies. Finally, the projects were presented to the host nation for concept approval. This process took theoretical concepts and turned them into an actionable plan in less than a week.

"To bring all these perspectives together early, the military engineer must be well-versed in the technical requirements for each project and able to articulate projects to nontechnical stakeholders within the staff."

Input by relevant experts and stakeholders is critical to any good plan. The range projects required input from capable range experts from the Seventh Army Joint Multinational Training Command and the USACE range centers of excellence, life support required buy-in from the Assistant Chief of Staff for Logistics, and ammunition storage required coordination with the safety office. In addition, all projects would eventually need to be approved by the Chief of Operations and the host nation, deemed a legal expenditure of funds by the Assistant Judge Advocate General, designed by an architectural engineer firm, and executed by a unit or contractor.

Each stakeholder has a significant impact on the plan and may make significant changes to projects. This "thrashing" must be done as early as possible in the planning process, when change is cheap and little time has been invested. To bring all these perspectives together early, the military engineer must be well-versed in the technical requirements for each project and able to articulate projects to nontechnical stakeholders within the staff. Close follow-on coordination with the architectural engineering firm preparing formal scopes and cost estimates for contract bidding is also essential to ensure that requirements are met and that the product provided to bidders is accurate.

Keeping Options Open

While executing more than 100 projects on a short timeline, a three-headed financial hydra emerged. The first head represents a common challenge facing military engineers: No individual construction project can exceed the current $1 million limit placed on Army operations and maintenance funding. Secondly, roughly the same amount of money must be spent in each country to avoid the appearance of political favoritism. Thirdly, the amount of money spent on each task order

Soldiers from the 194th Engineer Brigade construct pads for a range storage building at the Novo Selo Training Area, Bulgaria.

must closely match estimates since there is very little extra time in the contracting timeline, meaning very little time to adjust the funding for projects if the actual amounts did not match the estimates.

The first part of the solution is the multiple award task order contract. USACE develops a contract that is signed with several qualified bidders in a particular country and then issues task orders on which only those contractors are allowed to bid, considerably shortening the contracting timeline. The second part of the solution is the targeted use of options in the task orders. These options are priced separately by the contractor and form a menu of projects from which the customer can choose. The options are used in two important ways. They provide flexibility in projects where there is a risk of exceeding military construction thresholds. This method places most of the project in the base—or mandatory—part of the contract and leaves part of the project as an option that can be exercised by the team once the bids are received. The second way that options can be used is to provide flexibility to the overall task order by adding several projects entirely as options. This ensures that if the contractor bids come back higher or lower than expected, options can be used to adjust the number of projects executed to align with the amount of funding available.

An officer from the Polish Land Forces (center) discusses ERI projects with representatives from Seventh Army Joint Military Training Command and USACE, Huntsville District.

Using options proved to be critical for the contracting process in the case of a motor pool paving project for the Novo Selo Training Area cantonment area. The cost estimates for placed concrete in Bulgaria were very uncertain, and the project cost estimate was highly variable and near the threshold. By using options, the team was able to scope the project in individually priced pieces. Although the cost of the entire project must be considered against the military construction cap, portions of the project can easily be canceled to ensure that no funding limits are violated.

However, for these solutions to be effective, projects must not be deemed illegal due to faulty assumptions about operational funding limits. Any military engineer who has executed projects with Army operations and maintenance funds has experienced the frustration presented by the "minor military funding threshold," a term that refers to the $1 million cap on projects not approved by Congress in advance. Any construction project that exceeds this threshold must be submitted to Congress as a traditional military construction project request, with an approval timeline of about 5 years. Along with the legal requirement of staying under the limit, there are a host of nuances and questions about whether projects are separable or must be combined, whether a project is a repair or construction (with different limits applying to each), and whether there is significant variation expected in the project proposal prices. The lead office for these types of projects must be intimately familiar with these details since making faulty assumptions about these points during planning can derail the contracting process once it is too late. References such as Army Regulation 420-1, *Army Facilities Management*,[2] and Department of the Army Pamphlet 420-11, *Project Definition and Work Classification,*[3] are useful for navigating this regulatory thicket and ensuring project success.

Results

The process of going from project definition to construction completion is complex, and accomplishing the task requires a tremendous amount of energy from all of the parties involved. Each expert providing input must be concise and accurate or the plan will be based on a foundation of inaccuracy and misinformation. However, the role that the military engineer lead must play cannot be overstated. Without competent, motivated engineers synchronizing the planning and design activities, ensuring that technical requirements are met, ensuring that all stakeholders are involved, and completing all project thrashing early, the process will quickly fall apart. In this case, the combined efforts of those involved accomplished what many thought was not feasible. Endeavors like this are why the Engineer Regiment has earned a reputation as the force that can deliver, even when the task at first seems unreasonable or impracticable.

Endnotes:

[1]A charrette is a meeting in which all stakeholders in a project attempt to resolve conflicts and map solutions.

[2]Army Regulation 420-1, *Army Facilities Management*, 12 February 2008, (Rapid Action Revision 24 August 2012).

[3]Department of the Army 420-11, *Project Definition and Work Classification*, 18 March 2010.

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Terrain Expertise and the New Urban Environment: U.S. Army Engineers and the Modern City

By Colonel Robert G. Dixon

Army engineers have historically claimed the title of terrain experts, with expertise in civil and mechanical engineering matters translating to distinct advantages for commanders. Providing on-the-spot expertise regarding fortifications, lines of communication, obstacle integration and reduction, and the effects that terrain in various atmospheric conditions have on operations made engineers an invaluable asset for maneuver commanders. The changing nature of the operational environment, however, challenges the ability of the Corps of Engineers to provide this expertise. Global urbanization practically guarantees that U.S. land forces will be conducting operations in large, urban areas—an environment where the Army in general and the Corps of Engineers specifically are largely unprepared to operate. Further, the lack of training, doctrine, and equipment for urban operations in huge, modern cities will certainly leave engineer leaders on the ground with little hope of providing maneuver commanders with the expertise or engineering advantages they have come to expect.

Current Army doctrine for urban operations spells out many of the expectations for engineers. Some are highly technical, such as—

- Analyzing buildings and other infrastructure for structural integrity.
- Evaluating, assessing, and restoring utilities.
- Advising civilian construction about civil survivability shelter.
- Providing specialized breaching and reconnaissance capability.

U.S. Army National Guard photo by Captain William Carraway

Combat engineers from the 810th Engineer Company, Georgia Army National Guard, inspect a simulated collapsed building site.

- Understanding and assessing the construction capabilities of nongovernmental organizations and other unified action partners.

Other expectations are more practical, such as—

- Clearing obstacles.
- Providing mobility support for mounted and dismounted maneuver.
- Reinforcing existing infrastructure, such as bridges or rooftops, that may be required by the maneuver force.
- Providing countermobility, survivability, and general engineering support to friendly and civilian populations.
- Supporting civilian evacuation planning and execution.
- Constructing lines of communication.
- Maintaining or restoring infrastructure such as roads and highways, over-the-shore facilities, ports, railroads, airports and heliports, fixed bridges, electric power facilities, petroleum pipelines and storage facilities, and water facilities.
- Serving as the primary interface with indigenous engineers, public works employees, fire departments, and city managers.

The wide variety of expectations outlined in Army urban doctrine suggests that the development of Army engineer leaders requires at least some knowledge of how modern cities operate. A robust understanding of modern sanitation, power, communications, subterranean navigation, the science of buildings, and vertical logistics is essential. This kind of expertise takes time and focus to develop. Yet engineer doctrine and development are not currently focused on the environment; instead they are focused almost exclusively on the activities of friendly forces, such as the construction of base camps and roads for construction units, counter improvised explosive device operations, and mobility support. Aside from forward engineer support teams–main, which have fewer than 40 Soldiers and civilians, and forward engineer support teams–advance, with fewer than 10 personnel, there are few engineers developing expertise in modern city science with the intent of developing terrain expertise.

The challenges and opportunities of the modern city require intense study. Exploiting the engineering and scientific aspects of modern cities can improve the effects that combat engineers can provide for maneuver commanders. For example, tactical, cyber-enabled engineers can control airflow in skyscrapers or change traffic patterns for surface or subsurface transportation. Engineers with knowledge of modern port and rail systems can enable or improve the flow of forces and sustainment without the lag time often seen when awaiting indigenous worker capabilities. An engineer with knowledge of the natural gas or steam networks of a city can help a maneuver commander avoid costly damage to these systems, which will be critical in postconflict operations. Engineers helping a staff understand zoning and street patterns in urban areas will help commanders and staff gain insights into the cultural and social fabric that exists in the city. Engineers with a robust understanding of modern building science can help commanders identify weaknesses in target buildings, advise aviators on urban aerodynamics and building sway, and help identify the resistance of modern antiearthquake and blast protection materials to weapons. Current doctrine, for example, suggests that engineers can create "mouse hole" breaches in building walls or ceilings to enable dismounted mobility—horizontally between rooms or buildings or vertically between floors. In many modern cities, however, construction materials resist the explosive and cutting tools normally used (much to the frustration of urban search-and-rescue units).

Educating Army engineers in these areas won't happen overnight. Urban engineering is a specialty that requires significant investment, and there are already robust learning requirements levied on Army engineers. The Army relies on four basic arenas for developing leaders: professional military education; civilian education; individual development; and experiential learning on the job, which includes broadening assignments.

Photo by Sergeant Terence Ewings

Engineers from the 178th Engineer Company apply wooden bracing and linked chains to a pillar supporting a collapsed parking garage during a field training exercise.

Photo by Staff Sergeant Steven C. Eaton

Soldiers dump snow cleared from a narrow Massachusetts road.

The strategy for educating engineer leaders on modern urban environments necessarily starts at the U.S. Army Engineer School and with civilian education. The Corps of Engineers has taken a great step forward by increasing requirements for science, technology, engineering, and mathematics (STEM) education for many key leadership positions. This educational background will help set the foundation for advanced learning on the urban environment. However, professional military education concentrates very little on the modern urban environment, instead focusing much of the training and education for junior leaders on traditional engineer roles in offense, defense, and stability operations. With limited time and resources, it is unlikely that the Engineer School can provide more than basic knowledge in these areas. Additional learning requirements for the modern urban environment means that something in the current curriculum must be removed. While reviewing and eliminating outdated or unnecessary portions of the professional military education curriculum is always beneficial, it is doubtful that anything close to urban expertise can be developed in the classroom, regardless of how much time is dedicated to it.

Individual development and broadening assignments have the most potential for expanding engineer leader expertise in the modern urban environment. Individuals can enroll in online education (often free of cost) that will help them understand the challenges of modern urban operations. For example, the Massachusetts Institute of Technology offers free online graduate and undergraduate courses on topics such as disaster relief in megacities, food security, freshwater distribution, and the differences between First World and Third World cities. Other schools and the relevant topics available include The Ohio State University, which offers classes in exploiting networks, sensors, and mobile technologies; and Harvard University, which offers studies in urban water supplies, future cities, the next generation of infrastructure, metrics for "smart" cities, and social physics, among others. Engineer leaders should invest the time to learn about changes in the environment and require those they mentor to do so as well. This is something that can be implemented immediately at no cost to the Army.

Finally, the Corps of Engineers should assign leaders to positions in which they can learn about the modern urban environment through personal experience. Engineers assigned to work in public works or emergency response offices in major cities in the United States and abroad would garner a level of knowledge equivalent to a Training With Industry assignment that no current assignment provides. Working alongside emergency response professionals and city planners and engineers would expose Army engineer leaders to the systems that keep modern cities operating and the challenges of keeping those systems operational. Engineers serving in overseas cities would develop relationships that would be beneficial if the Army were called to conduct operations there. If coordinated with the Army's regionally aligned forces, engineers with city-specific knowledge and relationships could be an invaluable asset to maneuver commanders operating in and around those cities.

The Corps of Engineers has provided terrain experts to the Army since its inception. During that time, the terrain and infrastructure faced by the Army have changed and the Corps of Engineers has changed with them. But the world is becoming increasingly urban, and the urban environment is becoming increasingly sophisticated. If the Corps of Engineers is to retain the title of terrain expert, we must update our doctrine and equipment for urban operations and invest in the development of engineer leaders who have expertise in the modern urban environment.

For more information on the Army and large urban areas, see *Megacities and the United States Army: Preparing for a Complex and Uncertain Future* at <http://usarmy.vo.llnwd.net/e2/c /downloads/351235.pdf>.

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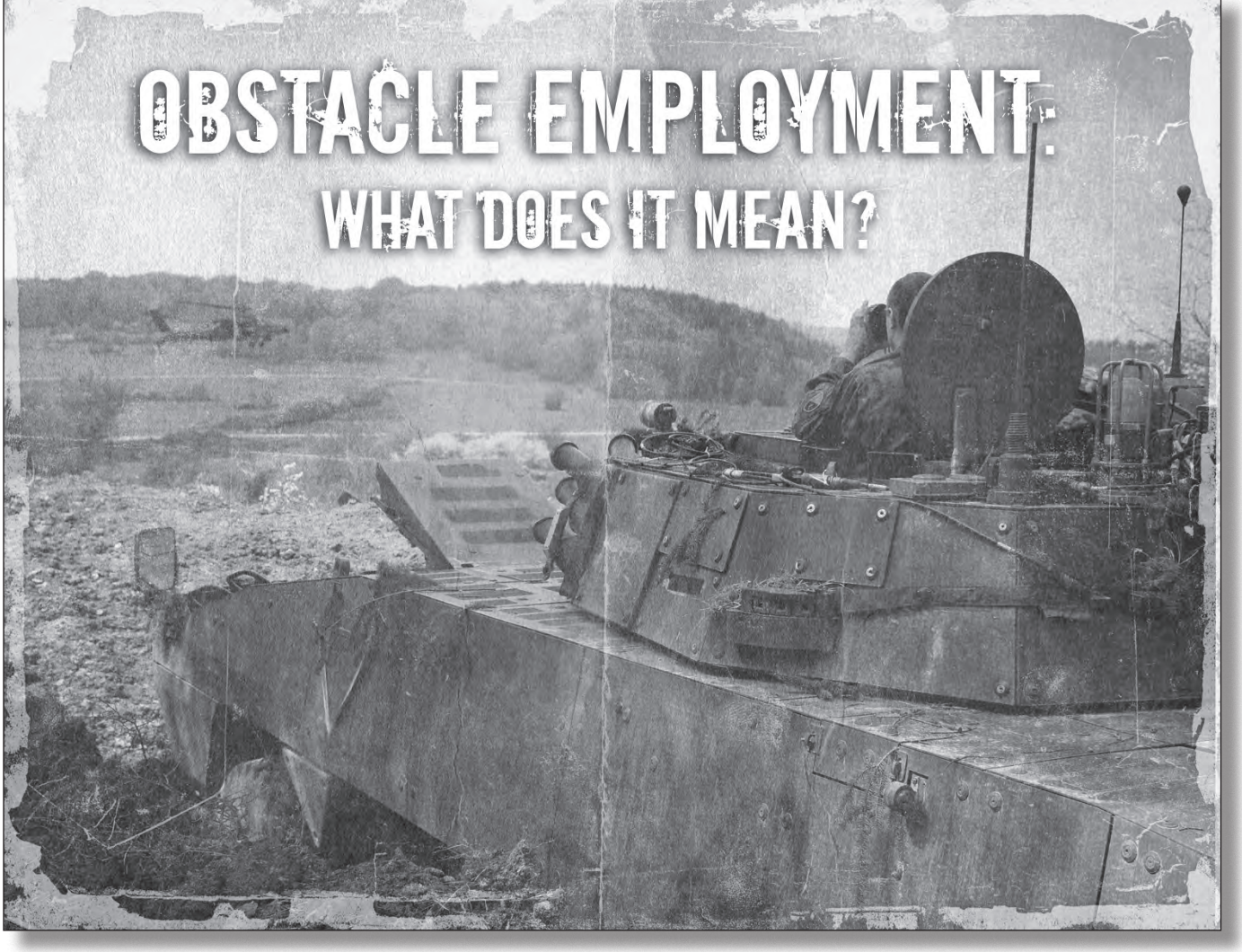
OBSTACLE EMPLOYMENT: WHAT DOES IT MEAN?



By Major John L. Miller

North Atlantic Treaty Organization (NATO) Allied Joint Publication 3.12, *Allied Joint Doctrine for Military Engineering*, defines military engineering as those activities that physically shape the operating environment.[1] Over the past 11 years, U.S. military commanders have lost significant capability to shape terrain using the full range of persistent antivehicle and antipersonnel land mine systems without a reciprocal increase in a persistent land mine-alternative capability (except in the Korean Peninsula). Remote antiarmor mines and select Volcano munitions make up the remaining land mine terrain-shaping capability following U.S. policy changes. Between February 2004 and September 2014, the only significant addition to the terrain-shaping capability of commanders was the XM-7 Spider network command munition. The remaining U.S. Army terrain-shaping capabilities are similar to methods and obstacles meant to deny movement or maneuver to the enemy—such as ditches, earthworks, and abatis—used by armies for more than 2,000 years. The only difference is the terrain-shaping technology used to deny the enemy access to, or use of, advantageous terrain.

Engineers must understand the methods, theory, and employment of obstacles in shaping terrain to meet the intent of commanders. A knowledge of U.S. Army obstacle doctrine is no longer sufficient to effectively shape terrain against a near-peer threat. Effective obstacle application demands that engineers apply the five obstacle employment principles; possess a military sense of terrain; understand obstacle methods, capabilities, and effects; exercise adaptive, experience-based obstacle design; and use available, commercial, off-the-shelf, terrain-shaping technologies.

The five obstacle employment principles are—[2]

- Support the maneuver commander's plan.
- Integrate with observation and fires.
- Integrate with other obstacles.
- Employ in depth.
- Employ for surprise.

This article focuses on these five principles and the ways a successful engineer planner can use obstacle employment planning to mitigate the loss of obstacle capabilities.

Combined arms obstacle integration operations commonly involve the defense, but obstacles are used throughout the spectrum of unified land operations. For example, commanders might use situational obstacles during an attack to protect a flank from an enemy spoiling attack or strike force in a mobile defense. Planning obstacle employment is generally left to engineers. They are introduced to

the steps of engagement area development as a guide to planning obstacles, but these steps are primarily designed for the maneuver commander and staff as a planning checklist during the defense. The seven steps of engagement area development are—[3]

- **Step 1.** Identify likely enemy avenues of approach.
- **Step 2.** Identify the enemy scheme of maneuver.
- **Step 3.** Determine where to kill the enemy.
- **Step 4.** Plan and integrate obstacles.
- **Step 5.** Emplace weapons systems.
- **Step 6.** Plan and integrate indirect fires.
- **Step 7.** Conduct an engagement area rehearsal.

During offensive operations, these steps do not always apply. The five obstacle employment principles provide guidance on obstacle planning for any operation type and complement Step 4, plan and integrate obstacles.

Support the Maneuver Commander's Plan

Supporting the maneuver commander's plan is arguably the most important of the five obstacle employment principles. Considering the maneuver commander's intent and operational concept during planning ensures that obstacles increase the probability of hits by direct and indirect fire systems and negatively affect the ability of the enemy to gain access to favorable terrain. The engineer planner must understand where the maneuver commander wants to mass effects on the enemy force and then plan terrain-shaping operations to influence the enemy force to that point. Engineers are susceptible to a few common pitfalls with this principle because they tend to—

- Overthink the maneuver commander's intent.
- Do not completely understand the commander's intent and/or operational concept.
- Develop unsupportable obstacle plans.
- Do not fully understand enemy mobility and counter obstacle capabilities or how the enemy maneuvers through the existing terrain.

Overthinking the commander's intent and operational concept during obstacle planning usually leads to an obstacle plan that does not support the commander's intent, is overly complicated, and commits more engineer effort than is required. Engineer planners participating in rotations at the Joint Multinational Readiness Center (JMRC), Hohenfels, Germany, tend to develop obstacle plans to independently block enemy maneuver instead of developing plans that conform to the friendly maneuver plan.

In a recent rotation at JMRC, one maneuver commander's intent was to delay the opposing force (OPFOR) along two mobility corridors, attrit the enemy, and trade space for time to develop a substantive engagement area. The brigade engineer planned block obstacle groups in the mobility corridors instead of the fix effect the commander desired. Ultimately, the block obstacle groups were not emplaced, but significant time and resources that could have been used elsewhere were expended in preparation.

The three remaining pitfalls are usually attributed to the engineer planner's lack of knowledge, education, and experience. Engineers should not be embarrassed to ask questions during the planning process to clarify misunderstandings of the operational concept. Engineer planners are expected to perform as the master craftsmen of all things related to countermobility. Inability or incompetence in the development of a supportable obstacle plan is inexcusable. Obstacle plans must consider all materiel, personnel, equipment, and time resources required and available to meet the operational concept. If a resource gap exists in the obstacle plan, then the plan is not supportable and must be modified until the resource gap is diminished. Unfamiliarity with enemy mobility and counter obstacle capabilities is normally rectified by close coordination with the intelligence section.

Through a lack of knowledge and experience, engineer planners habitually fail to develop obstacle plans that meet the maneuver commander's intent. At JMRC, this is usually highlighted in a mobility corridor referred to as the 15T. Engineer planners constantly develop obstacle groups in the 15T open space and do not tie the obstacle groups into the surrounding terrain. Normally, maneuver commanders want to canalize the OPFOR into the center of the 15T to mass effects on them. However, placing obstacles in the center of the 15T does not affect the OPFOR maneuver tactics, techniques, and procedures of using the terrain to the north and south of the open area. Instead, the OPFOR just diffuses around the obstacle groups with little or no effect on their maneuver. Engineer planners must understand how the enemy uses the existing terrain and then how to shape the existing terrain to change the enemy maneuver.

Integrate With Observation and Fires

The principles of integrating obstacles with observation, fires, and other obstacles are accomplished in concept and action. Conceptually, the engineer planner integrates obstacles in the planning and preparation phases and then the responsibility shifts to the emplacing engineer leader to actively integrate the obstacles on the ground with the covering unit. NATO Standardization Agreement 2036, *Land Mine Laying, Marking, Recording and Reporting Procedures*, states that obstacles cannot achieve the desired obstacle effect unless they are used in combination with observed fires.[4] Only then can the obstacle achieve its desired effect on the enemy. Unless obstacles and fires are properly integrated, the OPFOR can quickly negate any obstacle effect given enough time and adequate resources. Failure to integrate observation and fires with obstacles gives the OPFOR time and reduces the resources they need to breach or bypass an obstacle.

Engineer planners integrate obstacles with observation and fires through coordination with the maneuver, intelligence, and fires functional staff chiefs. Integrating observation and obstacles during planning is achieved by assigning unit responsibility and allocating assets. The maneuver

U.S. and Bulgarian soldiers prepare a road-cratering demolition.

and fires functional chiefs assign obstacle responsibilities to subordinate units and advise on observation system capabilities. The intelligence functional chief assists in synchronizing intelligence, surveillance, and reconnaissance (ISR) assets through the ISR collection manager, providing the observation of obstacles that are not directly overwatched by ground forces. Items to be considered when integrating obstacle observation include—

- Assignment of an owning unit to overwatch.
- Use of ground reconnaissance assets.
- Use of forward observers and joint terminal attack controllers.
- Capabilities of optical systems, limitations on range, and limited visibility operations.
- Use of rotary wing aircraft.
- Use of unmanned aerial surveillance assets.

Direct- and indirect-fire effects are amplified when properly integrated with obstacles. The engineer planner coordinates directly with the maneuver and fires functional chiefs to ensure that all obstacles are effectively integrated with fires. Considerations when integrating obstacles with fires include—

- Assignment of engagement responsibilities and criteria.
- Weapons system and effects desired.
- Use of direct versus indirect fires.
- Use of echelon fires using maximum-range weapons at maximum-range obstacles.
- Integration at seams, transitions, and endpoints.
- Orientation of obstacles to achieve the desired direct-fire engagement method (enfilade, oblique, flanking, or frontal).
- Determination of priority targets and target protection/hardness.

At the JMRC, rotation unit obstacle plans seldom effectively integrate observations and fires, resulting in the OPFOR easily maneuvering around or through planned engagement areas with minimal negative effects. However, the OPFOR regularly integrates effective observed fires on existing and reinforcing obstacles with devastating effects on rotation unit maneuver. There are many reasons for the failure to integrate obstacles with fires, but the primary reason is that obstacle plans are developed in isolation from the rest of the maneuver plan. Engineer planners must develop effective working relationships with the maneuver, fires, and intelligence planners and must attain a working knowledge of maneuver, fires, and intelligence to better facilitate integration.

Integrate With Other Obstacles

While integrating observation and fires, the engineer planner should integrate obstacles with other reinforcing obstacles. The engineer planner makes every effort to maximize the use of existing obstacles and complement them with the minimum required reinforcing obstacles to achieve the desired obstacle intent. NATO Allied Tactical Publication 3.2.1, *Allied Land Tactics,*[5] points out that the engineer effort required to meet the commander's intent is rarely adequate, requiring engineer planners to maximize the use of existing obstacles. Reinforcing obstacles are planned to minimize the transition or gap between existing obstacles or to link existing obstacles together. This strengthens an obstacle group and increases the probability that the enemy will follow the planned script. Engineer planners ensure that the combined effect of integrated obstacles does not deviate from the desired obstacle group

intent. Common pitfalls observed at the JMRC when planning obstacle integration with other obstacles are—

- Obstacles are not completely tied in; there are weak seams and transitions.
- Obstacle design strength is too little or too great; the desired intent/effect is diminished.
- Obstacles interfere with other obstacles.
- Obstacles are not emplaced to take advantage of existing terrain, or they are too dependent on existing terrain countermobility properties.

Employ in Depth

Obstacle control measures give commanders obstacle emplacement authority for a geographic area. Brigade and lower obstacle control measures are normally associated with obstacle intent to achieve a desired effect on the enemy throughout the depth of a specified geographic area. Engineer planners cannot ignore the concept of depth during obstacle planning. Obstacles employed in depth force the enemy to consume reduction assets early and often and eventually force the enemy to avoid the remaining obstacles, thereby achieving the obstacle intent. ATP 3-90.8, *Combined Arms Countermobility Operations*, lists the following benefits of employing obstacles in depth:[6]

- Disrupts the timing and tempo of an attack.
- Stresses enemy mission command.
- Depletes obstacle reduction assets.
- Increases exposure to fires.
- Degrades the will to fight.

Ultimately, obstacles employed in depth prevent the enemy from declaring a single breach operation as the decisive point of the battle and massing effects at that location to achieve success. There are many reasons why obstacles are not employed in depth. The most common reasons at JMRC are—

- Absence of plans to fight through the depth of the operating area.
- Failure to plan obstacles in depth.
- Obstacle resourcing not planned or not properly executed.
- Obstacle plans not completed early, resulting in incomplete obstacle execution.
- Obstacle plans not synchronized with the rest of the maneuver plan.

These trends are primarily observed during the planning and preparation phases of combined arms obstacle integration. Although engineer planners are not responsible for developing the maneuver concept of operation and ensuring that the plan maximizes the depth of the operating area, engineers can influence the plan by identifying the requirements gap in the current plan with the commander's intent. For example, the commander's intent is to delay the enemy advance along an avenue of approach for a set period of time. But in the plan developed by the staff, only one engagement area has a template, with a corresponding disrupt obstacle group located along a segment of that avenue of approach. Engineer planners should articulate to the commander and staff that adversely affecting the mobility of an enemy force along that avenue of approach in the most effective manner requires obstacles employed in depth. Most engineer planners recently observed on JMRC staff are precommand captains who have not established their credibility as the technical and tactical masters of their craft. The ability of these captains to influence the maneuver plan is limited, but the engineer planner is obligated to address any identified military engineering gaps with the commander and staff.

Conversely, the maneuver plan may take advantage of the entire depth of the operating area to affect the enemy force, yet the engineer may not plan the corresponding obstacles to support the operation. Failure to plan obstacles occurs for various reasons, but usually originates from improper employment of the staff engineer or from a dearth of obstacle planning knowledge and experience. During one JMRC rotation, the maneuver commander's intent was to block enemy forces along an avenue of approach and disrupt enemy forces along another avenue of approach. Corresponding obstacle belts were assigned to the task forces, but staff engineers did not establish planned obstacles at either the brigade or task force level, resulting in obstacles being developed between engineer and maneuver platoon leaders. The depth of the obstacles employed in that rotation was generally 500 meters to either side of a designated phase line, through which the OPFOR quickly passed. Staff engineers must take the time to plan obstacle groups and directed obstacles that support the commander's plan and are placed in depth throughout the operational area. Senior engineer leaders in the brigade combat team must take the time to coach and mentor staff engineers on obstacle planning and review the plan before execution.

A great plan that precisely supports the maneuver commander's plan, is integrated with fires and existing obstacles, and covers the depth of the operating area will be ineffective unless it is resourced and synchronized. Ensuring that the barrier materials and explosives required for obstacle construction are available and delivered to centralized locations is critical to obstacle employment. Unit standard operating procedures outlining obstacle designs allow for the development of combat-configured loads of these materials. Combat-configured loads streamline the process of forecasting and delivering resources supporting an obstacle plan. The observation of recent trends at the JMRC indicate that units do not understand and use the combat-configured load concept for resourcing obstacles. These units habitually fail to emplace obstacles in depth because the required materials are not readily available to the emplacing unit. Additionally, units do not take the time during the course of action analysis or combined arms and sustainment rehearsals to synchronize the delivery of obstacle materials with the emplacing units. This also leads to the failure of units to employ obstacles in depth.

Employ for Surprise

Tactical surprise on the battlefield is difficult to achieve with the increase in ISR technologies and even harder to achieve when proven capabilities are no longer available. Obstacle plans designed to surprise the enemy give the maneuver commander flexibility regarding how, when, and where effects are brought to bear on the enemy. Scatterable mine capabilities can easily create countermobility effects triggered by the commander's decision points, but other obstacle methods may be used to create an uncertain mobility picture for the enemy. Current countermobility capabilities require engineer planners to apply imagination and ingenuity to achieve surprise with the obstacle plan. Considerations for employing obstacles for the element of surprise include—

- Obstacle intent.
- Triggers.
- Emplacement speed.
- Duration.
- Detectability.
- Predictability.

Obstacle intent is part of the obstacle planning process; however, the components of target, effect, and relative location can be used to create uncertainty with the enemy. Each obstacle should be emplaced with the intent to affect a specific element of the enemy force. For instance, the enemy force may organize into reconnaissance, advanced guard, and main body formations, with the intent to affect the main body. The reconnaissance and advanced guard formations may pass through a planned obstacle area, which is then triggered to affect the main body of the enemy. The main body may not expect to encounter an obstacle in that area if recent reports indicated that the area was free of obstacles. Additionally, the obstacle can generate surprise and uncertainty with the enemy formation if the obstacle effect is outside of the doctrinal application. This may cause enemy commanders to assess the perceived situation and change their course of action, thus disrupting operations. Finally, surprise may be generated if the obstacle is emplaced in an area that is not commonly restricted or in terrain that is capable of masking the obstacle, such as a wooded reverse slope.

Carefully planned obstacles that make use of triggers, maximum emplacement speed, and variable duration create a dynamic situation for the enemy. The use of triggers with scatterable mines and demolition obstacles allows the commander to affect a specific formation and requires fewer resources than simply emplacing obstacles along all possible avenues of approach. Individual obstacles and multiple obstacle groups may be planned, but may not be emplaced until a specific condition is met, thus increasing the uncertainty of the enemy force. Maximizing the emplacement speed of obstacles minimizes the enemy reaction time once the obstacle is emplaced. Once emplaced, varying the obstacle duration forces the enemy to actively respond to the emplaced obstacle. During one recent JMRC rotation, a brigade combat team employed a short-duration, remote, antiarmor minefield that effectively blocked the primary avenue of approach to the OPFOR objective. The obstacle was identified during emplacement; and because the OPFOR commander understood that it was unlikely that anything other than a short-duration mine would be emplaced, he adjusted his execution time by 4 hours. Once the minefield began to self-destruct, the OPFOR commander rapidly pushed a mechanized company team through the area without effect. If obstacle duration times had been varied, the OPFOR commander would have sent the company through a mined area or been forced to adjust his plan.

Conclusion

Conducting countermobility operations in a complex world against a near-peer adversary requires the engineer planner to fully understand and use all planning tools at his disposal. Recent JMRC rotations demonstrate that many units do not understand, and are not ready to successfully execute, combined arms obstacle integration operations against a near-peer threat. This trend is worrisome, considering the increase in hostilities in Eastern Europe from a near-peer adversary with a tremendous ability to rapidly maneuver and occupy advantageous terrain. The five obstacle employment principles provide engineer planners with a framework to develop unique solutions to deny the enemy the ability to maneuver or occupy advantageous terrain with the limited countermobility capability currently available to the force. To reverse the trend, engineer leaders must educate themselves on these principles and use them during the planning processes for all operations—not just for defensive operations.

Endnotes:

[1]NATO Allied Joint Publication 3.12, *Allied Joint Doctrine for Military Engineering,* 20 June 2014.

[2]Army Techniques Publication 3-90.8*, Combined Arms Countermobility Operations,* 17 September 2014.

[3]Field Manual 3-21.8, *The Infantry Rifle Platoon and Squad,* 28 March 2007.

[4]NATO Standardization Agreement 2036, *Land Mine Laying, Marking, Recording and Reporting Procedures*, 27 January 2007.

[5]Allied Tactical Publication 3.2.1, *Allied Land Tactics*, 9 November 2009.

[6]Army Techniques Publication 3-90.8.

Major Miller is the brigade engineer observer-coach trainer at the JMRC. He was formerly an observer-controller at the National Training Center, Fort Irwin, California. He holds a bachelor's degree in mechanical engineering from the University of Missouri–Rolla (now Missouri University of Science and Technology), and master's degrees in energetic concepts from the University of Maryland–College Park and national security and strategic studies from the Naval War College.

BEFORE YOU DIG THAT WELL . . .

An Interview With the Special Inspector General for Afghanistan Reconstruction

By Major David E. Leiva

The hospital could have been any one of the many built in Afghanistan with American funds. This one, in Parwan Province, was erected through the Commander's Emergency Response Program—a funding source for unit commanders to respond quickly to immediate humanitarian relief and reconstruction projects. Like many of the hospitals inspected by a select group of American auditors, reality was far different from the initial plans.

According to the auditors' report, the hospital had a leaking roof and a vertical expansion joint that was not reinforced, was overgrown with mold, and had no running water or electricity. Newborn babies were washed with untreated river water, and doctors and nurses used their own money to pay neighbors for electricity to operate three light bulbs for emergency care at night. The American engineers conducting the inspection said that, because of the cracked, unreinforced brick walls between concrete columns, the hospital was highly susceptible to earthquakes.

"I really find that this is an example of where we probably have done more harm than if we just hadn't even tried to build a hospital," said Mr. John Sopko, head of the U.S. oversight for reconstruction projects in Afghanistan, in an interview last year.[1]

"When the villagers are told the U.S. government is coming and we are going to provide you medical care and, at the end of the day, we build a hospital that cannot provide almost any of the basic services that we said they would provide and we build them a building that isn't safe to occupy, I think that sends a very poor message," he said.[2]

Unlike his predecessors, Mr. Sopko is one of the most engaged and vocal figures in the Afghanistan rebuilding effort because he has been the Special Inspector General for Afghanistan Reconstruction (SIGAR) since 2012. Some see his role as a safeguard for the American taxpayer. To others, he is an unabashed critic.

. . . As the United States draws down in Afghanistan, there is merit to using hindsight to gain perspective. This article looks at reconstruction through a different lens to see if future rebuilding efforts should be viewed in a new light . . .

In January 2015, the U.S. Army classified Afghanistan training expense reports, which had previously been releasable to the public for years and used by Mr. Sopko to explore the problems of efficiencies. Less than a week later, the move was reversed after the SIGAR's office went on a media blitz. Mr. Sopko's main criticism, however, is usually levied against the U.S. Agency for International Development and the U.S. State Department, which spend billions of dollars on reconstruction.

Still, not everyone is a fan of this watchdog. Ms. Ellen Laipson, president and chief executive of the Henry L. Stimson Center (a Washington, D.C., think tank) says that Mr. Sopko's authority is "overstretched." Although the nonpartisan Stimson Center hosted the SIGAR at an event in recent years, Ms. Laipson believes that Mr. Sopko has entered into the realm of creating policy.

"The SIGAR went a little further than the original mandate," she said. "He has a narrowed mandate, and it's overstretched." She said that it is unrealistic to expect contracting in developing nations to go as smoothly as in Western nations or for money not to be wasted in the process.[3]

An American civil engineer meets with an Afghan engineer at a building site to make sure that construction is progressing according to the International Building Code and the plans and specifications for the site.

Understanding Civil-Military Operations

What the SIGAR finds at odds with the way military units handle construction projects becomes a matter of sorting between military doctrine and Mr. Sopko's plainspoken ideas. As the United States draws down in Afghanistan, there is merit to using hindsight to gain perspective. This article looks at reconstruction through a different lens to see if future rebuilding efforts should be viewed in a new light.

Military doctrine states that civil-military operations (CMO) are a joint operational construct that involves interagency coordination, multinational partnerships, and coordination with nongovernmental organizations and other entities to formulate, manage, and integrate strategic, operational, and tactical plans and operations.[4]

CMO activities typically occur in the following five phases:

- ***Phase 0–Shape.*** CMO activities can shape the environment during this planning phase, which includes meetings among stakeholders to work out problems that may be brewing and work on economic agreements to stabilize the region.
- ***Phase I–Deter.*** During this phase, CMO can advance activities developed during the shaping phase.
- ***Phase II–Seize the Initiative.*** During this phase, CMO are designed to minimize friction with local civilians and support the political-military objectives that would grant freedom of maneuver and access to needed infrastructure.
- ***Phase III–Dominate.*** CMO that limit collateral damage can minimize civilian backlash and may reduce the duration and fervor of combat operations.
- ***Phase IV–Stabilize.*** As combat operations transition to stability operations, a failed or perceived failed government will require local governance and the support of multinational, intergovernmental, and nongovernmental organizations until local authority is restored. These activities may include facilitation of humanitarian relief, maintenance of civil order, and restoration of public services.
- ***Phase V–Enable Civil Authority.*** The final phase fosters the legitimacy of local authority by coordinating the multiple stakeholders, establishing and assessing measures of effectiveness and performance, and swaying local public opinion favorably toward U.S. and host nation objectives.[5]

While the distinctions between measures of effectiveness and measures of performance (often referred to as the effects achieved and the tasks accomplished, respectively) are definitive, they can be the source of complication because they are used interchangeably and collectively to evaluate tendencies, which could impact future operations. Because many of the CMO programs involve construction and economic development projects, it is in Phase V that Mr. Sopko departs from the guiding doctrine for these activities. Instead, he opts for a simpler way to decide whether to begin construction.

Lessons Learned

In February 2013, Mr. Sopko told the Center for Strategic and International Studies (a prominent Washington, D.C.-based think tank) that seven pointed questions should be asked before starting a project to determine if the project would contribute to U.S. national interests, was desired by the local population, and included oversight to allow effective implementation and deter corruption. He cautioned that many organizations involved in Afghanistan reconstruction were not being good stewards but were poised

to obligate as much money as possible before the troop drawdown took place.

"If that happens without our first answering these questions in the affirmative, we are likely to waste billions," he said. In the case of the hospital described earlier, SIGAR recommendations included seeking reimbursement from the Afghanistan government for $507,000 in overpayments, strengthening U.S. government accounting controls to prevent future overpayments, and conducting a detailed financial audit of costs to determine whether there had been other contractor overpayments.

The following examples illustrate points to consider when answering the seven questions mentioned above:

1. Does the project or program make a clear and identifiable contribution to U.S. national interests or strategic objectives?

The SIGAR released a report on the Local Governance and Community Development Program, a noteworthy U.S. Agency for International Development plan to stabilize the political, economic, and social environments in Afghanistan. The report found that program activities increased exponentially in eight provinces between 2006 and 2010. In some cases, projects were behind schedule and were not likely to achieve positive counterinsurgency effects. And like the case of the Parwan Province hospital, adverse effects occurred because of the gap between expectations and accomplishments.

2. Does the local population want and need the project?

In Kunduz Province, a $7.3 million border police facility was expected to house 175 people, but only 12 Afghans worked in it. While on-site, the inspectors could not access much of the building because the police did not have keys to access the entire building.

3. Has it been coordinated with other U.S. implementing agencies, with the Afghan government, and with other international donors?

In 2011, the SIGAR assessed U.S. efforts to strengthen and safeguard the financial sector in Afghanistan. In separate programs, the Department of Defense and the Department of Homeland Security worked with the same commercial banks to strengthen controls over funds held in those banks. The two agencies did not realize they were working independently to solve the same issues.

4. Do security conditions permit effective implementation and oversight?

The withdrawal of U.S. and coalition forces makes it increasingly more difficult to monitor projects and programs. In northern Afghanistan, the situation was deemed unsafe and 38 facilities worth $72 million have gone uninspected.

5. Does the project have adequate safeguards to detect, deter, and mitigate corruption?

Afghanistan's reputation for corruption is deep-rooted and widespread. A program to place currency counters in Kabul International Airport to count and track bulk cash flows out of Afghanistan was purchased and installed in 2011. The Afghan government chooses not to use it. At a 2012 international donor conference in Tokyo, incentives were created to stymie corruption. Proposals from the Afghan government had not been submitted.

6. Do the Afghans have the financial resources, technical capacity, and political will to sustain the project?

The SIGAR's office found that the Afghan government lacked personnel with the technical skills required to operate and maintain critical facilities and had filled less than 40 percent of its authorized operation and maintenance positions. Some officials claim that operation and maintenance cost estimates are not performed, and they doubt that the Afghan government will sustain the projects.

7. Have implementing partners established meaningful, measurable metrics for determining success?

In a speech delivered at the Center for Strategic and International Studies early in his tenure, Mr. Sopko said, "Too often, we find that agencies are focused on outputs, not outcomes. For example, how many teachers did we train? How many hospitals did we build? How many kilometers of road did we build? These metrics give us part of the picture, but they do not truly give us meaningful assessments of whether programs achieved their goals. . . . As we proceed with our audit work, we are going to be increasingly looking for ways to go beyond the stated output metrics to assess impact. What did a project or program actually achieve? If we cannot answer that question, then why did we spend the money? At the end of the day, the American people need to know what the U.S. reconstruction effort has accomplished in Afghanistan."[6]

For more information about the SIGAR, see <www.sigar.mil.>

Endnotes:

[1]Mr. John Sopko, SIGAR, telephone interview, 24 January 2014.

[2]Ibid.

[3]Ms. Ellen Laipson, president and chief executive of the Henry L. Stimson Center, telephone interview, 9 January 2015.

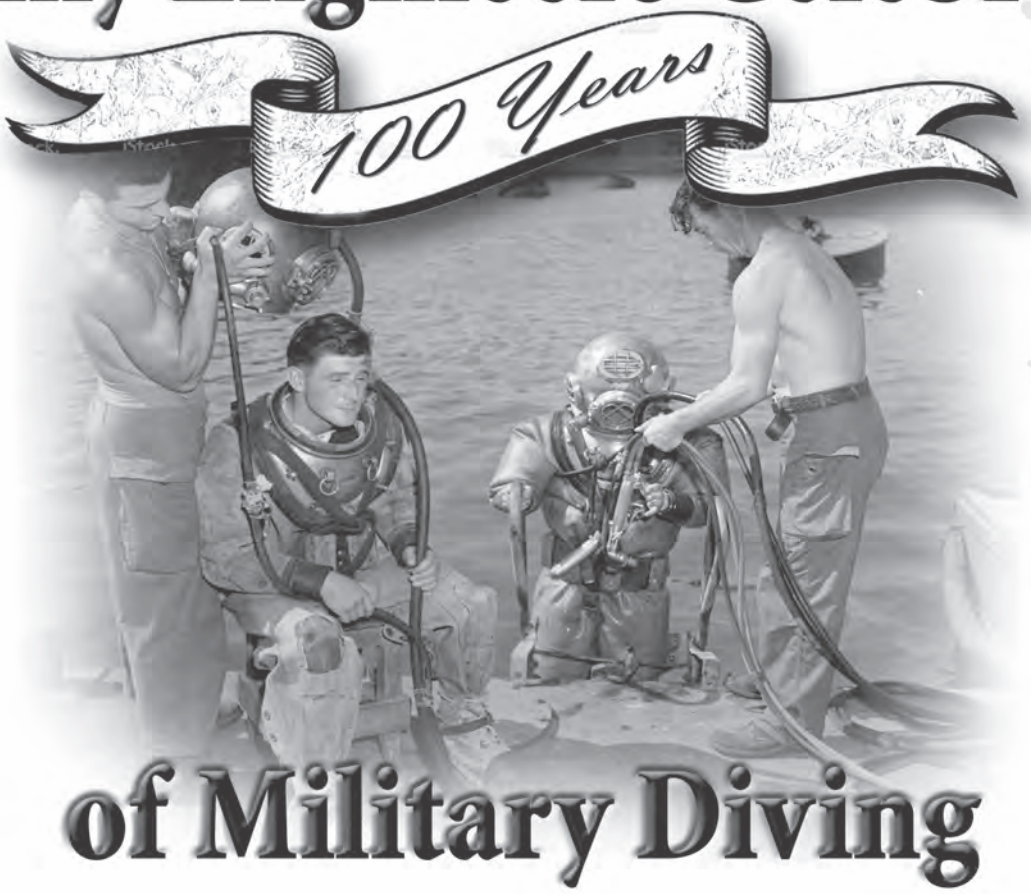
[4]Field Manual 3-57, *Civil Affairs Operations,* 31 October 2011.

[5]Joint Publication 3-57, *Civil-Military Operations,* 11 September 2013.

[6]Mr. John Sopko, SIGAR, speech given at the Center for Strategic and International Studies, Washington, D.C., 4 February 2013.

Captain Leiva is an Army National Guard civil affairs officer who has deployed to Iraq, Afghanistan, and Kuwait. He interviewed Mr. Sopko while serving as a member of the Mississippi National Guard in 2014 and updated this article in 2015. A former civilian journalist, Captain Leiva holds a master's degree in economic development.

Army Engineers Celebrate 100 Years of Military Diving



By Second Lieutenant Grant W. Rice

When people think of deep-sea diving, they generally do not think of the U.S. Army. However, the training wing at the Naval Diving and Salvage Training Center (NDSTC) contains the headquarters of Company A, 169th Engineer Battalion. The Panama City, Florida, diving facility is the largest in the world; and more than 1,200 deep-sea special operations divers from the Army, U.S. Navy, and U.S. Coast Guard are trained there annually. The unit trains Soldiers, Sailors, and Coast Guardsmen; supports operational units; and serves as the Army representative to the joint diving community for training and doctrine development. Normally closed to civilians, in May, NDSTC opened its doors for a weeklong celebration to show local citizens, veterans, former divers, and local and state officials the contributions that have been made by Army divers.

Events included live diving and technology demonstrations, historical society diving presentations, and static displays. Company A students and staff demonstrated the capabilities of a wide range of diving equipment, including a hyperbaric treatment chamber, underwater mapping equipment, and underwater hydraulic tools that are critical to Army diver missions. One of the vintage skills that students learn is the line-pull communication system. In the event the Mark V helmet internal communication system fails, the dive tender must know line-pull signals that can be sent via the diver's air hose. Although the dive helmets used in contemporary Army missions are more advanced, all Army divers still learn the 100-year-old line-pull language during their courses at NDSTC in case of a communications failure.

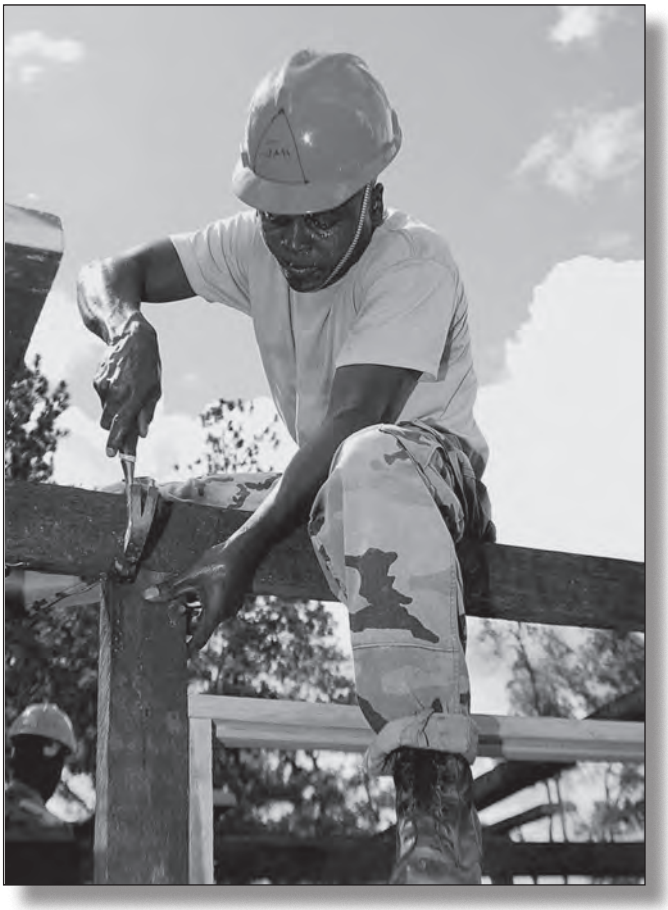
During the weeklong observance, a state-of-the-art physical training facility was dedicated to a former Company A commander, Captain Shawn L. English, who was killed in action in Iraq in 2006. The facility features equipment that will allow divers to train effectively year round. In the past, many classes exercised at 0430 (or earlier) during the summer before the Florida heat and humidity made physical training impossible.

When this article was written, Second Lieutenant Rice was an NDSTC student assigned to Company A, 169th Engineer Battalion, with a follow-on assignment as executive officer of the 511th Engineer Dive Detachment, Fort Eustis, Virginia. He holds a bachelor's degree in mathematical economics from Colorado College, Colorado Springs, Colorado; and he is a graduate of the Engineer Basic Officer Leadership Course, the Sapper Leader Course, and the Joint Service Diving Officer Course.

Operation United Assistance

By Mr. William A. Gibson

At its core, a humanitarian mission is not a military operation and is conducted under different rules and expectations. Since most nations prohibit other sovereign nations from acquiring real property interests without a specific agreement, authorization for U.S. use of property in a foreign nation during peacetime is generally initiated through diplomatic channels. When recurring military use is expected, the most common form of agreement is a status of forces agreement. Although host nations are usually expected to provide adequate real estate (RE) at no cost in cases of conflict, when the host nation government is not functioning, U.S. forces must lease necessary land and facilities from private property owners.



An Armed Forces of Liberia engineer hammers in nails to set up a tent for an Ebola treatment facility.

Sometimes RE records are accurate and available, but sometimes it is not easy to identify landowners. U.S. Army officials often must deal with high-level, host nation government officials to confirm data and facilitate U.S. leasing activities. While leases are treated like contracts, they are not signed by contracting officers who are warranted to sign Federal Acquisition Regulation-based contracts. Army officials who sign leases of real property receive their authority through the Secretary of the Army.

As part of a massive, presidentially mandated ramp-up of military efforts against the Ebola outbreak in Liberia, U.S. Army Africa (USARAF) deployed to the capital city of Monrovia to establish a mission command node to aid U.S. Agency for International Development efforts in controlling the disease. The move provided Department of Defense support of efforts to contain Ebola, alleviate human suffering, increase Liberian and international community response capacity, facilitate international assistance, and promote internal and regional stability. During predeployment reconnaissance, USARAF was required to immediately engage with local leaders, identify bill of materials and bill of equipment requirements, and conduct site assessments. Local leaders had to approve all identified Ebola treatment unit site locations, and the contracting process had to be rapidly facilitated. These actions were crucial to the mission and had to be completed before the arrival of the advance echelon and the main body.

Upon arrival, the USARAF RE element engaged with the Liberian government and private corporations to obtain land for the coming support elements. American embassy officials worked with the Liberian president, who issued a directive to all Liberian government agencies to give the

Military personnel supporting Operation United Assistance enter a U.S. Marine Corps Osprey to depart Cesco City, Liberia.

U.S. military no-cost use of any public lands required to accomplish Operation United Assistance.

One company, the subsidiary of an American tire manufacturer, signed a no-cost agreement that allowed Joint Task Force United Assistance access to land and buildings on its million-acre rubber plantation for humanitarian use for as long as the mission required it. A private logistics company with headquarters in France offered the U.S. government badly needed land at the Port of Buchanan for an "average market price," which was determined through consultation with the economic officer at the U.S. embassy and the in-country Defense Logistics Agency representative. With staff judge advocate oversight and negotiations with the company, a fenced, lighted site was secured to offload the Military Sealift Command ship that was due to arrive within days.

To accommodate force build-up in the initial phases of an operation, USARAF requires its RE element to rapidly deploy to determine property requirements that may be needed to support the contingency response operation. The RE element includes a specialist who has contingency experience and who deployed in the first days of Operation United Assistance. The specialist initiated discussions with Liberian government agencies and international corporations for facility usage.

USARAF is designed to provide the theater army commander with an organic capability to meet geographic combatant commander requirements for immediate response to unanticipated crises within the area of responsibility. As an organic element of the theater army headquarters, the contingency command post is committed to the theater and is immediately available for deployment to mission command operations within the area of responsibility. Conducting RE activities within that contingency command post overseas is a constant, fluid challenge with a mission that often expands to new nations and new environments. Lease formats tend to change from one operation to another. Variations in languages, cultures, and laws require careful investigation and cautious progress. Security is a constant concern in unstable regions or in areas of conflict. RE capability is integral to operational access, particularly in situations of area denial and hybrid warfare.

Upon entry to a new area of responsibility, an RE officer should become familiar with any international agreements in place for the particular country. All RE activity is subject to these agreements. The U.S. embassy is a good source for this information if it is not available through the chain of command. The embassy can provide information about interpreters, drivers, vendors, market research, and other topics. For this mission and future missions, it is important for the USARAF RE officer and USACE RE to work closely to ensure rapid response to acquire needed lands and facilities.

Mr. Gibson is the USARAF realty officer.

Engineer Doctrine Update

U.S. Army Maneuver Support Center of Excellence
Capabilities Development and Integration Directorate
Concepts, Organizations, and Doctrine Development Division

Engineer leaders,

One of our key programs for the Engineer Regiment is the Doctrine Sponsorship Program. It was implemented as part of Doctrine 2015, which focused on the improvement and renewal of many of our publications. Commanders were asked to sponsor publications, based on resident skill and experience. We received great support, and the program has proven beneficial in the doctrine development process. Please contact the doctrine team if you are interested in sponsoring a publication. This will allow engineer doctrine to incorporate essential feedback from the field.

Below is the list of publications either currently under review or scheduled to be reviewed as part of the standard doctrine process for fiscal year (FY) 2016 with sponsors noted.

Army Techniques Publication (ATP) 3-37.10, *Base Camps*—Sponsor: 555th Engineer Brigade

ATP 3-37.34, *Survivability*—Sponsor: 555th Engineer Brigade

ATP 3-34.45, *Engineer Prime Power*—Sponsor: 249th Engineer Battalion

ATP 3-90.8, *Combined Arms Countermobility Operations*—Sponsor: 20th Engineer Brigade

Where did all the doctrine go?

Part of the Doctrine 2015 Program process included placing publications in the doctrinal hierarchy where appropriate and numbering in keeping with joint doctrine, the "3-34" series. The result is a change in our naming conventions for many publications that we had been familiar with for years as well as the consolidation of some of these publications into another with a new publication number. In an effort to help the Engineer Regiment better understand where all of the doctrine went, we have provided an easy cross-reference and current status below.

Publication Title Before Doctrine 2015	New Publication Title	Status
ATP 3-37.10/Marine Corps Reference Publication (MCRP) 3-17.7, *Base Camps*	ATP 3-37.10/MCRP 3-17.7, *Base Camps*	Published
Army Tactics, Techniques, and Procedures (ATTP) 3-34.23, *Engineer Operations–Echelons Above Brigade Combat Team*	ATP 3-34.23, *Engineer Operations–Echelons Above Brigade Combat Team*	Published
ATTP 3-34.39, *Camouflage, Concealment, and Decoys*	ATP 3-37.34/Marine Corps Warfighting Publication (MCWP) 3-17.6, *Survivability Operations*	Published
ATTP 3-34.80, *Geospatial Engineering*	ATP 3-34.80, *Geospatial Engineering*	Published
ATTP 3-90.4, *Combined Arms Mobility Operations*	ATP 3-90.4/MCWP 3-17.8, *Combined Arms Mobility Operations*	Final Editing
FM 3-34, *Engineer Operations*	FM 3-34, *Engineer Operations*	Published
FM 3-34.170, *Engineer Reconnaissance*	ATP 3-34.81/MCWP 3-17.4, *Engineer Reconnaissance*	Final Editing
FM 3-34.2, *Combined Arms Breaching Operations*	ATP 3-90.4/MCWP 3-17.8, *Combined Arms Mobility Operations*	Final Editing
FM 3-34.210, *Explosive Hazards Operations*	ATP 3-34.20/MCRP 3-17.2D, *Countering Explosive Hazards*	Final Editing
FM 3-34.214/MCRP 3-17.7L, *Explosives and Demolitions*	Technical Manual (TM) 3-34.82, *Explosives and Demolitions*	Final Editing
FM 3-34.22, *Engineer Operations–Brigade Combat Team and Below*	ATP 3-34.22, *Engineer Operations–Brigade Combat Team and Below*	Published
FM 3-34.280, *Engineer Diving Operations*	TM 3-34.83, *Engineer Diving Operations*	Published
FM 3-34.331, *Topographic Surveying*	TM 3-34.53, *Topographic Surveying*	Published
FM 3-34.343, *Military Nonstandard Fixed Bridging*	TM 3-34.22, *Military Nonstandard Fixed Bridging*	Published

Publication Title Before Doctrine 2015	New Publication Title	Status
FM 3-34.400, *General Engineering*	ATP 3-34.40/MCRP 3-17.7, *General Engineering*	Published
FM 3-34.465, *Quarry Operations*	TM 3-34.65, *Quarry Operations*	Published
FM 3-34.471, *Plumbing, Pipe Fitting, and Sewerage*	TM 3-34.70, *Plumbing, Pipe Fitting, and Sewerage*	Published
FM 3-34.480, *Engineer Prime Power Operations*	TM 3-34.45, *Engineer Prime Power Operations*	Published
FM 3-34.480, *Power Generation and Distribution*	ATP 3-34.45, P*ower Generation and Distribution*	FY16 Initiative
FM 3-34.5, *Environmental Considerations*	ATP 3-34.5/MCRP 4-11B, *Environmental Considerations*	Published
FM 3-90.119, *Combined Arms Improvised Explosive Device Defeat Operations*	ATP 3-90.37, *Countering Improvised Explosive Devices*	Published
FM 3-90.12, *Combined Arms Gap-Crossing Operations*	ATP 3-90.4/MCWP 3-17.8, *Combined Arms Mobility Operations*	Final Editing
FM 3-90.61, *The Brigade Special Troops Battalion*	ATP 3-90.61, *Brigade Special Troops Battalion*	Published
FM 5-102, *Countermobility*	ATP 3-90.8/MCWP 3-17.5, *Combined Arms Countermobility Operations*	Published
FM 5-125, *Rigging Techniques, Procedures, and Applications*	TM 3-34.86, *Rigging Techniques, Procedures, and Applications*	Published
FM 5-134, *Pile Construction*	TM 3-34.72, *Pile Construction*	Published
FM 5-233, *Construction Surveying*	TM 3-34.55, *Construction Surveying*	Published
FM 5-277, *M2 Bailey Bridge*	TM 3-34.23, *M2 Bailey Bridge*	Published
FM 5-34, *Engineer Field Data*	TM 3-34.85, *Engineer Field Data*	Published
FM 5-410, *Military Soils Engineering*	TM 3-34.64, *Military Soils Engineering*	Published
FM 5-412, *Project Management*	TM 3-34.42, *Construction Project Management*	Published
FM 5-415, *Fire-Fighting Operations*	TM 3-34.30, *Firefighting*	Published
FM 5-424, *Theater of Operations Electrical Systems*	TM 3-34.46, *Theater of Operations Electrical Systems*	Published
FM 5-426, C*arpentry*	TM 3-34.47, *Carpentry*	Published
FM 5-428, *Concrete and Masonry*	TM 3-34.44, *Concrete and Masonry*	Published
FM 5-430-00-1/2, *Planning and Design of Roads, Airfields, and Heliports in the Theater of Operations*	TM 3-34.48 1/2, *Design of Theater of Operations Roads, Airfields, and Helipads*	Final Editing
FM 5-434, *Earthmoving Operations*	TM 3-34.62, *Earthmoving Operations*	Published
FM 5-436, *Paving and Surfacing Operations*	TM 3-34.63, *Paving and Surfacing Operations*	Published
FM 5-472, *Materials Testing*	TM 3-34.43, *Materials Testing*	Published
FM 5-480, *Port Construction and Repair*	TM 3-34.73, *Port Construction and Repair*	Published
FM 90-7 *Combined Arms Obstacle Integration*	ATP 3-90.8/MCWP 3-17.5, *Combined Arms Countermobility Operations*	Published
TM 5-5420-212-10-2, *Medium Girder Bridge*	TM 3-34.21, *Medium Girder Bridge*	Published
TM 5-545, *Geology*	TM 3-34.61, *Geology*	Published
TM 5-581B, *Construction Drafting*	TM 3-34.51, *Construction Drafting*	Published

The following publications are new and/or have maintained the previous nomenclature:

TM 3-34.84, *Swift Water Diving Operations*
TM 3-34.56, *Waste Management for Deployed Forces*
TM 3-34.41, *Construction Estimating*
TM 3-34.49, *Water-Well Drilling Operations*

Doctrine 2015
Publications Currently Under Revision

Publication Number	Title	Description (and Current Status)
ATP 3-34.23 (ATTP 3-34.23)	*Engineer Operations—Echelons Above Brigade Combat Team*	This is a revision and conversion from ATTP 3-34.23, *Engineer Operations–Echelons Above Brigade Combat Team*, to ATP 3-34.23. **Status:** Published, June 2015
ATP 3-34.20 (FM 3-34.210)	*Countering Explosive Hazards*	This is a multi-Service manual and conversion from FM 3-34.210, *Explosive Hazards Operations*, to ATP 3-34.20, *Countering Explosive Hazards*. It is a complete reorganization of the information and introduction of the overarching framework for how combat engineers apply their disciplines/functions of combat, general, and geospatial engineering to countering explosive hazards. **Status:** Staffing of the final draft is complete, and the final approved draft is being prepared. To be published 1st quarter, FY 16.
ATP 3-34.5 (FM 3-100.4)	*Environmental Considerations*	This is a conversion from FM 3-100.4, *Environmental Considerations in Military Operations*, to ATP 3-34.5. **Status:** Published, August 2015
ATP 3-90.4 (ATTP 3-90.4)	*Combined Arms Mobility Operations*	This is a multi-Service manual and conversion from ATTP 3-90.4, *Combined Arms Mobility Operations*, to ATP 3-90.4. **Status:** Staffing of the final draft is complete, and the final approved draft is being prepared. To be published 1st quarter, FY 16.
ATP 3-90.61 (FM 3-90.61)	*Brigade Special Troops Battalion*	This is a revision and conversion from FM 3-90.61, *The Brigade Special Troops Battalion*, to ATP 3-90.61. **Status:** Published, August 2015

Notes:

1. Current engineer publications can be downloaded from the Army Publishing Directorate Web site at <http://www.apd.army.mil>. The manuals discussed in this article are currently under development and/or recently published (within 6 months of review date). Drafts may be obtained during the staffing process by contacting the Engineer Doctrine Branch at commercial (573) 563-0003, DSN 676-0003, or <usarmy.leonardwood .mscoe.mbx.cdidcodddengdoc@mail.mil>. The development status of these manuals was current as of 5 October 2015.

2. Items in parentheses are publication numbers of current publications, which will be (or have been recently) superseded by the new number at the top of the entry. Multiple numbers in parentheses indicate consolidation into one manual.

Please contact us if you have any questions or recommendations concerning doctrine.

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"Doctrine is indispensable to an army. Doctrine provides a military organization with a common philosophy, a common language, a common purpose, and a unity of effort."

—General George H. Decker,
U.S. Army Chief of Staff, 1960–1962

Army Reserve Recognized For Energy-Saving Measures

By Colonel Stewart R. Fearon

During the Building Owners and Managers Association (BOMA) Conference on 29 June 2015, the U.S. Army Reserve 63d Regional Support Command (RSC) received an award for the Lighting Energy Efficiency in Parking (LEEP) Campaign by reducing the energy used at the military equipment park on Camp Pike, Arkansas, from 72,883 kilowatt hours to 10,883 kilowatt hours, yielding an 85 percent reduction of 62,000 kilowatt hours.

BOMA is a professional association of 91 U.S. and 17 international organizations that represent commercial property owners, managers, developers, and leasing professionals. It encourages sharing of best practices in all aspects of building operations and management through publications, conferences, seminars, and awards programs. BOMA sponsors the LEEP Campaign to encourage the retrofitting of existing parking lights and the installation of state-of-the-art lighting technologies to reduce maintenance costs and save energy. BOMA provides online tools and access to U.S. Department of Energy technical expertise.

The 63d RSC partnered with Pacific Northwest National Laboratories and the U.S. Army Reserve Installation Management Division energy team to earn the award. Pacific Northwest National Laboratories is one of 10 Department of Energy laboratories. Its experts worked with representatives from the 63d RSC to identify ways to conserve power to comply with presidential executive orders.

Executive Order 13423, *Strengthening Federal Environmental, Energy, and Transportation Management*,[1] signed by President George W. Bush in 2007, requires federal agencies to reduce energy intensity by 3 percent annually through fiscal year 2015. Executive Order 13693, *Planning for Federal Sustainability in the Next Decade*,[2] signed by President Barack H. Obama in 2015, calls for the reduction of energy intensity in federal buildings by 2.5 percent annually through fiscal year 2025.

The Army Reserve Installation Management Division, Pacific Northwest National Laboratories, and the 63d RSC completed economic analysis and return-on-investment calculations to determine the best way to spend the limited funding available. Replacing traditional lighting in parking lots with light-emitting diode lights proved to be one of the quickest payback projects with the largest energy savings.

A U.S. Department of Energy official said, "It might only take one person to change a light bulb, but it took dedicated efforts by the many thoughtful leaders of LEEP award winners to demonstrate how much can be gained through advanced, cost-effective lighting technologies in parking lots and garages. These innovative solutions also enhance safety and improve working conditions for customers, tenants, and employees."

The 63d RSC chief of staff said, "The 63d RSC is dedicated to conserving energy, expanding the use of renewable energy, and creating sustainable installations as part of our efforts to be good stewards of the environment." The LEEP award is a testament to U.S. Army Reserve support of President Obama's plan to achieve 20 percent more energy efficiency over the next decade. The efforts of the U.S. Army Reserve and its strategic partners are having a direct impact on reducing greenhouse gas emissions and the tax dollars spent on energy bills.

Light-emitting diodes at the Camp Pike military equipment park save electricity and money.

References:

[1]Executive Order 13423, *Strengthening Federal Environmental, Energy, and Transportation Management*, 24 January 2007.

[2]Executive Order 13693, *Planning for Federal Sustainability in the Next Decade*, 19 March 2015.

Colonel Fearon is the director of public works at the 63d Regional Support Command. He holds a bachelor's degree in mechanical engineering from the U.S. Military Academy–West Point, New York, and master's degrees in strategic studies from the U.S. Army War College and business administration from National University. He is a registered intern engineer in New York and is certified as a project management professional.

130TH ENGINEER BRIGADE CELEBRATES ESSAYONS SPIRIT

By First Lieutenant Yunmi L. Sefers

To build *Essayons* spirit, the 130th Theater Engineer Brigade, 8th Theater Sustainment Command, Schofield Barracks, Hawaii, hosted an Engineer Week celebration 10–14 August 2015. This event, much like the Muster Run conducted in June, built teamwork and resiliency. Companies from the 65th Engineer Battalion; Alpha Company, 249th Engineer Battalion (Prime Power); 84th Engineer Battalion; and 29th Brigade Engineer Battalion joined the festivities. Events included—

- 12-mile ruck march.
- 5- and 10-kilometer runs.
- Ultimate disc.
- Soccer.
- Flag football.
- Softball.
- Basketball.
- Volleyball.
- Swim relay.
- Timed company run.
- Tug-of-war.
- Mystery event.

Each company, along with engineers from the 25th Infantry Division, competed for the Commander's Cup, which recognizes company cohesion and motivation.

Above: A Soldier completes the timed company run.

Left: During Engineer Week, Soldiers participate in the 10-kilometer run.

Above: As part of the difficult mystery event, Soldiers push a loaded Humvee.

Left: The mystery event also included repetitions of dips on parallel bars.

One participant said that the competition was interesting and challenging, while still fun. The most difficult challenge was the mystery event, which pushed Soldiers to their limits. In addition to a Humvee® load-up with 130 kilograms of miscellaneous items and a 130-meter Humvee push, the mystery event consisted of 130 repetitions of:

- Push-ups.
- Sit-ups.
- Pull-ups.
- Water jug carries.
- Dips.
- Box jumps.
- Tire flips.

The 84th Engineer Battalion took home the Commander's Cup, but the week developed company teams, built camaraderie, and celebrated history across U.S. Army Hawaii engineer units.

First Lieutenant Sefers is the public affairs officer for the 130th Engineer Brigade, Schofield Barracks, Hawaii. She holds a bachelor's degree in criminal justice and history from the University of Texas at El Paso.

130th Engineer Brigade Marks Accomplishments in Pacific Theater

By First Lieutenant Yunmi L. Sefers

To celebrate the history of engineers and their joint accomplishments throughout the Pacific Theater, the 130th Engineer Brigade, 8th Theater Sustainment Command, hosted its first luau at a Honolulu, Hawaii, hotel on 7 August 2015. The festivities included an awards ceremony, with seven spouses receiving the Essayons Award from Colonel Blace C. Albert, 130th Engineer Brigade commander, for the time and effort they dedicated to making the unit better and stronger; a cake-cutting ceremony; and live entertainment. Among the accomplishments celebrated were strengthening partnerships with U.S. allies and winning U.S. Army Pacific Color Guard, Noncommissioned Officer of the Year, and Soldier of the Year competitions. The highlight of the event was a speech by Admiral Harry B. Harris, commander of U.S. Pacific Command.

Engineer divers take part in the cake-cutting ceremony.

"Engineers—everyone here today—have gone a long way in growing important relationships throughout the area of responsibility by executing and supporting a wide variety of missions from overseeing and executing military construction, providing host nation-funded construction, constructing facilities support to foreign military sales, and responding quickly and effectively to humanitarian aid and disaster relief events in the region," said Admiral Harris.

Throughout the year, the 130th participated in 11 theater security cooperation plan missions in seven countries and provided companies to four combat training center rotations. The brigade supported numerous exercises and training events and executed dive missions in support of the Defense Prisoner of War/Missing in Action Accounting Agency to bring home those who were left behind. It also established the Theater Construction Effects Workgroup to prioritize and synchronize troop construction projects in the U.S. Pacific Command area of responsibility.

"Hard is certainly not new for our engineers. Hard is what you do. The world will change in ways we can hardly imagine. So will our platforms, systems, and equipment. The one thing that will never change is the ability of our people—our engineers—to achieve ultimate success, regardless of circumstance," said Admiral Harris.

First Lieutenant Sefers is the public affairs officer for the 130th Engineer Brigade, Schofield Barracks, Hawaii. She holds a bachelor's degree in criminal justice and history from the University of Texas at El Paso.

RENDER-SAFE:

CONFRONTING EXPLOSIVE ORDNANCE IN THE GUNPOWDER ERA

By Mr. Robert Donayre

Render-safe procedures are the cornerstone of the explosive ordnance disposal (EOD) technician mission to prevent unexploded ordnance from detonating and causing harm to people and damage to surrounding areas. Though the phrase *render-safe* is a modern-day construct directly related to the EOD mission of properly handling unexploded ordnance, "render-safe procedures," as defined by the U.S. Joint Chiefs of Staff, were implemented in one form or another throughout the nearly 400-year era of the dominance of gunpowder as an explosive substance. While EOD technicians today use "the application of special explosive ordnance disposal methods and tools to provide for the interruption of functions or separation of essential components of unexploded explosive ordnance to prevent an unacceptable detonation,"[1] so too did the technicians of the gunpowder era. Those first modern military engineers employed their own methods and tools to prevent unacceptable detonations accompanying the awesome and ever-increasing power of explosive devices.

As the Middle Ages came to an end during the 15th century, an artillery gun much stronger than the small cannons that the English used against the French at the Battle of Crecy in 1346 did away with the basic wall, moat, and tower defense system that townsfolk had relied on for centuries. This became evident in 1453, when Ottoman Empire forces conquered the once-impregnable city of Constantinople, which had survived 20 sieges over the centuries. Employing newly constructed "bombards" (including a supergun that could throw a stone ball weighing more than half a ton), the Ottoman forces breached the outer wall of the fortification in one military campaign; the conquest of the city itself quickly followed. What could not be done over the centuries took Ottoman forces just under 2 months. The ominous news left Europe with a sense of helplessness. Gunpowder was starting to change the world. With this change, people were awakened by the threat of gunpowder weaponry and the need to develop render-safe procedures.

To better protect town dwellings from intruders wielding wall-busting artillery, engineers (those who operated the engines of war, such as catapults, and designed fortifications to defend against them) needed to redesign their barrier creations. This was a pressing concern since artillery weaponry itself was undergoing rapid technological advancements. The virtually immobile bombard, firing fragmenting stone balls, was giving way to the less cumbersome cannon that could launch projectiles of unbreakable metal. Iron balls from the new cannon could reduce the strongest walls to rubble.

Military historian John Keegan outlined the new type of fortification that was engineered to nullify the impact of cannon fire:

> *The new defenses are technically called artillery forts, but they're often thought of as star forts because in plan they did often resemble stars. And the idea was that the incoming ball would glance off the angles of the star. Instead of being able to hit the face of the wall directly and doing damage in that way, they would bounce sideways and the energy of the impact would be absorbed by the thick earth bank behind the masonry face.*[2]

Though the ball "exploded" from the cannon itself, the perimeter defenses of a star castle hampered the intended effect of the projectile. Therefore, it could be said that this new type of fortification rendered-safe many a cannonball.

Not only could a star castle effectively neutralize the capabilities of offensive artillery, but defensive cannons strategically placed around the perimeter of the castle could also greatly help render-safe hostile threats. It was a sort of "fight fire with fire" stance similar to an EOD technician using an explosive charge to dispose of unexploded ordnance. Defending cannons were used to deal with attempts to storm the walls and to challenge attacking cannons by preventing the cannons from approaching close enough to the fort for them to engage in direct fire.

In the early days of artillery, the detonation of gunpowder inside a cannon to launch the ball was sometimes overshadowed by the unacceptable detonation of the gun itself, which might gravely injure or kill those in its immediate vicinity. King James II of Scotland, personally overseeing an artillery assault on the English-held castle of Roxburgh in 1460, was killed when a cannon blew up beside him. One problem noted by Richard Cowen, senior lecturer emeritus of the University of California–Davis, was that many of the earliest guns were made of relatively weak "wrought iron bars forged together to form a circular barrel, with wrought iron hoops fixed around them to hold them together . . . there were naturally many points of potential weakness, especially after repeated firing."[3]

To overcome this weakness, a more standardized method of cannon construction and a complete redesign of the gun's aerodynamic attributes needed to be engineered. The spread of smelting blast furnaces across Europe in the 1500s made this possible.

> *To make the guns safer and to cut down on their weight, they were cast with a thick breech end and a tapered barrel. Solid metal measuring 8 inches thick at the breech would contain the sharp explosion of powder, while farther along the barrel, where the pressure was less, 2 or 3 inches of solid metal might be enough. Barrels that were longer relative to the size of the bore gave the powder time to burn while the ball was still in the gun. The result was the classic, tapered cannon that would set the standard for the rest of the gunpowder era. By the early 1500s, engineers had devised a form of artillery that was to be the epitome of gunpowder weaponry for centuries to come.*[4]

Of course, cannons were inoperable without gunpowder and its deadly effects. The handling of gunpowder itself was a hazardous venture that could, and often did, result in unacceptable detonations. At the manufacturing stage, the powdermaker (as those who worked in the industry came to be known) had to painstakingly grind the three ingredients of gunpowder—saltpeter (potassium nitrate), charcoal, and sulfur—into a fine, flourlike substance, a 20-hour process known as "incorporation." Anything less would have produced a powder that was capable of burning, but in a weakened state and without the required explosive property needed to hurl the ball from its cannon at deadly speed. Getting the gunpowder just right was a continuous flirtation with death. During incorporation, powdermakers faced the greatest danger.

According to *Gunpowder; Alchemy, Bombards, and Pyrotechnics: The History of the Explosive That Changed the World*, "Friction, a bit of iron that gave rise to a spark, or carelessness with a lamp meant instant cataclysm. When the fine powder was agitated, it gave off a cloud of dust. This made the mill extraordinarily hazardous since the dust could drift to an open flame, ignite, then carry the fire back to the mass of powder."[5]

And because dust could easily escape from the smallest of barrel openings, anyone who transported, stored, or used the powder became endangered. Aboard warships, imminent death was a constant reality for sailors. Warships carried several tons of gunpowder in their holds, and a spark from two bits of metal clicking together could obliterate the vessel in a flash. The gunner required all fire on board to be extinguished before supervising the handling of this explosive material. He stored it in a magazine in the belly of the ship, where it would be most secure from enemy fire.

To render the incorporation process a safer one for those who made gunpowder their business, a small amount of liquid such as distilled wine spirits or human urine was added to the three ingredients to reduce the dust and the risk of explosion.

Over time, other developments and procedures to lessen the deadly handling of gunpowder were incorporated into industry practices. As the Du Pont family dynasty of gunpowder manufacturing became established in the United States in the early 1800s, more effective methods of gunpowder production for military use and the burgeoning mining industry were engineered. The process of incorporation had been taken to an advanced level of "pressing," in which workers used a screw press to apply a standard amount of force to the incorporated powder. This produced a final product that was more durable and safer to transport. In another

Photo courtesy of the National Park Service

The Castillo de San Marcos is a star fort built in Florida by the Spanish in the late 1600s.

Photo courtesy of the National Park Service

Cannons overlook the Hudson River Valley at Bemis Heights, site of a crucial American victory in the Revolutionary War.

manufacturing advance, powdermen moistened the ingredients with distilled water instead of urine. Improving the gunpowder craft also brought increased safety standards for the powdermen. They used wooden shovels and wore shoes with wooden pegs instead of hobnails. Those who smoked switched to chewing tobacco.[6]

Despite the render-safe procedures implemented before the days of officially designated unexploded ordnance, horrendous accidents still occurred with explosive devices all too frequently. Powdermen used the phrase "to go across the river" to refer to dying in a gunpowder accident. On 19 March 1818, the Du Pont works exploded, killing 36 workers. Accidents hit the mills an average of once every 14 months. A bit of a nail or a piece of grit in the mixture could set off a spark during processing. A wagon wheel could jar against a stone. An excess of friction, a moment of carelessness, or an unattended candle could mean an instant calamity.

Though gunpowder accidents were frequent enough to cause grave concern, the "devil's distillate," as gunpowder was referred to in its early history, continued to be in high demand for militaries around world and for the growing mining industry. It was the grave concern that led others to search for and engineer an alternative to gunpowder. Paul Ronney, professor of aerospace and mechanical engineering at the University of Southern California, sums up the problem that plagued gunpowder, particularly as a mining explosive. "For blasting, people used black powder, what we call gunpowder, which was very unstable and you could only ignite it with a fuse. You could not control very well when it ignited or the pattern of the explosion that was generated by it."[7]

In the 1860s, Swedish chemist Alfred Nobel experimented with recently discovered nitroglycerin, a liquid explosive. Spillage problems accompanied nitroglycerin, resulting in devastating explosions during experimentation, including the death of Nobel's younger brother in 1864.

According to *Gunpowder: Alchemy, Bombards, and Pyrotechnics: The History of the Explosive That Changed the World,* "(Nobel) searched for a way to make spills impossible. After trying many absorbents—charcoal, sawdust, cement—he hit on diatomaceous earth, the tiny silica skeletons of algae, as the ideal dope. *Kieselguhr*, as it was called, absorbed three times its weight in nitroglycerine and turned the volatile chemical into a much more stable commodity."[8] Nobel's high-explosive nitroglycerin sticks, which he named "dynamite," quickly came to be known around the planet as a safer and more effective device than gunpowder. With dynamite, handlers could more easily control explosions, revolutionizing mining, road-building, and construction. In World War I, artillery shells could be safely loaded with dynamite for devastating effects against enemy troops.

In the end, gunpowder was rendered-safe to an unprecedented degree because it was supplanted by superior explosives. These included dynamite for mining and large-scale munitions and synthetic propellants for handheld rifles, pistols, and other projectile-firing weapons. Gunpowder is still in use today, mostly in fireworks. Fireworks handlers continue to apply render-safe procedures in the use of these modern-day gunpowder devices of entertainment. All the while, EOD technicians around the globe put themselves in harm's way using doctrinal render-safe procedures and the latest engineered equipment and tools to save lives and property threatened by explosive devices of devastating potential.

Endnotes:

[1]Joint Publication 1-02, *Department of Defense Dictionary of Military and Associated Terms,* 8 November 2010, (As Amended Through 15 January 2015), p. 204, accessed on 21 March 2015.

[2]John Keegan, "War and Civilization—Episode 4: Gunpowder," 10 February 2014, <https://www.youtube.com/warch?v=oRyHcxLF_nE>, accessed on 18 August 2015.

[3]Richard Cowen, "Chapter Ten: Iron and an Early Military-Industrial Complex," April 1999, <http://mygeologypage.ucdavis.edu/cowen//~GEL115/115CH10.html>, accessed on 28 March 2015.

[4]Jack Kelly, *Gunpowder: Alchemy, Bombards, and Pyrotechnics: The History of the Explosive That Changed the World,* Basic Books, New York, New York, 13 April 2004, pp. 67-68, accessed on 19 March 2015.

[5]Kelly, pp. 58–59.

[6]Kelly, p. 176.

[7]"Alfred Nobel," The *Biography.com* Web site, <http://www.biography.com/people/alfred-nobel-9424195>, accessed on 29 March 2015.

[8]Kelly, p. 228.

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JOINT PARTNERSHIP IN TEACHING SURVEYORS

By Sergeant First Class Sean P. Shannon

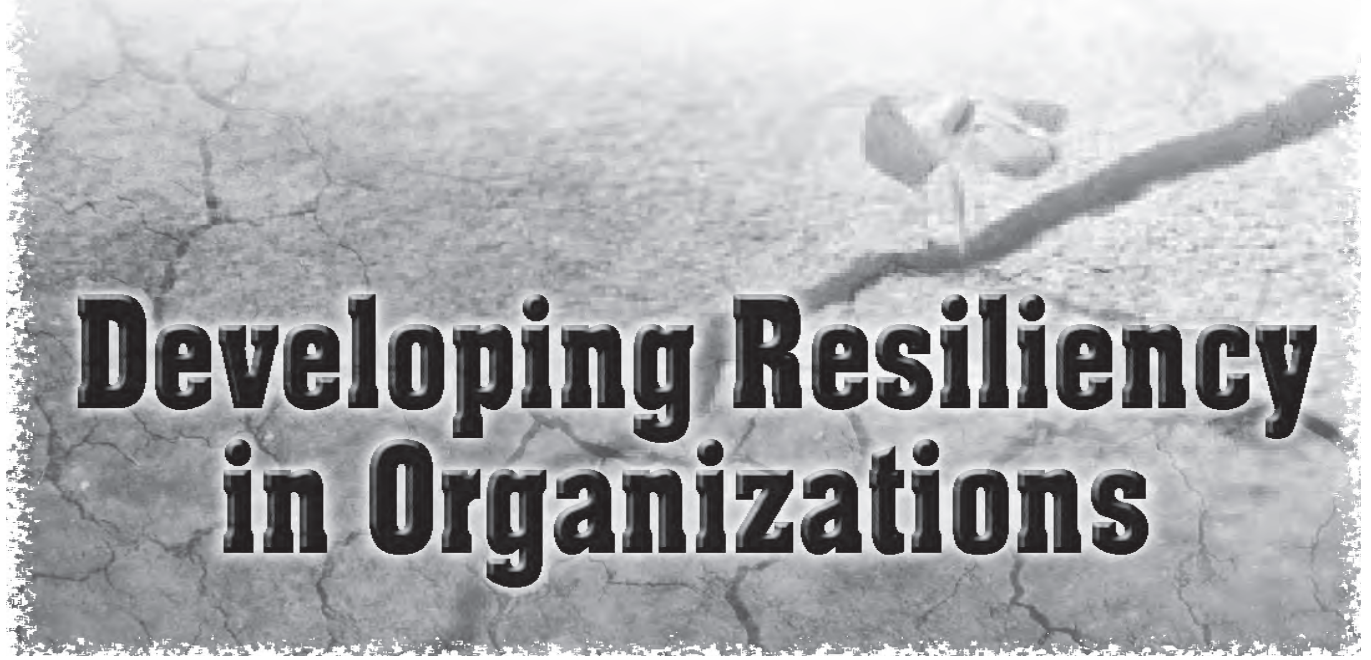
January at Fort Leonard Wood, Missouri, can be frigid; and Soldiers, Marines, Sailors, and Airmen shivered as they tried to hold their carbon fiber measuring rods level during the ninth week of training as technical engineers, Military Occupational Specialty 12T.

The Vertical Skills Division at Brown Hall is the hub of civil engineer training for the Department of Defense. Technical engineers use various tools and wear many hats to accomplish their missions. If they were civilians, they would be able to perform three separate trades—draftsman, surveyor, and materials technician. The tools and duties have changed since George Washington, Thomas Jefferson, Benjamin Banneker, Meriwether Lewis, and William Clark worked as surveyors. Everything has already been mapped out, unlike the world in the time of America's infancy. The tools have also evolved with the times. Instead of a plane table, paper, and a chain, technical engineers now use an electronic instrument that functions as a plane table and a laser that functions as a chain. They use Global Navigation Satellite System and Global Positioning System receivers to collect elevation points that are accurate to within a millimeter. However, they are not just surveyors. They draft construction prints for carpenters and heavy-equipment operators using terrain modeling and computer-aided design software and help construction project managers by testing the strength and flexibility of soils and concrete.

The technical engineer course arrived at Fort Leonard Wood when the Inter-Service Training Review Organization was implemented in 1993, though it took 4 years to bring all the Services to Brown Hall for training. The course, which is divided into four 21-day phases, can now lead to credentials for graduates. The goal for credentialing is to give students a record of their coursework accomplishments and an additional credibility that can be identified by employers. The Ozarks Technical Community College, Waynesville, Missouri, assists by presenting students with an associate's degree once their general education credits have been earned. Even if students do not have a college education, they could earn a certificate of achievement in drafting from the college. The credentialing program provides students with the tools to succeed in the military and help them prosper later in life. Since technology constantly modifies the operational landscape of the course, new software and equipment are being implemented to make surveying more efficient and more precise.

An instructor answers questions during a class for future technical engineers.

Sergeant First Class Shannon is a Technical Engineer Course instructor at Fort Leonard Wood. When writing this article, he was completing work for a bachelor's degree in business management with the American Military University.



Developing Resiliency in Organizations

By Major Christopher W. Pierce

Anxiety, alcoholism, posttraumatic stress disorder, and suicide are some of the effects suffered by survivors of the Holocaust. The traumatic experiences they endured had long-term effects that eventually destroyed the lives of many. One Holocaust survivor who spent 3 years in some of the worst Nazi concentration camps was Dr. Viktor E. Frankl, a successful neurologist and psychiatrist. However, the effects of the Holocaust did not destroy his life. He survived to become a world-famous therapist, lecturer, and author. By learning from the catastrophic events he suffered, he became stronger, resilient, and more successful.

What are the key traits of a resilient person? What allows someone like Dr. Frankl to overcome the traumatic changes that occurred in his life while others allow such events to destroy their lives? Developing resilient behavior is the primary focus of this article, which identifies the traits of resiliency and how they can be developed. It also examines some of the reactions that take place in the human brain when traumatic events are experienced. This article presents one perspective on resiliency that may help readers to develop stronger personal resiliency, find ways to create an environment that develops resilient Soldiers, and enable resiliency within organizations as they cope with change and traumatic events.

For the U.S. Army Ready and Resilient campaign, resiliency is defined as "The mental, physical, emotional, and behavioral ability to face and cope with adversity, adapt to change, recover, learn and grow from setbacks."[1] Based on personal research, I define resiliency as the ability to demonstrate an optimistic behavior and the potential for growth in the face of change or traumatic experiences.

Resilient individuals react positively to events, while nonresilient individuals become pessimistic, fail to develop, and allow events to destroy them emotionally and physically. Resiliency enables growth. Change, stressful events, weakness, and trials are variables to which Soldiers may be exposed. These variables require that Soldiers learn to adapt and overcome, thereby becoming wiser and stronger. Through this adaptation, Soldiers can become innovative and discover new talents and strengths they would not have known they possessed. Stress, catastrophe, and drastic change are events that enable the discovery of hidden talents. Resiliency is the tool that enables innovation, the discovery of new talents, strengthening, and development.

To achieve this, leaders must learn what makes an individual resilient. Resilient individuals have specific traits that allow for an easier and more positive reaction to change or traumatic events. Individuals are not born to be resilient; resiliency is a trait that is developed throughout life. The following are associated with resilient individuals:

- A nurturing environment.
- Fulfilling experiences.
- A motivating purpose.

Nurturing Environment

The nurturing of a resilient individual begins during childhood and continues through adolescence. This nurturing can continue through adulthood via mentorship and guiding leaders who display their own resiliency. The process of nurturing helps create and shape a more resilient attitude in people. Attitudes are nurtured through the examples of parents, peers, leaders, and the culture to which an individual is exposed.

Fulfilling Experiences

Fulfilling experiences are those that make an individual stronger for having successfully coped with change or catastrophic events. They can lead to the reaching of a goal or the achievement of tangible results. Leaders can find ways of creating fulfilling experiences for their Soldiers, who can use this variable as an opportunity for growth. Resilient individuals grow and become more resilient as they overcome exposure to negative changes or catastrophic events.

The sustained, strategic bombing of the United Kingdom during the Blitz of World War II provides an example of how exposure to change or catastrophe can increase the resiliency of a group. Those who survived the countless German attacks became stronger because of them. In *David and Goliath: Underdogs, Misfits, and the Art of Battling Giants*,[2] Malcolm Gladwell describes the work of a psychiatrist who studied Londoners who survived the Blitz. Those who experienced "near misses" were traumatized, but "remote misses" made people feel invulnerable. The experience of the air raids greatly impacted the lives of Londoners, but did not destroy their ability to fight through the event; they become stronger and more resilient. A leader must take advantage of the learning opportunities caused by change to improve an organization. The leader must guide the members of the organization through the change-adapting process to enable them to have a fulfilling experience that supports their resiliency.

Having a Motivating Purpose

A motivating purpose plays the largest role in developing psychological resiliency. An article on psychological resiliency written by Michele M. Tugade, Barbara L. Fredrickson, and Lisa F. Barrett states that ". . . positive emotions contribute to psychological and physical well-being via more effective coping."[3] The authors explain that focusing on a purpose can help an individual develop the positive emotions necessary to be resilient during times of change or stress. Any change or catastrophic event can be overcome when positive emotions are focused toward that purpose.

A great example of how a purpose can motivate a man to push for survival can be found in Aron Ralston's book, *Between a Rock and a Hard Place*.[4] While rock climbing in Utah, Ralston became trapped in a crevasse when an 800-pound boulder pinned his arm. He endured 6 days stuck in the crevasse before finding the determination to amputate his own arm. He found this determination—his motivating purpose—when he dreamed of a little boy running toward him, giving him a vision of the son he wanted. This became his purpose, which gave him the psychological strength to amputate his arm and save himself from dying in the hot Utah desert. That purpose gave him the resiliency to take the action that saved his life.

A Soldier's motivating purpose may be a personal matter or an organizational matter. Leaders must help peers and subordinates become more resilient by helping them realize their purpose. A biological effect takes place in the brain of individuals with a purpose, allowing them more optimism in the face of change or catastrophic events. Researchers using a functional magnetic resonance imaging system exposed highly optimistic subjects to evidence that would challenge their optimistic perceptions of specific everyday activities, such as the likelihood of dying in a car accident. When that evidence contradicted the optimistic perceptions of the subjects, brain imaging indicated that the evidence was not stored in memory. However, when the evidence substantiated the optimistic outlook of the subjects, there was an increase in brain activity showing that the information was being stored in memory. The research on optimism demonstrated that chemical reactions in the brain allow greater resiliency when events threaten the perspective or outlook of optimistic people. When people focus on a purpose, anything that threatens or contradicts that purpose will not be stored into memory. That lessens the effect and allows people to retain their level of resiliency.

"Leaders can enable resiliency and growth in an organization by recognizing the learning opportunities and the opportunities for development created by change or catastrophic events."

As the military evolves and is exposed to changes and catastrophic events, organizations must learn to adapt to become successful. The manner in which the members of the organization adapt and respond to those changes and catastrophic events determines if the organizations will succeed or fail. Catastrophic events can have positive or negative effects on an organization, depending on the resiliency of its members. Leaders can enable resiliency and growth in an organization by recognizing the learning opportunities and the opportunities for development created by change or catastrophic events. Leaders must understand the variables that create a resilient Soldier and attempt to help the Soldier become more resilient. A resilient organization will be a learning organization, with the understanding that growth comes from failure and the ability to adapt to and overcome challenges. If the leaders of an organization recognize that change and flux will occur and understand that they can result in growth, a transformed attitude will enable the resiliency of the members of the organization.

Endnotes:

[1]"Ready and Resilient," <http://www.army.mil/readyandresilient>, accessed on 24 August 2015.

[2]Malcolm Gladwell, *David and Goliath: Underdogs, Misfits, and the Art of Battling Giants*, Little, Brown, and Company, New York, New York, 1 October 2013.

[3]Michele M. Tugade, et al, "Psychological Resilience and Positive Emotional Granularity: Examining the Benefits of Positive Emotions on Coping and Health," *Journal of Personality,* Vol. 72, No. 6, 2004, pp.1161–1190.

[4]Aron Ralston, *Between a Rock and a Hard Place,* Atria Books, New York, New York, 2004.

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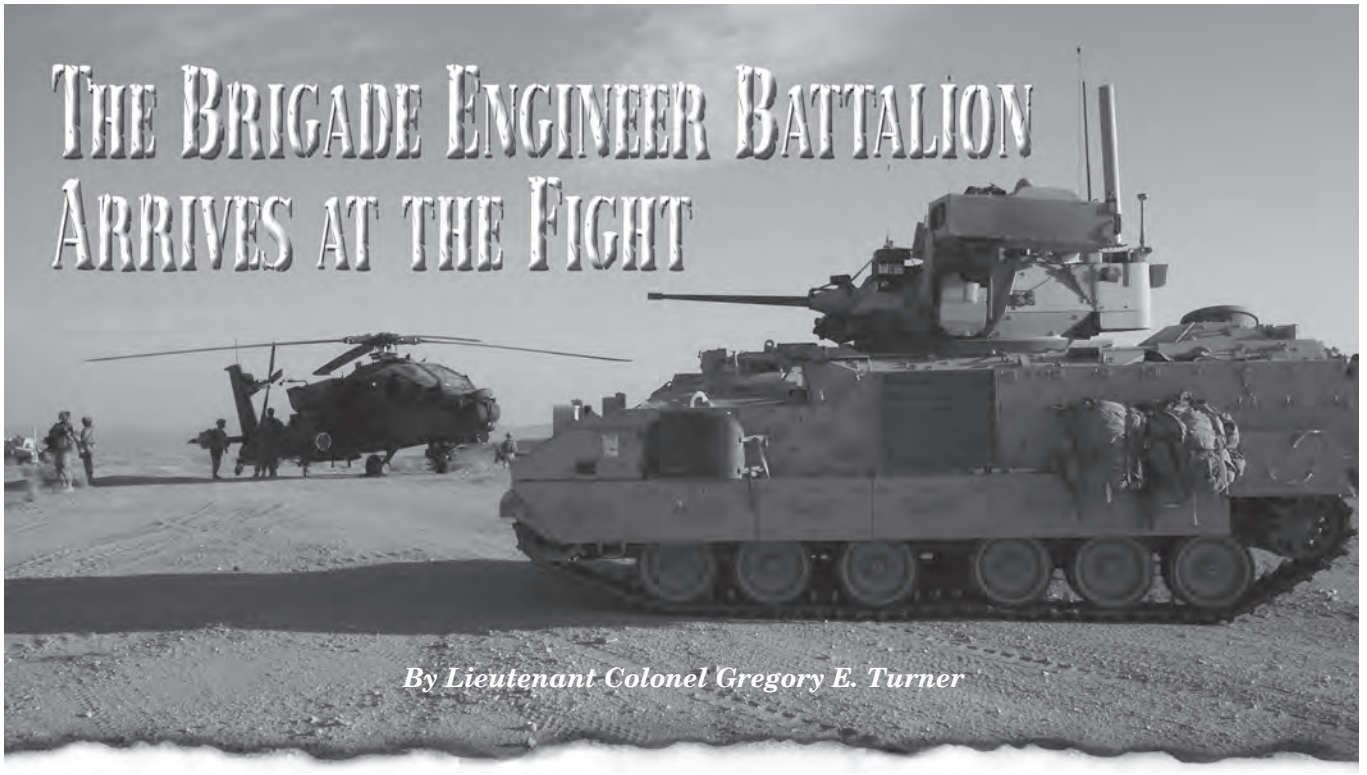
The Brigade Engineer Battalion Arrives at the Fight



By Lieutenant Colonel Gregory E. Turner

The Path to the Brigade Engineer Battalion

Since the first U.S. Army units began converting into modular brigade combat teams (BCTs) in September 2003, divisional engineer battalions habitually assigned to support BCTs were replaced with brigade special troops battalions (BSTBs). In heavy BCTs (now designated armored BCTs), engineer companies were initially assigned to each combined arms battalion before they were combined into a single engineer company in the BSTB (like infantry BCTs). In a few years, engineer support to armored BCTs dropped from a full engineer battalion to a single company. As impressive as it was for the Army to make these changes while fighting wars in Iraq and Afghanistan, shortcomings in this new organization were clearly revealed. While the loss of the mission command provided by the engineer headquarters was felt, the nature of the conflicts highlighted gaps in general engineering and mobility—especially route clearance—capabilities.

By early 2009, the requirement to bring an engineer headquarters back into the BCT was identified and the design of the brigade engineer battalion (BEB) began at the Maneuver Center of Excellence, Fort Benning, Georgia; and the Maneuver Support Center of Excellence, Fort Leonard Wood, Missouri. By fiscal year 2014, the first BEBs were forming from BSTBs or echelons-above-brigade (EAB) engineer battalions.

Leaders from the 588th BEB gather before conducting a mission rehearsal at NTC.

Cuts and Changed Capacities

In essence, the BEB was not fundamentally different from the BSTB. It continued to house the engineer, intelligence, signal, aviation, and chemical units organic to the BCT. Even the

Soldiers carry a casualty role player to a waiting ambulance.

number of Sapper platoons did not change. However, this new organization did address mission command and specific engineer capability gaps. The engineer colors brought with them an engineer command team and engineer staff, providing a focus and expertise that often didn't exist within the BSTB. In the Stryker BCTs, the addition of BEBs filled an even greater mission command gap since these units had not been authorized BSTBs. The BEB also added organic route clearance and gap-crossing capabilities, while significantly increasing the breaching capability of armored BCTs through the fielding of the Assault Breacher Vehicle. Also, the BSTB support platoon was replaced by a forward support company. The reality of growing this engineer capacity in a constrained environment led to several cuts. The BSTB organic military police platoon and a planned vertical construction platoon were eliminated from the structure to help keep the total number of troops in the BCT below 4,500.

BEBs at the National Training Center

The National Training Center (NTC), Fort Irwin, California, saw its first BEB in February 2014 when the 1st Armored BCT, 1st Cavalry Division, deployed with the 1st Brigade Special Troops Battalion "Centurions." That battalion was reflagged during the rotation to become the 91st BEB "Sabers." While the 91st BEB transition was not entirely complete, the BEB had reorganized its companies, lost its military police platoon, and formed a forward support company (FSC). The second engineer company of the battalion did not participate in the rotation since it had recently redeployed from Afghanistan. The 91st BEB had a successful rotation, but it was not asked to integrate the two clearance companies, which were instead task-organized under the combat sustainment support battalion.

The next BEB trained at NTC when the 588th BEB arrived with the 3d Armored BCT, 4th Infantry Division, in November 2014. The 588th BEB, the first fully formed BEB to train at NTC, included a number of task-organized enablers, including military police, explosive-ordnance disposal, civil affairs, and tactical psychological-operations companies. (While two additional EAB engineer companies also supported the BCT, they fought under the 4th Engineer Battalion.)

During the next rotation, the 70th BEB arrived at NTC in support of the 1st Stryker BCT, 25th Infantry Division. While NTC had seen Stryker BCTs with provisional BSTBs and EAB engineer battalions, the 70th BEB was the first of its kind there, providing mission command for BCT enablers and increased engineer capabilities. Since then, every active duty BCT that has deployed to NTC has been organized with a BEB. The 3d Stryker BCT, 2d Infantry Division, even borrowed the 14th BEB from its sister BCT since its own BEB had not been activated in time for the rotation in July 2015.

Observations and Challenges

While the BCTs clearly benefited from the engineer capabilities and mission command provided by the BEBs, the significant challenges identified include the—

- ***BEB commander role as engineer coordinator.*** The addition of the BEB provides the BCT with a robust battalion staff and a senior engineer commander who has

much more experience than the BCT staff engineer and is capable of complementing BCT engineer plans and operations officers. Units are successful in sending an engineer tactical command post forward so that the BEB commander or operations officer can monitor and adjust obstacle and survivability support to the BCT defense. This allows the resynchronization of the engineer effort when it changes from the plan and facilitates the shared understanding of the engineer portion of the common operating picture.

However, although doctrine now designates the BEB commander as the brigade engineer in the BCT, it does not dictate who the engineer coordinator is in cases where an EAB engineer battalion is assigned to the BCT. That decision can go either way, based on a number of factors, including the BCT commander's concept for employing the BEB and an established working relationship with the EAB engineer battalion.

Another factor is that, unlike the commanders of the premodularity/divisional engineer or EAB engineer battalions, the BEB commander often does not have the luxury of focusing exclusively on the engineer fight. In addition to providing oversight of the BCT military intelligence and signal operations, the BEB is often assigned an area of responsibility. In the first three BEB rotations at NTC, two BCTs assigned responsibility for the security area to the BEB. In the third rotation, the BCT did not assign the security area to any particular headquarters. The BCT commander's decision to assign an area of responsibility to the BEB risks greatly reducing the ability of the BEB commander to serve as the engineer coordinator.

Additionally, the BCT staff engineer must establish a close relationship with the BEB commander and staff. While divisional engineer battalion commanders are the senior raters for the BCT staff engineers, there is no consensus on the relationship between the BEB commander and the BCT staff engineer. Instead, the BCT staff engineer is frequently assigned other duties within the brigade staff, which hinders the development of a relationship with the BEB and with engineer planning as a whole.

- ***BEB relationship with an EAB engineer battalion.*** The issue of the BEB commander role as the engineer coordinator is not as simple as an internal BCT discussion. While only one of the first three BEB rotations at NTC included an EAB engineer battalion, most rotations since then have included a BEB and an EAB engineer battalion. In the first case with both a BEB and an EAB, the EAB engineer battalion commander served as the BCT engineer coordinator. This was partially due to the timing of the BEB conversion and to the habitual relationship that the EAB engineer battalion had established with the BCT.

  Unit staffs must analyze the number and types of engineer and other enabler companies, the breadth of missions and their geographical dispersion, and the capabilities of each headquarters on a case-by-case basis. Only then can they make decisions to assign tasks, array forces, and locate headquarters.

Soldiers defend the perimeter of the 70th BEB tactical assembly area.

BEB leaders review operational graphics in preparation for the defense.

Instead, BCTs are requesting to drop EAB engineer battalions from their rotations as an unintended consequence of the conversion of BSTBs to BEBs. While they have legitimate concerns about the number of subordinate, battalion level headquarters under their umbrella, the primary issue seems to be a lack of understanding of the capabilities and limitations of the BEB.

- ***Span of control.*** The BEB starts with six organic companies (seven in a Stryker BCT); but much like the BSTB before it, the BEB usually receives all the enablers who are assigned to the BCT without their own battalion headquarters. This normally consists of at least military police and explosive ordnance disposal companies, but may also include additional engineers, civil affairs personnel, psychological operations, and chemical units. Though the 91st BEB was an outlier with only five companies, the other BEBs fought with 10 to 11 subordinate companies each. Since a BEB provides only about 25 percent of the engineers required for a BCT (based on doctrinal rules of allocation), there is a presumption that they will receive augmentation by EAB engineers. However, if an EAB battalion headquarters is not assigned to the BCT, the BEB could be task-organized with 14 or more company headquarters (six to seven organic companies, six EAB engineer companies based on rules of allocation, and military police and explosive ordnance disposal companies).

  Aside from too many participants to effectively control, another challenge facing the BEB is the tasking of too many mission sets. The most basic responsibility of the BEB is to provide all of the functions formerly conducted by the BSTB. As a force provider for military intelligence, signal, and engineer capabilities, the BEB provides mission command, sustainment, and advocacy for these essential enablers. To those who claim that the BEB can just give up direct support of the military intelligence and signal units to the BCT, consider that the BCT intelligence and signal officers no more "own" these companies than the BCT logistics officer owns the brigade support battalion. When asked to perform the historical BSTB function, serve as the engineer coordinator, and execute other tactical tasks, something must fall to the wayside.

- ***FSCs not fully formed.*** On top of these other more academic challenges, BEBs are arriving at NTC with very real deficiencies in personnel and equipment within their FSCs. Often, the FSCs are new to the BEBs, built up from the former support platoons of the BSTBs. Even when units bring an existing FSC during their conversion from an EAB engineer battalion, there are serious personnel shortages, especially among noncommissioned officers. These problems are further aggravated by the lack of organic lift support within the engineer companies. This leaves the engineer platoons unable to execute a task as simple as loading a mine-clearing line charge tube without finding external support.

Conclusion

The transition to the BEB has provided an amazing opportunity to increase the effectiveness of engineers where the rubber meets the road within the BCTs. Now that the Army is far enough along with its conversion to the BCT 2020 design, BEB participation in rotations will be the norm. How will the design and use of the BEB help enable the BCT? I hope that this article helps BCT and EAB leaders better understand the evolving role and specific challenges of the BEBs.

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Economic Analysis: Metric-Driven Decisionmaking

By Major Bryan R. Dunker

Between 2010 and 2015, the U.S. defense budget was reduced from $721 billion to $637 billion, while funding for military construction decreased by 75 percent. Resourcing for buildings needed for training, administrative, and maintenance purposes for the U.S. Army will probably follow this declining trend over the next several years. How do we determine the best way to allocate diminishing funds for military construction?

One powerful tool to use in finding a solution is economic analysis (EA), a method that allows planners to evaluate project alternatives and provides a process to identify the optimal solution. This article describes the fundamentals of EA and explains why it is important for engineer professionals to understand this effective tool.

EA is a systematic method used to identify, quantify, and analyze alternative approaches to achieve the most efficient economical solution to resolve a specific requirement. Due to budgetary limitations, the Army cannot fund and construct all required projects. EA provides a metric-driven comparison for all possible alternatives to meet the project requirements. Ultimately, the decisionmakers in the Department of Defense and Congress will review this data to make the best-informed decision on the use of resources.

The seven steps of EA are as follows:

- ***Establish the project objective.*** A clear and concise statement that quantitatively describes the project requirements is a critical beginning step. An unbiased statement that does not propose possible solutions is the key to the objective.
- ***Identify alternatives.*** All viable and nonviable alternatives need to be identified to ensure that a methodical and thorough analysis was incorporated into the process. It is important to note that failure to include all alternatives might challenge the validity of the EA.
- ***Formulate assumptions.*** The identification of assumptions is necessary to account for circumstances that may affect the results. Some common areas of assumptions include the estimated life cycle of a building, the estimated replacement time of different building components, and the estimated future costs of typical mechanical repairs.
- ***Perform a cost–benefit analysis.*** The costs and benefits associated with each alternative over the life of the project must be assessed. In an EA, costs are compared over the period of the analysis, taking into account money that is received or spent at different times. To accurately account for the time value of money, present value calculations are completed. This "discounting" calculation converts future values of money to the present value to ensure that fair comparisons of costs and benefits are reported for each alternative.
- ***Determine nonmonetary considerations.*** This step is an opportunity to define issues of morale, mission impact, security, and safety for all viable alternatives. It allows the decisionmakers to review and weigh the impact of nonmonetary effects.
- ***Perform a sensitivity analysis.*** This step addresses the "what if" questions. For example, what if construction costs turn out to be 15 percent higher than estimated? Selected expenses can be varied between lower and upper limits for comparison. That comparison often clarifies alternatives that are similarly ranked from previous steps.
- ***Report results and recommendations.*** The EA report contains significant details of the analysis and includes data sources for estimated costs and benefits. The report also specifies the recommended alternative since the cost comparison alone may not determine which alternative best meets the project objective.

A properly executed EA requires a significant amount of data, advanced accounting calculations, and a clearly stated report that summarizes the results. The software program Economic Analysis Package helps facilitate the EA process and accurately calculates the results. It also produces the results in a concise report that complies with Department of Defense regulations. The program is available to contractors working on government projects and to users of the Military Construction Programming, Administration, and Execution System.[1]

EA is a powerful tool for engineer professionals to support data-driven decisions in military construction. It provides comparable metrics for decisionmakers in the Department of Defense and Congress to best allocate funding in this age of limited resources.

Endnote:

[1]Department of the Army Pamphlet 451-3, *Economic Analysis: Description of Methods*, 10 August 1992.

Major Dunker is an engineer project officer at the U.S. Army Reserve 63d Regional Support Command, Mountain View, California. He is a graduate of the U.S. Army Ranger School and the Sapper Leader Course. He holds a bachelor's degree in mechanical engineering from Lehigh University, Bethlehem, Pennsylvania. He is a certified project management professional.

By Captain Garrett D. Anderson

This article is directed toward new Soldiers who are comfortable in their jobs. They should remember that life begins at the end of their comfort zone and realize that uncomfortable jobs will broaden their experience and allow them to grow.

The comfort zone is the area in one's mind where he or she can feel at ease performing familiar jobs proficiently. There may be occasional stress and anxiety, but people are generally happy to stay in the zone and achieve mediocrity. Some people who stay in their comfort zone will be successful and get promoted, but some will find themselves outside the zone and will fail because they are in an unfamiliar place. The Army does an outstanding job of laying out a typical, comfortable career path for officers and enlisted Soldiers and facilitating each step along that path. An enlisted Soldier will typically become a team leader, attend the Warrior Leader Course to learn small-group leadership skills, and eventually become a squad leader and platoon sergeant. Officers regularly progress from platoon leader to executive officer to staff officer.

"Duties that force us out of our comfort zone typically enhance our ability to see the whole fight—not just the fight from our own foxhole."

Engineers typically work in an operations section, where it should be relatively easy to maintain their comfort zone. This doesn't imply that assignments in the operations section are unimportant; they are crucial for leader development and essential to gaining the common operating picture needed for a successful career in the Army. But staying there may not help an engineer expand as a leader. People who stay in their comfort zone and continue doing the same jobs over and over will be very proficient at them and will likely become the "go to" people for those jobs. But exposure to other facets of the total Soldier experience will be greatly limited.

Leave the Zone

An assignment on an operations staff is not a bad thing. Engineers can be very useful and successful without ever leaving their comfort zone. However, there is more to a mission than just operations. There are numerous moving pieces in the background that are vital for the success of the operation. Therefore, it is a leader's responsibility to understand the pieces, such as personnel actions, communications, intelligence, and the unsung but vital workings of logistics. Duties that force us out of our comfort zone typically enhance our ability to see the whole fight—not just the fight from our own foxhole. This is important because it helps enhance predictability (which is crucial to the morale of subordinates), and it helps leaders better advise their superiors. Leaders who have stepped out of their comfort zone and can offer a different perspective on a situation will likely be better off than people who have stayed in their own lane.

Continue to Grow

Throughout my career, it has been my goal to take jobs outside my comfort zone. I chose to become an engineer officer even though I am terrible at mathematics. I chose to work at U.S. Army Central as a captain when most people assigned there are in the grade of lieutenant colonel or above. I volunteered to be a battalion supply officer with no experience in logistics. I didn't know beforehand that, as a battalion supply officer, I would learn how to push a unit out for a no-notice deployment to Africa. My most recent job as company commander in an aviation support battalion is completely outside my comfort zone. I am certain that in my current assignment, I will learn invaluable lessons that will take me to the next level of my career. I challenge readers to also take the leap, step out of their comfort zone, and take the tough jobs.

Captain Anderson is a graduate of Officer Candidate School, the Engineer Officer Basic Leader Course, and the Engineer Captains Career Course. He holds a bachelor of science degree from Fayetteville State University, Fayetteville, North Carolina, and a master of public administration degree from Webster University. He serves as the commander of Headquarters Support Company, 404th Aviation Support Battalion at Fort Carson, Colorado.

THE REAR AREA FIGHT:
844TH ENGINEER BATTALION
IMUA DAWN 2015 PERSPECTIVES

By Major Jeffrey M. Jones

The 844th Engineer Battalion, U.S. Army Reserve, headquartered in Knoxville, Tennessee, was an available (but unsourced) Army force generation unit in fiscal year 2015. Therefore, the battalion did not receive a programmed, formal exercise for the 2015 training year. However, the 844th completed a combat support training exercise as the engineer headquarters assigned to the 303d Maneuver Enhancement Brigade (MEB), Fort Shafter, Hawaii, and found that the battalion and brigade staffs worked well together. The senior enlisted Soldier in the 303d said that the staffs became *ohana*, or "family." At the conclusion of that exercise, the 303d MEB began planning Exercise Imua Dawn 2015 and invited the 844th Engineer Battalion to participate.

Brigade Training Intent

Exercise Imua Dawn is the command post exercise for 3d MEB operations in the Pacific area of responsibility. It focuses on the brigade mission-essential tasks in a fictitious location in the Pacific. The scenario is an active Phase 3 fight, with the brigade conducting offensive operations in the division rear area. Held at Sagami Depot, Japan, the 10-day exercise aims to establish, implement, and test the exercise concept, design, and infrastructure; integrate exercise controller operations with observer-controller support; exercise the commander's training objectives for the staffs of the brigade and the participating battalions; and set the conditions for making it the Army's premier MEB command post exercise.

Battalion Training Objective

Because the 844th Engineer Battalion received external evaluations from the 75th Training Division at Warrior Training Exercise in 2013 and Combat Support Training Exercise 91-14-03 in 2014, the desired outcome was to use the battalion observers-controllers trainers as coaches, teachers, and mentors. The commander's training objectives were focused on implementing the rapid decisionmaking and synchronization process on the digital battlefield, while integrating a newly formed staff.

Significant planning must go into staffing to gain maximum benefit from a command post exercise based on the Joint Command and Control Attack Simulator. Two main objectives were used to fill the 18 positions required for the 844th Engineer Battalion team attending Exercise Imua Dawn 2015: bring as many primary staff officers and noncommissioned officers as possible; and place two future company commanders to operate the lower control, execution-level Joint Command and Control Attack Simulator. The primary benefit of this approach is that it created cohesion among a newly formed staff consisting of a battle captain and intelligence, operations, and supply officers who had been assigned those roles for less than 6 months. In simulation events, some headquarters elements may begin micromanaging operations at a lower level than necessary. This usually happens when units provide junior enlisted Soldiers to act as company commanders with responsibilities for which they have no experience or frame of reference. To prevent this, two senior first lieutenants were assigned as simulation operators and provided with the operational instructions to fight and manage their terrain. This allowed the lower controls to engage enemy targets in their operational areas without battalion tactical operation center (TOC) directions and approval. The lower control unit commanders made those decisions just as small-unit leaders on the battlefield would, operating within the rules of engagement and reporting details and results to the battalion TOC. Staffing the event this way allowed the battalion staff to exercise its real function in tracking and managing the higher-level fight rather than directing squad- and team-level movements on the battlefield.

Digital Battlefield Visualization

In 2010, the 926th Engineer Brigade, 412th Theater Engineer Command, issued nine Command Post of the Future (CPOF) Systems to each battalion headquarters, setting conditions to move operation centers into the digital battlefield. The 844th Engineer Battalion began training in depth with these systems in 2012 as preparation for the Warrior Training Exercise. During the trainup for that event, the battalion used a 4th Infantry Division tactical standard operating procedure (SOP) as the template to create a digital battlefield visualization SOP for its own TOC. Unfortunately, the backbone network for the system did not materialize, so the digital battlefield SOP remained incomplete. Exercise Imua Dawn 2015 would provide full CPOF functionality for the first time since the battalion became involved in forward deployed operations. The intent was to force complete use of the CPOF System for all battalion TOC functions as a way to validate the digital battlefield tactical SOP for functionality and use in the battalion headquarters. Therefore, all analog tracking systems were removed from the battalion TOC to

eliminate the crutch of defaulting to the hard mapping and tracking matrices normally found in any TOC. The battalion entered the exercise with digital battlefield visualization and tactical SOP development at about 15 percent completion. Leaders estimated that the battalion would finish the exercise with a 75 percent solution.

An 844th Engineer Battalion battle captain manages the fight using battlefield visualization techniques with the CPOF-generated common operating picture.

Overall Impressions

Working with the 303d MEB for 24 months was a great experience for the 844th Engineer Battalion. The conduct of an exercise in the rear area offensive fight provided training that none of the staff captains, lieutenants, or senior noncommissioned officers had ever received. Leaders took away clear lessons in conducting offensive task force-based combat, area security operations, and consequence management in a First World country. The unit left the exercise with an updated tactical SOP equipped with running estimates for tracking and employing infantry; chemical, biological, radiological, nuclear, and explosives; and military police Soldiers. It also attained a functional digital battlefield visualization standard. The successful completion of the exercise means that the headquarters will return with a readiness posture much higher than what it had when it arrived. Sagami Depot was a terrific host for this event, with a modern, comfortable simulation center and many interesting nearby entertainment options that provided battalion Soldiers with an unparalleled avenue for experiencing Japanese culture. The location forced closer interaction between battalion and brigade staff elements. Based on the results of this event, the 844th Engineer Battalion staff fully supports the Imua Dawn concept and looks forward to training with ohana again in the future.

Major Jones is the executive officer of the 844th Engineer Battalion. He holds bachelor's and master's degrees in agricultural and biological engineering from Mississippi State University and is a registered professional civil engineer and project management professional. He is a senior project manager for Tetra Tech, Incorporated.

Soldiers from the 255th Engineer Detachment (Asphalt), a unit of the 230th Engineer Battalion, Tennessee Army National Guard, conduct paving operations at the Milan Volunteer Training Site, Lavinia, Tennessee. The Soldiers were some of the 36 detachment members who took part in the annual training. They paved two parking lots and three driveways, using 805 tons of asphalt in the process. The site, midway between Memphis and Nashville, is used by all Tennessee Army National Guard units; Regular Army units from Fort Campbell, Kentucky; U.S. Navy and U.S. Air Force Reserve Officer Training Corps cadets; sheriff departments from across the state; and local police departments and special weapons and tactics teams.

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ENGINEERS' CREED

As a Professional Engineer, I dedicate my professional knowledge and skills to the advancement and betterment of human welfare.

I pledge—

- To give the utmost of performance.
- To participate in none but honest enterprise.
- To live and work according to the laws of man and the highest standards of professional conduct.
- To place service before profit, the honor and standing of the profession before personal advantage, and the public welfare above all other considerations.

In humility and with the need for divine guidance, I make this pledge.

Adopted by National Society of Professional Engineers, June 1954

PIN: 105442-000