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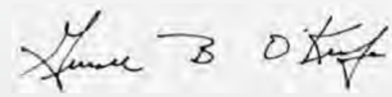

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Front cover: The 19th Engineer Battalion conducted a spring field training exercise on Tobacco Leaf Lake at Fort Knox, Kentucky. Photo by Charles Leffler.

Back cover: 12th Annual Lieutenant General Robert B. Flowers Best Sapper Competition. Photos by Mike Curtis.

DEPARTMENTS

FEATURES

Clear the Way

Brigadier General Robert F. Whittle Jr.
97th Commandant, U.S. Army Engineer School

The Engineer Regiment in 2040

In 1927, the 1st Cavalry Division Commander, Brigadier General Moseley, wrote to the Chief of Cavalry, Major General Crosby, "that his division had too many animals and needed more motor transportation, particularly in the logistical elements. Furthermore, he wanted more armored cars. To drive his point home, Mosely wrote: 'When the cowboy down here is herding cattle in a Ford®, we must realize that the world has undergone a change.' "[1]

The Engineer Regiment must lead today's revolution in military affairs in order to deter our enemies and ensure victory. In previous decades, we held many advantages over our enemies, including precision-bombing, night vision, and unmanned aircraft system capabilities. Those advantages have largely eroded due to the democratization of technology. On multiple occasions last year in Mosul, Iraq, the Islamic State in Iraq and Syria (ISIS) equipped recreational drones with grenades, flew them to precise locations, and dropped the ordnance on exact targets. This clearly demonstrates that the aforementioned advantages have eroded and that our enemies can rapidly adapt to technological change and field new systems.

It took the military forces of the world decades to adapt to the technological changes brought about by railroads, the combustion engine, flight, machine guns, and wireless communications, resulting in the long stalemate that occurred from 1914 to 1918, during World War I. Yet technology is evolving much faster today than it did in the late 1800s and early 1900s. In accordance with Moore's Law,[2] computing power continues to grow exponentially while our computing platforms grow smaller and smaller. Those increases in processing power, along with advances in autonomy, machine learning, locomotion, and battery power, are driving new opportunities in robotics.

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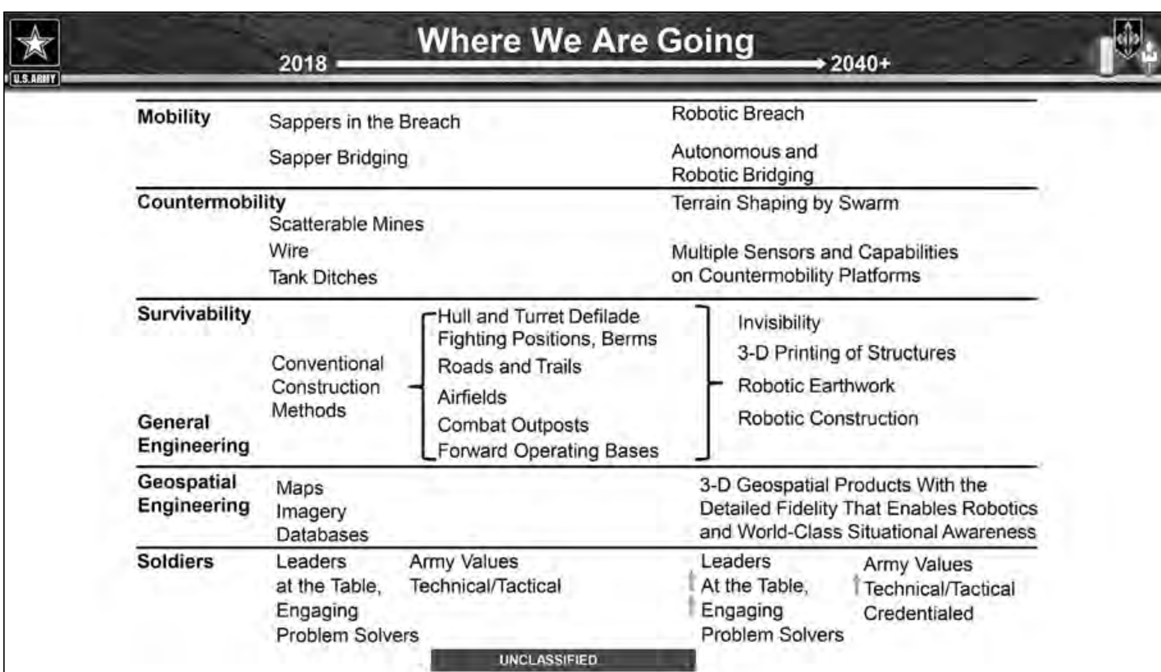

Lead the Way

Command Sergeant Major Trevor C. Walker
U.S. Army Engineer School Command Sergeant Major

Essayons! I hope everyone is having a great summer. We have been very busy here at the U.S. Army Engineer School (USAES) during the last couple of months. We continue to focus on the future to make sure that the Engineer Regiment is prepared for what is next and is ready to accomplish the Army missions, whatever they may be.

I am continuing to visit as many of our Engineer units as possible. Since my last article, I visited the Soldiers of the 911th Technical Rescue Engineering Company (TREC) at Fort Belvoir, Virginia. They have an awesome mission. The company is assigned to the 12th Aviation Battalion [Army Aviation Brigade], Military District of Washington. The 911th TREC includes combat engineers, firefighters, horizontal- and vertical-construction engineers, and various support military occupational specialties that receive training and certification as rescue technicians and mine rescuers. The 911th TREC is on a short response time to deploy anywhere in the National Capital Region. During my visit from 19 March to 2 April 2018, the 911th TREC conducted platoon validation with interagency partners at the Center for National Response in Gallagher, West Virginia. Some of the training they participated in included rope rescue, confined space, structural collapse, and mine and tunnel rescue. I am truly impressed with what the 911th does for the Engineer Regiment and our country.

While at Fort Belvoir, I also visited the 249th Engineer Battalion–Prime Power and met some amazing military occupational specialty (MOS) 12P engineers, who are helping to restore power to Puerto Rico and other areas of the world that were devastated by the hurricanes last year. The 249th Engineer Battalion–Prime Power, assigned to USACE, is a versatile power generation battalion assigned to the U.S. Army Corps of Engineers that provides commercial-level power to military units and federal relief organizations during full spectrum operations. The 911th and the 249th do great things for the U.S. Army and the Engineer Regiment. Please look for more information on these great units if you are interested in joining their teams. I am currently planning more trips to other units; I cannot wait to see what you all are doing out there to support the Army's mission. I may be seeing some of you soon.

We recently conducted the annual Engineer Regimental Week (16–20 April 2018). The week started with the 12th annual Lieutenant General Robert B. Flowers Best Sapper Competition and ended with the Engineer Total Army Planning Exercise (ENTAPE). As always, the Best Sapper Competition lasted a grueling 3 days, and it went very well. I want to congratulate all the competitors, especially the top three teams:

- In first place was team No. 13, with Sergeant First Class Robert Clark and Captain Rudy Chelednik from the 21st Brigade Engineer Battalion, 3d Brigade Combat Team, 101st Airborne Division, Fort Campbell, Kentucky.
- In second place was team No. 23, with First Lieutenant Thomas Hoyt and Sergeant Gary Coggins from the 1st Engineer Battalion, 1st Armored Brigade Combat Team, Fort Riley, Kansas.
- In third place was team No. 12, with First Lieutenant Louis Tobergte and First Lieutenant Andrew Warner from the 54th Brigade Engineer Battalion, 173d Airborne Brigade Combat Team, Vicenza, Italy.

The Best Sapper Competition was just the first of many events that week. We also conducted a field force engineer workshop, and a Best Sapper Competition dedication ceremony (in which the competition was officially named the Lieutenant General Robert B. Flowers Best Sapper Competition and Lieutenant General Robert B. Flowers [Retired], was made the first-ever honorary Sapper). At the beginning of Regimental Week, the 20th Engineer Brigade (Airborne) dedicated a new unit plaque for the Engineer Regimental Room—something that I would urge other units to do since some of the plaques are outdated. There was also a Spouses Day, an Army Engineer Association vendor display, a meeting of the Senior Engineer Leader Counsel, a sapper tribute ceremony (followed by a Gold-Star Family dinner), a Regimental Run, the Regimental Ball, and finally the ENTAPE. The Senior Engineer

Leader Conference and ENTAPE served to ensure a "Ready and Relevant Engineer Regiment" (across all components), ensure unity of purpose for vital modernization programs, and enable a forum to share readiness best practices. It was a great week to be on Fort Leonard Wood and to be able to reconnect with fellow engineers. If you are ever on Fort Leonard Wood during Engineer Regimental Week, you will be amazed at all that is going on.

Another big thing we are working on at USAES is the Specialized Deliberate Breaching Course. Training is currently taking place at the Fort Hood, Texas, Underground Training Facility and Urban Assault Course, April–November 2018. We are training two 11-day courses each month, with each course having 36 students and a training cadre of 14 personnel. We have completed two courses so far, and I must say that the training is going well. The trainers are providing the conventional force with training that has been long overdue, and those who attend the course get a great skill set. This may lead to a future enduring course here at Fort Leonard Wood.

The credentialing program within the Engineer Regiment continues to improve as well. This is the first year that we actually ran out of seats for the Project Manager Professional study program. However, although we are out of seats at this time, we can still fund the examination and membership for Soldiers who studied on their own. We are also continuing to work to align degree plans for the streaming Career Management Field (CMF) 12 MOS. We have completed the final CMF 12 MOS alignment with the National Center for Construction Education and Research by providing credentials for all engineer MOSs. The partnership with the USACE for the Fundamentals of Engineering, Professional Engineering, and American Institute of Architects examination preparation courses have been finalized and are open for enrollment. We are also working on future memorandums of understanding with universities so that engineers might earn college credit for the military schools they complete.

I want to congratulate all of the engineers who made the last master sergeant promotion list and the command sergeants major who are going into nominative positions. It makes me proud to see Soldiers progress through their military careers and take on roles of increased responsibility. I am sure they will all do great things in their new positions.

Finally, I urge everyone to visit the Army Career Tracker Web site at <https://actnow.army.mil> and frequently check the Enlisted Engineer Community page to view policy updates and initiatives that the Engineer Regiment is working on. We will continue to push farther to improve the Engineer Regiment, and I hope that you will also.

Essayons!

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

Additionally, 3-D printing is revolutionizing how we manufacture everything from weapons to large structures. These innovations are not proprietary. The democratization of technology enables nations and organizations to rapidly copy advances. Therefore, the military force that adapts the fastest will have the advantage.

Advances in areas such as robotics and 3-D printing will allow the Engineer Regiment to take leaps ahead in our ability to provide mobility, countermobility, survivability, general engineering, and geospatial engineering on the battlefield. Many innovations are already available for us to leverage. A company in Holland has used 3-D printers to build a bridge across a canal. Unmanned aircraft systems have already demonstrated the ability to autonomously build a rope bridge. An enterprising hobbyist built a completely autonomous vehicle-launched bridge from a Lego® Mindstorms® kit. The Engineering Research and Development Center is using 3-D printing to produce buildings, Jersey barriers, and T-walls. Autonomous earthmoving equipment already exists.

Therefore, it should come as no surprise that by 2040, breaching and bridging will be executed robotically. Unmanned aircraft system swarms will shape terrain on demand. Survivability will be aided with camouflage that renders equipment invisible to sensors. Dozers will autonomously dig fighting positions. General engineering will make use of 3-D printing for structures, and autonomous construction equipment will be used to build roads and airfields. Geospatial engineers will provide the data and tools that enable robots to navigate. Even as these changes take place, we must recognize that these technologies are vulnerable and we must be prepared to fight in a degraded environment where robotic and informational capabilities can suddenly become unavailable.

The physics of the battlefield will continue to require that military engineers use mathematics and science to solve problems. As technology evolves and our military adapts, the Engineer Regiment will be an agent of change. Just as sappers lead the way on the battlefield, so we will lead in the revolution of military affairs.

Essayons—we will succeed.

Endnotes:

[1]David E. Johnson, *Fast Tanks and Heavy Bombers, Innovation in the U.S. Army, 1917–1945*, Ithaca, 1998.

[2]Graham Templeton, "What is Moore's Law?," 29 July 2015, <https://www.extremetech.com/extreme/210872-extremetech-explains-what-is-moores-law>, accessed on 29 May 2018.

Show the Way

Chief Warrant Officer Five Jerome L. Bussey
U.S. Army Engineer School Command Chief Warrant Officer

Greetings from the U.S. Army Engineer School.

In the past year, we selected more than 50 new warrant officers to join our cohort. Our instructors trained more than 50 Warrant Officer Basic Course (WOBC) students, 52 Warrant Officer Advanced Course (WOAC) students, and 19 Warrant Officer Intermediate-Level Education Follow-On students at Fort Leonard Wood, Missouri. This is a testament to the hard work that our instructors, training developers, and Engineer personnel development staff are performing to ensure that we bring in and train the best warrant officers in the Army. The U.S. Army Human Resources Command continues to manage our warrant officers to ensure that the right warrant officer is in the right position to provide commanders and leaders with sound engineering technical advice.

In February 2018, Chief Warrant Officer Four Tavaras Jones replaced Chief Warrant Officer Four Donald Bond as the 120A Construction Engineering Technician Course manager. During Bond's tenure as the course manager, he and his team set up a program enabling WOBC students to receive their 30-hour Occupational Safety and Health Administration certification before graduating from WOBC. He also integrated the Associate Constructor Certification examination into WOBC, which provided an opportunity for our Warrant Officer One students to receive that certification while in WOBC. Chief Warrant Officer Four Jones also brings a wealth of experience and knowledge to the course. I am confident that the course will continue to grow and improve under his leadership.

The U.S. Army Prime Power School held a change of command in May 2018. Chief Warrant Officer Five Corey Hill relinquished command to Chief Warrant Officer Four Donald Bond. During his time as the commander, Hill and his team resecured full Army accreditation from the U.S. Army Training and Doctrine Command. They also created, staffed, and officially formalized the tenant unit support relationship for the Prime Power School on Fort Leonard Wood through a memorandum of understanding between the Maneuver Support Center of Excellence, Fort Leonard Wood, and the U.S. Army Corps of Engineers. As a result of the agreement, validated by the Maneuver Support Center of Excellence Commanding General and the U.S. Army Corps of Engineers Deputy Commanding General, the Prime Power School is now synchronized with the Corps of Engineers, Fort Leonard Wood, and the Engineer School for support through mutually beneficial partnerships that facilitate operational transparency.

One of our senior warrant officers, Chief Warrant Officer Five Russell Gaines, has retired from the Army after more than 38 years of service. Gaines is an exceptional warrant officer, and I know that he will continue to serve our Nation in some capacity. His contributions to the Regiment, the geospatial community, and the intelligence community have been monumental. The initiatives that he championed and spearheaded will have a lasting effect on our Regiment, the U.S. Army, and our Nation. He is retiring from the National Geospatial Agency, where he supported and advised senior government officials of agile geospatial-intelligence environments on multiple domains that support warfighter missions and operations, homeland security/defense, and humanitarian and disaster relief operations. As the U.S. Army Training and Doctrine Command Capability Manager–Geospatial Coordinator and subject matter expert in support of the Engineer School, he ensured that U.S. Army command and control systems were developed with the capability to integrate the Standard Sharable Geospatial Foundation

(continued on page 47)

"The U.S. Army Human Resources Command continues to manage our warrant officers to ensure that the right warrant officer is in the right position to provide commanders and leaders with sound engineering technical advice."

Understanding Scheduling and Construction Management: Things to Consider

By Lieutenant Colonel Laurence M. Farrell (Retired) and Mr. Sam Petros

Scenario: Major Smith slowly walked into the project trailer. Having graduated a month ago with a master's of science degree in engineering with a focus on structures, he had signed into the U.S. Army Corps of Engineers (USACE) district a week ago and was now the resident engineer on a $150-million starship barracks construction project. On his desk was the contractor's monthly schedule submission with a request for approval. The schedule, with its multiple columns and numbers, befuddled him. His degree in structures focused on mechanics and design, not scheduling. Major Smith tried to analyze the submitted schedule. In looking at the last three submitted monthly schedule updates, he winced at the dozens of rows shifting toward the right and increasingly showing up in red with each subsequent schedule submission. Knowing that red was used as a warning color in engineering, he grew concerned. He was now in charge of this massive project, and the district commander and engineer expected the project to be finished on time and within budget. He also did not understand the fundamental project-tracking system, and he was unsure if the submitted schedule was acceptable. Major Smith then realized that he needed to increase his knowledge of scheduling and how it relates to project management to get a handle on the situation.

This scenario is not unique. Many officers in all Services serve first in the Services strategic engineering organization (USACE, the Naval Facilities Engineering Command, the U.S. Air Force Civil Engineer Center), usually after multiple tactical operational tours and with little training. Even when the opportunity of advanced civil schooling is afforded to the officer, the course of study is often technical and may not exactly align with his or her initial duty requirements.

Successfully serving as an engineer officer requires a firm understanding of scheduling management and the way in which each submitted schedule, from the contractor to the government, functions as a project management tool. Project management through scheduling is also equally applicable to the acquisition career field. This article focuses on the Critical Path Method (CPM) using Oracle's© Primavera Version 6 (P6) scheduling program; this combination of method and tool is the most common combination used in the industry today.

On almost all projects, contractors must submit a baseline schedule and monthly updates (Figure 1). The baseline schedule describes the sequence of construction activities, the duration of each activity and, if loaded with equipment and personnel, the means and methods of each activity. Once the government representative (usually the resident engineer) approves the baseline schedule, the contractor begins to submit monthly updates.

To effectively interpret the contractor's submitted schedule and monthly updates, the officer in charge must understand the common terms associated with each schedule. A working knowledge of scheduling terms provides newly arriving officers with a foundation on which to begin understanding the data provided in each schedule and to effectively manage the project. The following descriptions are from the Oklahoma state glossary of project management terms Web page, located at <http://www.okstate.edu/sas/v8/sashtml/orpm/chapa/index.htm>[1]:

- ***Activity Length.*** An effective schedule does not contain activities of more than 30 days in duration. Activities longer than 30 days in duration tend to mask schedule delays. More than any other issue, incorrect activity duration is the driving force for delayed project completion. For example, a project that has a 100-day duration would not even begin to affect the subsequent activity in the schedule until Day 101. Even if major issues were identified on Day 1 of the activity, the schedule would not show this delay for more than 3 months. This is obviously unacceptable from a construction project management perspective. To mitigate this issue, activities should be limited to not more than 30 days in duration. This ensures that project-related issues are identified on at least a monthly basis. Most government construction contracts prescribe a maximum duration of 30 days, so this may not be an issue. If the contract does not prescribe this constraint, then the owner should make it a condition of accepting the baseline schedule.
- ***Critical Path.*** The critical path consists of a series of project activities that determines the earliest completion date of the project (Figure 2, page 8). In addition to serving as a project management tool, the schedule is a legal document. The schedule can be used in court as a primary document as evidence, for arbitration, and for mediation. The schedule submitted by the contractor to the government is a binding agreement. It not only describes how and when the contractor will build the project, but it also prescribes what the government provides the contractor. The government has specific areas of responsibility in the schedule (often in the form of design approvals). Many officers who are newly assigned to residencies are unaware of this. From an owner's perspective, the results of this situation are often catastrophic. For example, if the schedule states that the government will review and accept shop drawings in 21 days, then the government must complete the review in 21 days or less. Any costs associated with a review time beyond 21 days are the responsibility of the government. If the contractor can

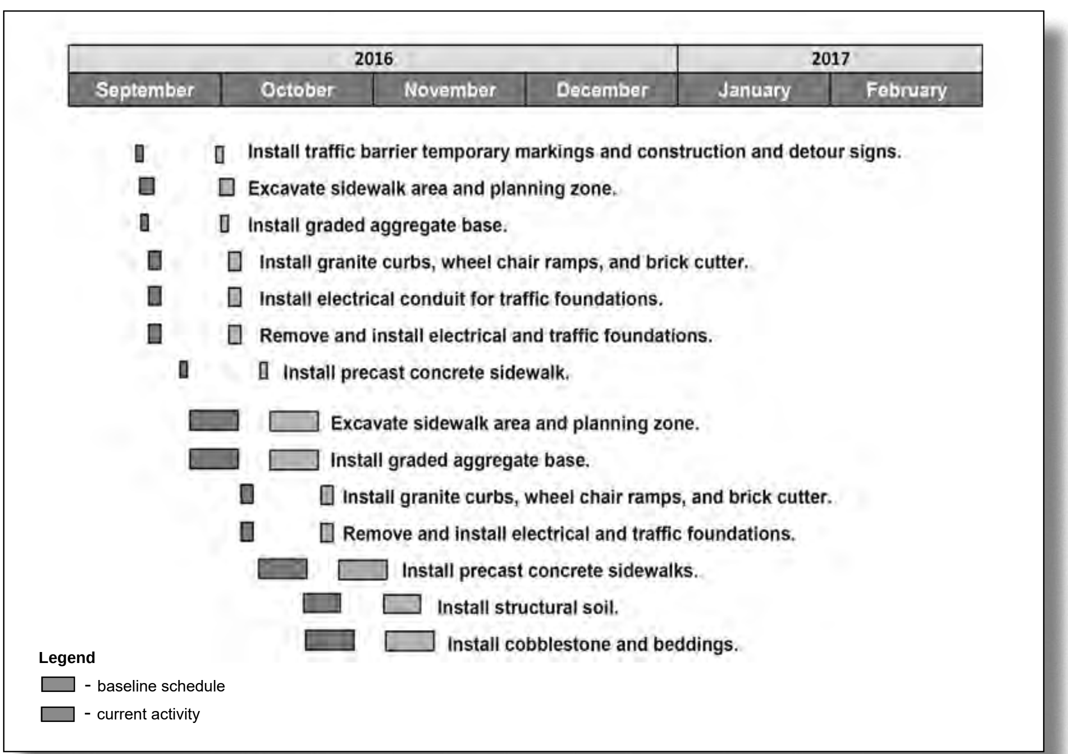

Figure 1. Sample baseline schedule and current activity progress showing how the schedule has shifted

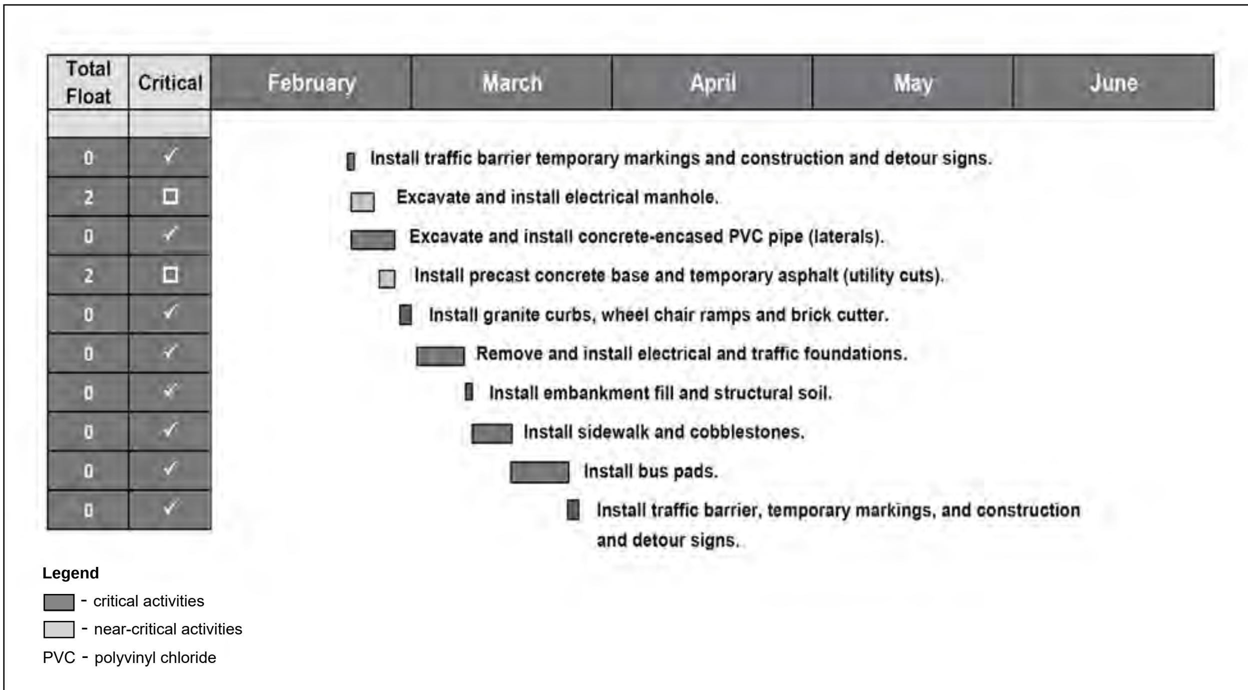

Figure 2. Critical/Near-Critical Path

prove that the government delay is on the critical path and extending the project's completion date, the contractor has a verifiable delay claim with a high probability of success. Therefore, it is critical that government approvals, as much as possible, are not on the critical path.

- ***Near-Critical Path.*** Near critical activities are those that are likely to affect the project with only the slightest of delays. Projects with many critical or near-critical activities are rigid and have completion dates that seem to extend on a continual basis. Activities that are near critical are often not closely Examined; yet, these activities can very easily become critical and begin to affect the completion date as well. The solution to this problem is to run a near-critical review. P6 easily accomplishes this task by designating all tasks that have less than a given amount of time that they can be delayed from their start without delaying the project (float) as critical. Once this near-critical review is completed, the project engineer has a list of the items that are not critical but soon will be, possibly affecting the completion date.
- ***Total Float Ratio.*** *Float* refers to the amount of time that an activity can be delayed from its start without delaying the project finish date. The total float ratio is the total float (in number of days) of each activity divided by the length (in number of days) of each activity. For example, an activity with 6 days of total float and a duration of 30 days in length has a total float ratio of 0.2, while an activity with 6 days of total float but a duration of 10 days in length has a total float ratio of 0.6. This function is essential in determining the likelihood that an activity will become critical and begin to delay the project completion. Although the total float is the same in both examples, one activity has three times the total float ratio, which means that it is far less likely to become critical and delay the project completion date. In military terms, the total float ratio is the

A project engineer walks the rail line at the Wedge Yard at Union Station, Washington, D.C.

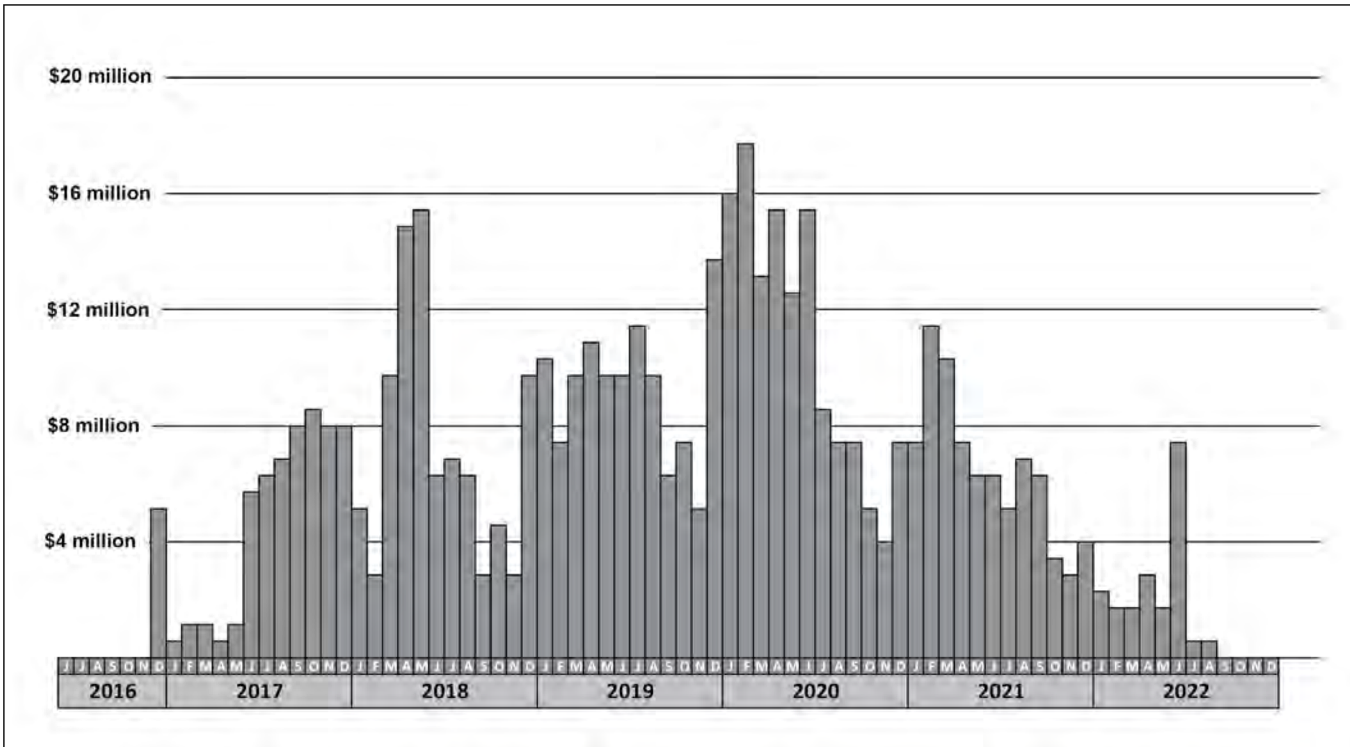

Figure 3. Resource-loaded histogram for a large vertical-construction project

activity's reserve time available. Similar to tactical combat operations in which more reserve generally equates to a higher probability of success, this relationship holds true in scheduling, as activities with a greater total float ratio have a higher probability of success. Activities with a higher total float ratio need less monitoring, and activities with a lower total float ratio need more monitoring. As a rule, activities with a total float ratio less than 0.1 need to be closely monitored.

- ***Resource-Loaded Schedule.*** Resource loading essentially aligns scheduled activities with equipment and personnel (Figure 3). P6 has the ability to resource-load schedules. Resource loading is uncommon on smaller projects; it is often required on projects greater than $100 million. In addition, although the construction contractor has sole discretion in resourcing the equipment and determining how to complete the activity, the government's official representative has approval authority regarding the duration of the activity and determining whether the activity is sufficiently resourced. If the officer does not believe that the equipment can be safely utilized given the available construction footprint or thinks that more equipment is needed to complete the activity in the time allotted, he or she may comment on the monthly schedule submission and, if necessary, reject the contractor's submission. Resource-loaded schedules provide an excellent method for reviewing the contractor's future committed resources and determining if the submitted activity durations and project completion dates are realistic.
- ***Project Crashing and Constraints.*** P6 allows the user to constrain specific activities to certain dates within the CPM. This artificial constraint provides an excellent means for determining the resources needed to complete the project on time. For example, if the critical path of a 3-year, 1,000-day project is delayed 50 days, then the project completion date should also be delayed 50 days. However, if the completion date is constrained, then that date does not shift. This would initially produce a negative float of 50 days. However, if activities and their respective durations are shortened or crashed on the critical path, the negative float dissipates. Shortening of the activity length minimizes the delay. Once the negative float reaches 0 days, the schedule is reset to the new critical path, with the original completion date. For both the contractor and the government, it is critically important that this method does not become a means of showing an unrealistic completion date. It is imperative that each time the project is crashed and this method is used to keep the original contract completion date, a resource meeting occurs between the contractor and the government to ensure that the contractor has the resources available to constrain the project.
- ***Long Lead Times.*** Long-lead items need to be separately and distinctly monitored in the CPM. These items often govern the critical path; and due to their specialized nature, accelerating the procurement of these items to shorten the project completion date is almost impossible. For example, the fire alarm and fire suppression system (sprinklers) comprise the fire protection (FP) system. The

Asphalt trucks line up to place asphalt along Vint Hill Road, Manassas, Virginia. A key part of asphalt placement is traffic management, as roads are built under normal operational traffic conditions.

FP system is a certified system. Not only is the FP system designed according to on-site specifications, but often there must also be an owner's representative on-site at the production factory while the parts are assembled and tested. In addition, the actual individuals on the production line must be certified to manufacture the equipment. Everyone involved in designing and fabricating the FP system is certified and must be on-site together (at least once). This scheduling nightmare is synchronized as much as 9 months in advance. Something this intricate, detailed, and subject to delay obviously needs a separate schedule. Simply placing this activity within a 5,000-line schedule increases the likelihood that it will be overlooked and not aggressively monitored, resulting in a delay of the project completion date.

- ***Meeting Management.*** For scheduling to be an effective construction project management tool, management and leadership must be involved. Even a quick review of the contractor's monthly schedule update on a regular basis can provide senior project leaders with valuable information. Leaders need to ensure that schedules are submitted on time and that the topic of scheduling is included in the routine weekly construction project meeting. Any slippage of the critical path beyond the number of preset days specified in the contract should trigger an automatic recovery plan involving the contractor and the U.S. government regarding how to meet the contract completion date.

Conclusion

In reviewing the monthly updates to the schedule, the officer should not exclusively focus on the critical path. Though the critical path defines the project completion date, how the project is progressing and trending is more important, as that describes future events. If more and more activities are being delayed and are not yet on the critical path, their effect on the project is masked. P6 includes a function that allows the current schedule to be superimposed over the approved baseline schedule, effectively showing how the project is trending. This method provides 100 percent clarity on the status of each activity and makes it easier to determine when an activity is slipping. This procedure is effective in determining if a project is slipping to the left or the right and what future activities may become critical.

Adhering to the schedule is an effective means of construction and project management, and it enables successful project completion. It is the contractor's responsibility to set up and submit the monthly schedule update to the government. The government's representative must be sufficiently proficient in scheduling knowledge to accept or reject the schedule. This article attempts to provide new construction managers, project managers, and resident engineers with a description of relevant scheduling tools that can be used to assist the decision maker in determining if the submitted schedule should be accepted and whether the project is on track to meet the contract completion date.

Endnote:

[1]Oklahoma State Glossary of Project Management Terms, <http://www.okstate.edu/sas/v8/sashtml/orpm/chapa/index.htm>, accessed on 7 May 2018.

Lieutenant Colonel Farrell (Retired) serves as the chief of engineering, construction, and property acquisition for the Prince William, Virginia, County Department of Transportation. He is a former USACE district commander. He holds a bachelor's degree in civil engineering from the Virginia Military Institute and a master's degree in civil engineering from Missouri University of Science and Technology at Rolla. He is a registered professional engineer and a certified project management professional.

Mr. Petros is the senior scheduler at a private engineering firm. He holds a bachelor's degree in construction building engineering from the Baghdad University of Technology and a master's degree in construction management from the University of Liverpool in the United Kingdom.

84th Engineer Battalion Takes on the Hybrid Threat

By Captain Blake Cannedy

Soldiers in echelon above brigade (EAB) units can be perceived as second-class to their engineer brethren in brigade combat teams (BCTs). However, few truly grasp the diversity in capabilities that EAB elements can bring to the fight. Members of the 84th Engineer Battalion (Never Daunted), Schofield Barracks, Hawaii, gained further appreciation of the capabilities and limitations of the 84th Engineer Battalion after taking on a military decision-making process (MDMP) session, followed by validation of platoons in the field. Shortly after beginning the assignment, the staff realized that it would be leading a strategic effort to insert an EAB battalion into a plan that was devoid of an EAB in the task organization. The staff was frustrated with this problem, but later acknowledged that the situation helped the unit gain a better understanding of how the EAB can strengthen the options a BCT commander has when it comes to his or her approach through warfighting functions.

Soldiers from the 95th Clearance Company provide first aid during a route clearance situational training exercise lane.

The staff started by conducting a crosswalk with the battalion mission-essential task list, which consists of mobility, countermobility, and survivability tasks and the five warfighting functions. The staff then categorized company assets under its respective warfighting functions to communicate engineer capabilities to the BCT commander and staff. This collaborative approach helped the staff identify the strengths and weaknesses of the unit from an organizational perspective, which was validated by the battalion experience in the field. After completing the crosswalk, the staff conducted an MDMP session focused on developing an annex for the BCT. The BCT faced an initial-entry operation opposed by a hybrid threat. This annex then morphed into the battalion operations order, which served as the foundation for planning a field training exercise centrally focused on platoon evaluations.

Soldiers from the 95th Clearance Company use a TALON® robot during a route clearance situational training exercise lane.

Training Circular (TC) 7-100, *Hybrid Threat,* defines the hybrid threat as a "diverse and dynamic combination of regular forces, irregular forces, and/or criminal elements all unified to achieve mutually benefiting effects."[1] As a battalion, the unit fights two levels down, employing platoon missions in the orders process. Thus, the battalion operations order produced by the staff was used during the battalion field training exercise focusing on platoon situational training exercise lanes matching the platoon missions generated from the MDMP session. Considering the specialized equipment used by the enemy, replicating the hybrid threat at the unit home station on the island of Oahu is very challenging. Incorporating the regular force component into the battalion situational training exercise lanes revealed how difficult but essential it is to change the mindset of the leaders by shifting focus away from winning the previous war. For instance, each platoon's leadership was slow to react when faced with a complex obstacle being observed by special-purpose forces with indirect-fire support on a clear obstacles lane. Multiple iterations were required before the platoons were able to break out of the stability operations paradigm of not needing to react to enemy artillery. When faced with a hybrid threat, units must address both the regular and irregular components at all echelons, especially at the platoon level.

One aspect that helped enhance the training was the development of the operating environment (OE). The OE

The 95th Clearance Company provides security as the 523d Engineer Company begins emplacing countermobility obstacles.

was initially established during the MDMP session for developing mission orders. This OE was refined to enable the necessary atmospherics of which Soldiers must be cognizant when facing a hybrid threat. One platoon was dedicated to serve as opposing forces representing a crime family, special-purpose forces, and insurgents. The regular forces threat was simulated through observer controller replication of conventional fires and chemical weapons effects. The established objective training requirements under the sustainment readiness model further reinforced the need for a developed OE in order to achieve efficiency for the updated training and evaluation outlines.

A Soldier from 561st Engineer Company provides security during the emplacement of survivability positions.

An EAB battalion can conduct various operations supporting the BCT scheme of maneuver. Enhancing protection of BCT critical assets through survivability construction or the development of new movement corridors for the maneuver commander are prime examples of engineer effects. Where the battalion assumes the most risk, however, is conducting these operations in the absence of external support. The location on the battlefield does not mitigate the risk against the hybrid threat; it simply magnifies the current shortfalls as an EAB. The battalion identified the following limitations of the current organizational structure during the exercise:

- Minimal organic fire capabilities.
- Limited intelligence-gathering capabilities.
- Restricted movement and maneuver due to the size and weight of the organic equipment of the battalion.

In reality, there is a dilemma for EAB elements as they erode the traditional advantage that an in-depth defense provides against a regular force. Consequently, the battalion trained with the mindset of limited support and it used organic tools to increase battlefield survivability, specifically constructing berms and digging bunkers. This training ideology supports the mindset, "Train for the worst, hope for the best."

The hybrid threat revealed that the 84th Engineer Battalion must continue to train in a manner that focuses on available equipment to overcome thinking traps learned by experiences from stability operations in Iraq and Afghanistan. The training scenario developed by the battalion was based on an initial-entry operation using organic—not theater-provided—equipment. The regular portion of the hybrid threat presented increased vulnerabilities with organic equipment and assets, which must be addressed through the application of new techniques and training. These techniques must address fighting against chemical, biological, radiological, and nuclear substances; conventional fires; and antiarmor systems. This complex OE with a hybrid threat makes the battlefield seem larger than it really is—even, as in this case, on a small island. The threat makes traditional boundaries seem porous and nonexistent, which is a direct result of the presence of the regular force aspect of the threat. Conventional fires with special-purpose forces as the controllers and chemical, biological, radiological, and nuclear hazards require subordinate forces to be more dispersed, which is an important change to many training practices established during the War on Terrorism.

Facing the hybrid threat creates a dilemma for EAB forces and is difficult to replicate at home station. The 84th Engineer Battalion used a holistic approach to creating an OE, a hybrid threat, and battalion orders through MDMP supporting a maneuver BCT in order to set up EAB platoons and companies for success on situational training exercise lanes. The hybrid threat provided difficult lessons learned for the staff, leaders, and Soldiers of the 84th Engineer Battalion, but undoubtedly instilled a better understanding of the perils that must be managed in order to survive on the modern battlefield.

Endnote:

[1]TC 7-100, *Hybrid Threat, 26* November 2010.

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Countermobility Effects Without the Boom: Rethinking Countermobility Operations

By Major Robert M. McTighe

"This M21 antitank land mine is the best Soldier in the world." I still remember my Basic Officer Leadership Course mine warfare instructor singing those praises of the virtues of the M21 antitank mine. The M21 does not need food, water, sleep, or care; and it does its job without favor or discrimination.

Countermobility is as important today as it was 20 years ago. However, over the last 2 decades, the execution of countermobility through mine warfare has become less acceptable throughout the world. Countermobility, as an engineering function, enhances terrain to delay, disrupt, and destroy the enemy with the primary purpose of increasing time for target acquisition and fires.[1] Policy restrictions, national caveats, aging munitions, delivery system availability, and the overall global nonacceptance of mine usage have led to a deficit, or gap, in the use of U.S. Army countermobility. Aspects of this countermobility deficit are also experienced by the North Atlantic Treaty Organization (NATO), our partner nations and, to an extent, our adversaries as well.

The United States and our allied nations are now exploring innovative ways to fix, disrupt, turn, and block the enemy while reducing noncombatant exposure to explosive effects. With new countermobility development in various stages across the globe, there is an opportunity for a paradigm shift in how the Army fundamentally approaches countermobility operations. All domains of multidomain battle and nonexplosive techniques must be taken into account when considering munitions that will make up the core of future countermobility operations.[2] This article begins

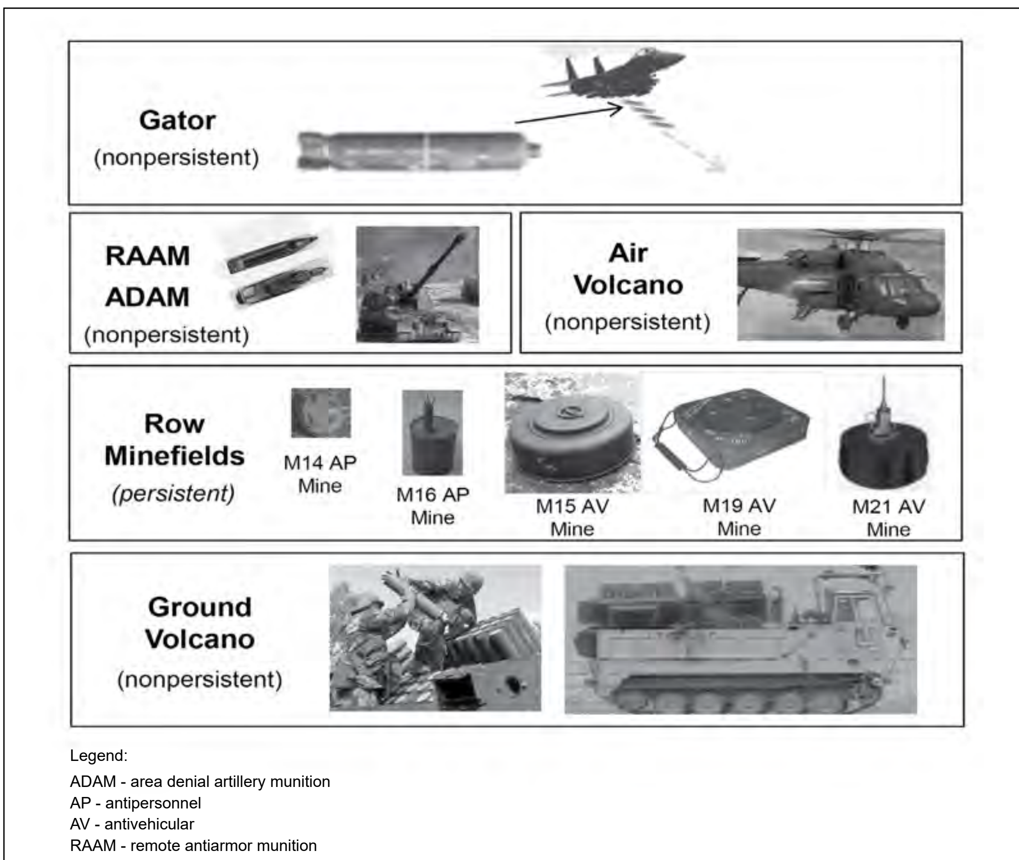

Figure 1. U.S. Army countermobility capabilities in the 1980s–1990s

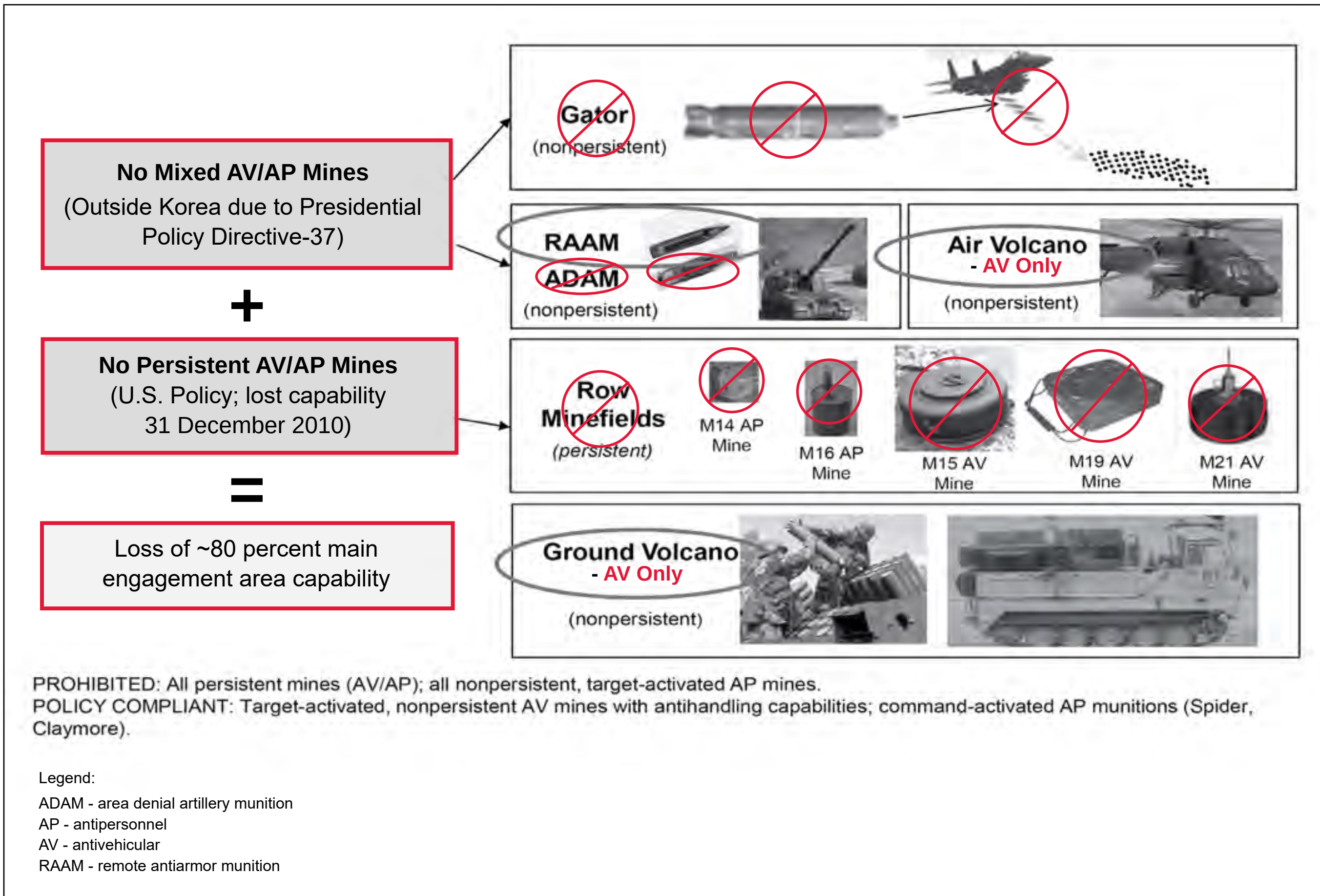

Figure 2. U.S. Army countermobilities capability today

with a review of Cold War-era countermobility capabilities and then examines the causes of the countermobility deterioration facing the U.S. Army, discusses ongoing efforts to improve countermobility capabilities and, finally, describes alternate approaches to materiel development to close the countermobility gap.

Figure 1 illustrates that the U.S. Army countermobility capabilities from the 1980s to 1990s were robust. I witnessed this firsthand during my first National Training Center rotation in 2002, when task force engineers used conventional mines to turn the opposing force formation into a well-developed engagement area. Since the late 1990s, our countermobility capabilities have been degraded. The Ottawa Mine Ban Treaty, which prohibits the use, stockpiling, production, and transfer of antipersonnel land mines, has been signed by 164 countries.[3] The United States is not a signatory of this treaty—primarily because of obligations on the Korean Peninsula. However, U.S. national policies are more restrictive than the Ottawa Mine Ban Treaty stipulations. Current U.S. policy prohibits the use of antipersonnel land mines and persistent (conventional) antivehicular land mines outside of the Korean peninsula. Therefore, in most of the world, policy-compliant explosive countermobility capability includes only target-activated (conventional) antivehicular mines. Remaining policy-compliant systems in the United States are shown in Figure 2. These systems include the Volcano and remote antiarmor munition. Although policies limit tactical, operational, and strategic application, they advance humanitarian considerations associated with mine usage. Limitations in mine warfare are not exclusive to the United States; the reduction in mine warfare is global.

In addition to policy restrictions, there is evidence of deterioration of munitions, systems, and training competency that negatively affects our ability to execute terrain-shaping operations. The 2017 NATO Military Engineering Information Exchange Seminar, held at the NATO Military Engineering Center of Excellence–Ingolstadt, Germany, focused heavily on countermobility operations. The seminar highlighted the countermobility deficit across the NATO alliance. With the exception of the United States, all NATO nations have signed the Ottawa Mine Ban Treaty. Unlike the United States, most NATO nations do not have restrictions on persistent (conventional) antitank mines. However, NATO nations available stocks and delivery systems are insufficient to counter our shared peer adversaries. Hence, most of our NATO allies view their abilities to execute countermobility operations as an area of weakness.

With countermobility operations a known vulnerable area, many countries are investing heavily in mines, minelayers, and even scatterable-mine delivery systems. The United States recently initiated a significant effort to modernize both close and deep terrain-shaping capabilities. New developments aim for "networked-embedded communications, controllable (human in the loop) lethal and nonlethal effects, rapid employment, and quick recoverability resourced at the lowest level to enable decentralized operations."[4] Additionally, future countermobility systems will include sensors deployed as part of the munitions. According to U.S. Training and Doctrine Command (TRADOC) Pamphlet (Pam) 525-3-5, *The U.S. Army Functional Concept for Maneuver Support, 2020–2040*, "Long-range communication to deployed components will rely on external assets such as satellite or aerial vehicle-relayed communications."[5] There is no doubt that these innovations will enhance our capability; however, they focus too much on the explosive effects of mine warfare. It appears that while new developments will allow U.S. forces to shape the battlefield at all echelons, the result will take us back to an enhanced version of the 1980s-era countermobility capability. Rather than a back-to-the-future approach to countermobility, since we are currently in a process of new materiel development, this period represents an opportunity to broaden our approach for a countermobility paradigm shift.

This period of countermobility modernization provides a chance to innovate solutions that cross into multiple domains. The Army seeks overmatch on its competitors by combining technologies and integrating them into changes in organization, doctrine, leader development, and training.[6] The battlefield has evolved, largely due to advancements in technology. Although the primary focus of the Army remains the land domain, the contemporary operating environment and future battlefields will span all domains.

Until now, the most effective way to disrupt, fix, turn, or block the enemy was to enhance natural obstacles with mines and other barriers. Mines have historically been tactically and universally effective, and their psychological effects have been universally acknowledged.[7] What if the new generation of land mine-like devices targeted computer or electrical systems onboard enemy vehicles through cyber or electromagnetic attacks instead of explosive or kinetic attacks? Would that also yield similar operational effects? Explosive mine capability is still needed, but nonexplosive assets must be developed to enhance our overall suite of countermobility capabilities.

Creating a divergence to the enemy maneuver plan through mine warfare is effective; however, there may be a more efficient way. Casting a wider net than a few explosions in a constrained area may be possible by expanding nonexplosive capabilities. As an example, high-power microwave systems that use electromagnetic energy to remotely disrupt or damage vehicles and boat microprocessors residing inside an electronic control module have been designed, built, and tested and are available on the open market.[8] Although this technology has yet to be used within the doctrinal framework of traditional Army countermobility operations, the example illustrates that non-explosive vehicle-stopping capability exists in multiple forms.

Countermobility or countermaneuver weapons using high-power microwave technology can be used in different ways. Such radiation can temporarily or permanently disable electronic circuits from operating. Using an omnidirectional transmitter approach, electromagnetic energy can be transmitted to deny movement in a limited radius—a so-called nonlethal area denial to vehicles. A second approach would be to radiate in a specific direction, like a predesignated engagement area.[9] It is important to note that such new technologies should not replace mine warfare altogether; they should simply enhance our overall suite of capabilities. High-power microwave systems and other nonexplosive technologies such as omnidirectional and directional high-power microwave systems could be used in conjunction with mines to enhance terrain in close and deep battle areas. Our next-generation mines could be used to turn the enemy into our designated engagement area, while nonexplosive technologies could be used to block the enemy in our engagement area. Expanding new countermobility initiatives into the space, cyberspace, and electromagnetic domain can be done in anticipation of future demands, helping to fill identified capability gaps. Additionally, nonexplosive approaches to countermobility are more widely acceptable across the international community from a humanitarian perspective. Most importantly, though, multidomain solutions used in conjunction with mines allow us to present greater effects on the enemy with less resources.

Given the evolution of technology applied to countermobility operations, such operations conducted in 2040 must not resemble those conducted in 1980. A nonexplosive approach to countermobility could potentially produce a larger, less resource-intensive, more effective result. While looking at countermobility of the future, it is paramount that the United States and our allies collectively expand our approach to materiel development. Future nonexplosive countermobility techniques must include more than earth moving. As our adversaries continue to evolve to challenge us in all domains, we must evolve as well. Taking into account all domains while developing new countermobility capabilities will certainly yield greater results.

Endnotes:

[1]Joint Publication 3-34, *Joint Engineer Operations*, 6 January 2016.

[2]*Multi-Domain Battle: Evolution of Combined Arms for the 21st Century, 2025–2040,* December 2017.

[3]*International Campaign to Ban Landmines*, <http://www.icbl.org/en-gb/the-treaty/treaty-status.aspx>, accessed on 8 May 2018.

[4]TRADOC Pam 525-3-5, *The U.S. Army Functional Concept for Maneuver Support, 2020–2040*, February 2017.

[5]Ibid.

[6]Ibid.

[7]TRADOC Pam 525-3-1, *The U.S. Army Operating Concept: Win in a Complex World, 2020–2040*, October 2014.

[8]Jeremy Hsu, "Electromagnetic Pulse Cannon Could Demo Car-Stopping Power Next Month," 20 January 2010, <https://www.popsci.com>, accessed on 14 May 2018.

[9]Telephone interview with Dr. James Tatoian, chairman and CEO of Eureka Aerospace Corporation, 19 January 2018.

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ROUTE CLEARANCE
IN THE WIDE AREA SECURITY FIGHT

By First Lieutenant Joshua H. Austin

The 70th Brigade Engineer Battalion (BEB), 1st Stryker Brigade Combat Team, 25th Infantry Division, deployed to National Training Center (NTC) Rotation 17-03 in January 2017. Through the duration of the training exercise, the 70th BEB was entrusted with the portion of unified land operations formerly known as wide area security while providing enablers to conduct combined arms maneuvers. These responsibilities are included in the unified land operations principle to "establish and maintain security in order to protect populations, friendly forces, installations, extended infrastructure, and activities crucial to mission accomplishment."[1] The efforts of the 70th BEB were successful, resulting in the best wide area security mission in years. The unit improvised explosive device (IED) find rate of 19 percent during the rotation equated to about a 17 percent increase in the find rate compared to the historical average 1–2 percent find rate reported by

70th BEB Soldiers implement the TALON® robot to investigate a possible IED found inside an abandoned vehicle.

An RCA Buffalo A2 arm operator successfully unearths a possible roadside IED.

other rotational training units. Route clearance elements that fully prepare for NTC challenges execute route sanitation, maintain a presence in areas of interest, and ensure deliberate urban clearance can be expected to achieve similar wide area security success.

The 70th BEB route clearance asset (RCA) offered unique capabilities and capitalized on opportunities that profoundly supported the wide area security effort. The overall effectiveness of the platoon, the percentage of IEDs found, and the contribution to wide area security are attributed to the balance of simultaneously defeating the device and attacking the network. Results of the route clearance after action reviews outlining successful practices and areas in need of improvement allowed for the creation of a recommended model for route clearance units in the wide area security fight.

Preparation for NTC

In anticipation of the mission at NTC, RCA leadership shaped training to instill a holistic understanding of the battalion and brigade fight and the role that route clearance fulfills. In September 2016, the battalion conducted external platoon evaluations and certified the platoons on the execution of their mission-essential tasks. Leaders identified areas of weakness and retrained Soldiers prior to the NTC rotation. The battalion command team added emphasis to information collection of threat networks, familiarization of terrain as it pertains to routes and avenues of approach, and the denial of unobserved enemy maneuvers. With this additional guidance, the RCA began preparatory training and further solidified its platoon internal tactics, techniques, and procedures.

The platoon leadership created standard operating procedures on snap traffic control points (TCPs), focusing on apprehending individuals involved with the insurgent threat network. Soldiers later expanded TCP proficiency through training conducted by military police. Noncommissioned officers were assigned to become subject matter experts on the Secure Electronic Enrollment Kit and oversaw the instruction and processing of the civilian population. Virtual Battle Space 3 technicians placed the platoon on crucial supply routes on NTC terrain. The benefits were two-fold: Soldiers were able to conduct route clearance missions in a simulated desert environment, rather than being restricted by home station forested training areas (and consequently, leaders were able to evaluate and shape terrain-specific techniques and procedures) and Soldiers familiarized themselves with NTC maps and reinforced their understanding with a digital representation of key NTC terrain.

Denial of IED Emplacement Through Route Sanitation

Much of the platoon's success during the NTC rotation was attributed to practices implemented on its first mission, although, no confirmed IED was found. The platoon conducted a combined route clearance, IED threat route reconnaissance, and removal of possible IED debris on the route. Soldiers recorded grid locations and other indicators of possible enemy activity affecting friendly forces within the area. The patrol effectively communicated IED indicators, establishing a strong basis for future change detection internal to the platoon. Finally, due to the ease of finding possible components, many potential IED parts were removed. This had been an uncommon practice in previous

> ***"The 70th BEB route clearance asset (RCA) offered unique capabilities and capitalized on opportunities that profoundly supported the wide area security effort."***

rotations. By the end of the mission, the RCA had picked up hundreds of meters of wire, two antennas, and three power sources and had removed more than 10 possible targeting markers. Although many of the IED components found may have been genuine trash left over from other rotations, the platoon denied partial placement and removed easily accessible resources from the enemy. Ultimately, the enemy method of IED construction was hindered and its likelihood of being detected was increased. Additionally, the sanitized route presented a clean slate, facilitating easy change detection for the brigade and RCA.

Route Presence Through Overwatch and TCPs

The enemy endures increasing levels of risk, the longer it remains engaged in the creation and initiation of IEDs. The platoon benefited from the number of hours spent out on the route, TCPs, overwatch of named areas of interest, and 24-hour observation of towns with known IED facilities. Overwatch and military presence along the routes are also attributed to other units within the brigade. In one instance, a friendly convoy drove up on a three-man team emplacing an IED. When the emplacement team fled, quick communication within the area of operations allowed RCA TCP personnel to engage the team. Ultimately, the desperate insurgents were forced to hastily emplace IEDs, which resulted in the IEDs being easily identifiable by route clearance and other brigade units. This contributed to the high find rate of the rotation and significantly increased the protection level of the force. Toward the end of the rotation, insurgents resorted to using surface-laid IEDs or dropping traffic cones with a remote-controlled IED inside from a speeding vehicle—only to be easily removed by route clearance and explosive ordnance disposal teams.

Overwatch of an area enabled simultaneous information collection of the threat network and population. While surrounding and observing one of the main towns overnight, the RCA reported four vehicles with six individuals tied directly to IED activities to the battalion. The platoon also identified key information concerning the daily actions of the civilians. Appropriate information updates were immediately sent to the battalion and later debriefed to the intelligence staff officer (S-2). Pictures of IED components, individuals, and vehicles were invaluable during debriefing. Knowledge of the road systems and familiarization with the terrain allowed platoon leaders to select effective locations for TCPs, maximizing the amount of traffic intercepted. Additionally, the patrol acted as a mobile TCP, checking vehicles approaching from the front and rear. The platoon stopped and recorded 15 civilians, inspected their vehicles, asked questions, and enrolled them in the S-2 database, identifying three of them as being involved in the IED network.

Deliberate IED Removal Through Urban Dismounted Clearance

The final RCA practice to successfully attack the network was conducted through combined dismounted and mounted clearance operations through urban areas. Dismounted personnel identified and removed four IEDs and two caches of enemy IED materials. Soldiers were able to interact with the civilian population and gain valuable intelligence concerning the town. The dismounted personnel found an enemy terrain model of the surrounding area, later discovered in the after action review to have dissuaded an enemy attack. Route clearance provides security for civilians and ensures mobility for friendly units. When communicated correctly, the population quickly understands the patrol's purpose in and around its town. Even those not expressly friendly to U.S. forces have a vested interest in daily routes being cleared of explosive hazards and may pass along crucial information on devices and networks to protect their families.

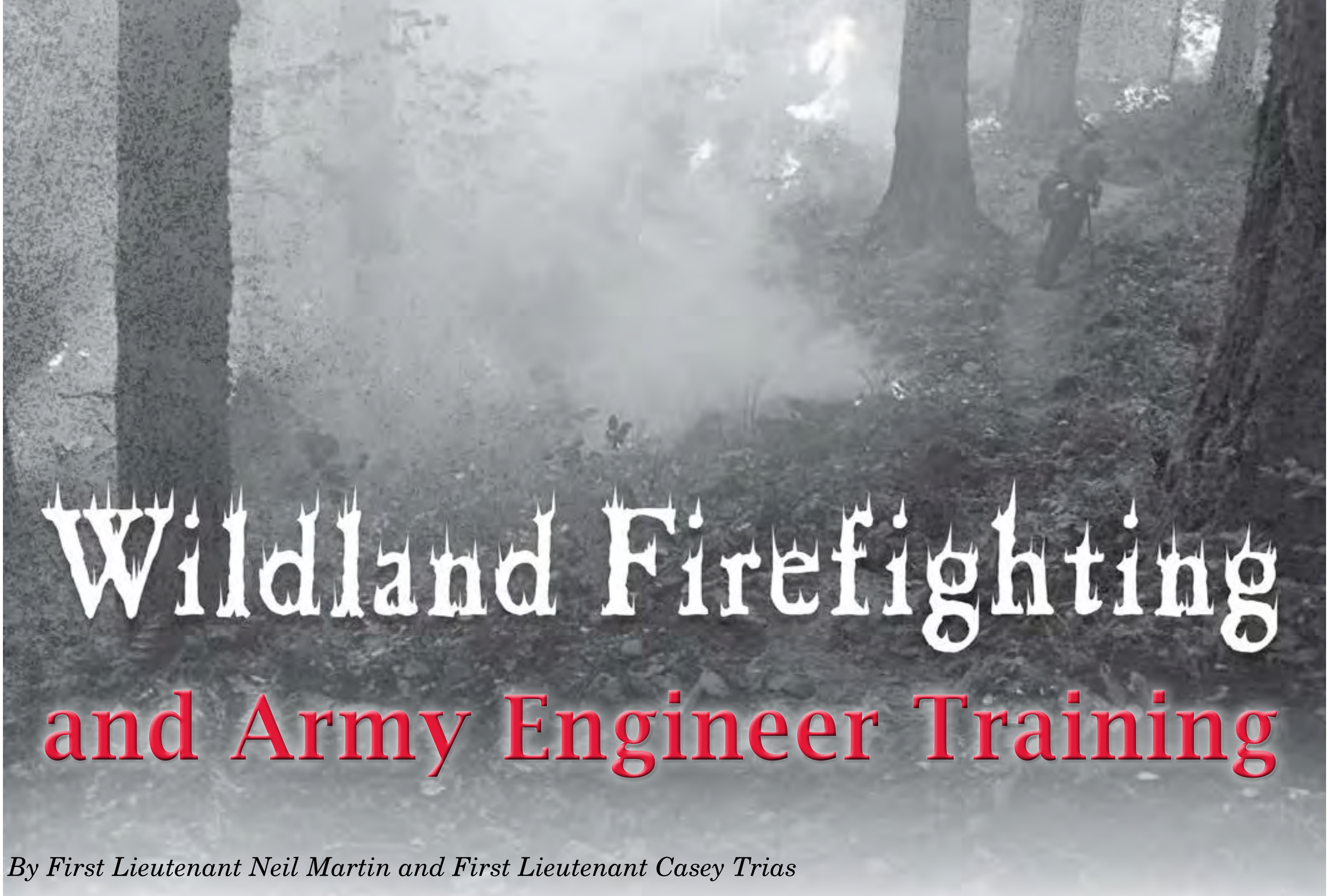
Conclusion

Utilization of the route clearance patrol in the wide area security fight is achieved by spending hours interacting with the population, providing presence in areas of interest, and protecting the force by deliberate clearance of the routes. Ultimately, the ability of the route clearance patrol to concurrently attack the threat network while clearing explosive hazards sets the patrol apart as a necessary component of the wide area security fight. Well-prepared units, route sanitation, the presence of named areas of interest, and deliberate urban clearance will significantly influence success in protecting the force in NTC and wartime operations.

Endnote:

[1]Army Doctrine Publication 3-0, *Operations,* 10 June 2017.

First Lieutenant Austin serves as the horizontal-construction platoon leader with the 70th BEB, 1st Stryker Brigade Combat Team, 25th Infantry Division, Fort Wainwright, Alaska. He was previously assigned to the battalion as a route clearance platoon leader. He is a graduate of the U.S. Army Engineer Basic Officer Leader Course and the U.S. Army Route Reconnaissance and Clearance Leader Course. First Lieutenant Austin holds a bachelor's degree in civil engineering from the U.S. Military Academy–West Point, New York.



Wildland Firefighting and Army Engineer Training

By First Lieutenant Neil Martin and First Lieutenant Casey Trias

Combat engineer operations normally consist of missions that closely support the maneuver of land combat forces through mobility, countermobility, and survivability operations. During these missions, engineers shape the physical environment by using hand tools, bulldozers, and explosives, while receiving direct and indirect fire from the enemy in a combat zone. However, during the late summer of 2017, the Soldiers of Task Force Spearhead faced a special type of enemy—wildfire.

There are several reasons why engineers, rather than Soldiers from other branches, should be preferred for wildland firefighting missions. Engineer Soldiers from Task Force Spearhead quickly discovered that the tools and methods used by firefighting crews are strikingly similar to those used by Army engineers. The hand tools are the same as those found in pioneer tool kits. Bulldozing operations that are used to create firebreaks across terrain and burning operations that slow the advance of the fire are comparable to demolition operations used in countermobility. The wildfire mission is like a massive exercise in countermobility, which is one of the combat engineer's key tasks on the battlefield. These similarities allow engineer Soldiers to grasp the situation quicker than Soldiers from other branches. For example, firebreaks, which are normally emplaced with hand tools or dozers, are used to

Soldiers participate in a mission briefing.

Soldiers install interceptor dikes.

prevent fire from spreading from one side to another, similar to a block obstacle in the terrain, which is used to halt the advance of the enemy. If we think of it like this, the fire is our enemy and firefighters are simply manipulating the environment in a countermobility effort.

Both the wildland firefighter and the Army engineer specialize in shaping terrain to achieve a desired result. A common firefighting mission is to install interceptor dikes, diagonal trenches cut across downhill firebreaks to prevent excessive erosion and runoff by reducing the amount and speed of flow and then guiding it to another area. Some Soldiers were confused as to the purpose of the trenches when the 23d Brigade Engineer Battalion received the mission. However, the Soldiers decided that the interceptor dikes were essentially antivehicular ditches used to turn the enemy (in this case, water) away from its desired avenue of approach and to an area where water was needed much more. The engineers of the 23d Brigade Engineer Battalion rapidly adapted and excelled at any missions tasked to them.

The similarities between firefighting and military operations were also evident at the leadership level. Leaders at the platoon and company levels received their daily mission—as well as information about the composition, speed, and likely activity of the fires for the next 24 hours—from the incident commander. The interagency management team used this information to develop a plan, give guidance to its subordinates, and execute its mission set for the day. Often, the team worked only on the task and purpose it had received that morning.

An engineer commander or platoon leader encounters similar situations at a combined training center or when forward deployed. Engineer companies and platoons rarely fight together. They are often broken off from their organic chains of command and attached to a maneuver unit to provide engineer expertise and support. Then they must integrate into the organization, receive their mission, and accurately convey their capabilities. For example, within the first days of the wildland firefighting mission, it became clear to the firefighters that engineer Soldiers excelled at moving through steep terrain to perform manual labor with heavy packs. After a few days, the interagency management team began to adjust its plans accordingly. Engineer capabilities could be used to an advantage in a situation in which an infantry battalion commander overestimates or underestimates how fast the mobility support platoon can emplace an obstacle. Wildland firefighting proved to be a great opportunity for engineer leaders at company and platoon levels to receive experience in integrating and working with an interagency organization unfamiliar with its culture and capabilities.

The most surprising aspect of the wildland firefighting mission was how similar it was to the mobility and countermobility operations for which engineer Soldiers train in their collective tasks. When briefing Soldiers, leaders naturally began to use standard engineer terminology about terrain shaping to assist the Soldiers in understanding the task and purpose. No one could have anticipated that the wildland firefighting mission would not only allow the Soldiers to serve their country at home, but also provide an opportunity for the unit to train on its engineer-specific tasks.

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RISK MANAGEMENT IN HUMANITARIAN OPERATIONS:

The Firefighter's Approach to a Familiar Problem

By Captain Matthew Tetreau

Consider this interesting exercise: Analyze and manage the risk to 40 personnel who are conducting a task with which they are completely unfamiliar, with which you have no experience, and which is being executed on unknown terrain. What are the most common risks to the mission? To personnel? Can the risks be mitigated?

Presented with this problem set and armed with the expertise and experience of a cadre of veteran firefighters, the leaders of the 23d Brigade Engineer Battalion (BEB) embarked on a mission to support the National Interagency Fire Center (NIFC) in suppressing and containing wildfires across central Oregon. For the third time in the last 15 years, the U.S. Secretary of Defense approved the deployment of Regular Army troops to support NIFC due to the unusually high level of fire activity across the western United States. Over the course of 3 weeks, the battalion leaders and Soldiers adapted the Army's approach to risk management to a mission replete with defense support of civil authorities interagency command relationships and unfamiliar hazards, while exercising distributed mission command and empowering leaders to make risk decisions. In retrospect, the wildland firefighting mission was a hands-on leader development opportunity that challenged junior leaders with a dynamic risk environment and took even the most seasoned Soldiers out of their familiar areas of expertise.

A wildfire sweeps through Central Oregon.

To the uninitiated, fire might seem to be the most common risk to firefighters; but the unseen, unplanned, and unobvious hazards actually result in more risk to mission and personnel. The drive to and from the job site, fallen trees or snags, environmental injuries, and lacerations all result in more injuries and greater decreases in mission readiness to the firefighting community than fire-related injuries do. The firefighting community has developed its own approach to managing risk, and the firefighters on the line practice a consistent, informal system of hazard analysis and mitigation. The bottom-up approach to risk management and incorporation of safety specialists at the operations planning and tactical levels result in a comprehensive program with an impressive safety record.

Soldiers receive a safety briefing.

Sterling as the NIFC safety program is, responsibility for the Soldiers executing the mission ultimately belongs to the unit commanders and leaders. With that in mind, the battalion leaders applied the Army deliberate risk assessment method while leaning on the expertise of wildland firefighting professionals and refining their analysis on a daily basis. At mission's end, the battalion task force redeployed to Joint Base Lewis–McChord, boasting an immaculate safety record without significant injuries despite engaging wildfires in rough terrain for 26 days. Equally important, the battalion came away with lessons learned and best practices adapted from its experiences and those of its firefighting counterparts. This article captures those lessons and best practices and frames them in a manner that will be useful to Army leaders at all echelons.

Watchouts

The 18 watchouts of wildland firefighting are safety commandments that all prospective firefighters are expected to learn and apply in the course of their duties. These rules are passed down from generations of firefighters who learned them the hard way. These simple guidelines provide spearhead leaders with an initial baseline regarding a hazard situation and provide input to their earliest hazard analysis. A list of commonly encountered hazards is compiled over the course of a given mission and passed on to the relieving unit during relief in place/transfer of authority, formalizing the risk discussion between incoming and outgoing leaders.

Risk Assessment

In the mid-1990s, wildfire-fighting strategy shifted away from aggressively attacking all fires to protecting at-risk structures and property, merely containing fires in less valuable tracts of land. The result was that firefighters' exposure to hazardous fire conditions was decreased and resources could be massed on the fires that threatened valuable property. For military purposes, this methodology has been employed by first focusing all risk planning on operational risk, or *risk to mission,* in order to determine vulnerabilities against which resources should be allocated. Though not a new concept in military risk assessment, the idea that risk to mission be prioritized over risk to personnel for planning purposes served as a valuable lesson to junior leaders.

Safety Officer

While the task force discovered a variety of parallels between military and firefighter culture, there were stark differences between the ways the task force employed safety officers compared to their professional firefighting counterparts. While the task force employed junior leaders as safety officers, the NIFC safety officers were the most experienced firefighters—senior even to the division chiefs (equivalent to company commanders). Furthermore, the safety officer served as a primary advisor and staff officer to the leadership and was consistently present on-site to advise as new threats emerged. The result of this dynamic was better-informed senior leaders, greater emphasis on risk planning, and constant availability of safety resources on the job site. The role is more similar to that of range safety officers than of unit safety officers; individuals are tasked with removing themselves from the tactical situation to focus on the bigger picture.

Safety Battle Rhythm

Just as in military operations, hazard analysis and mitigation are enduring mission sets, requiring constant follow-up and engagement. The task force leaders achieved an efficient and comprehensive safety battle rhythm, which necessitated a hierarchy of responsibilities and engagement by leaders at all levels. Leaders from squad through battalion levels attended daily briefings, which covered operations, intelligence updates, sustainment/personnel updates, and safety notes. Company level leaders (strike team leaders) focused on conducting leader reconnaissance on work sites 24 hours before the mission to identify site-specific hazards and evaluate ingress, egress, and casualty

(continued on page 37)

Book Review

Book reviews are a feature in each issue of *Engineer*. Authors of book reviews summarize the contents of books of interest and point out the key lessons to be learned from them. Readers who wish to submit book reviews may forward them to <usarmy.leonardwood.mscoe.mbx.engineer@mail.mil>.

Design in Nature: How the Constructal Law Governs Evolution in Biology, Physics, Technology, and Social Organizations, by Adrian Bejan and J. Peder Zane, New York: Anchor Books, 2013.

Reviewed by Captain James E. MacGibbon

The book *Design in Nature: How the Constructal Law Governs Evolution in Biology, Physics, Technology, and Social Organizations* is the work of Adrian Bejan and J. Peder Zane. This is Bejan's second book concerning constructal law. It explains Bejan's and Zane's theory of constructal law and the reason for all discernable design in nature. Constructal law dictates that all animate and inanimate systems evolve in order to enhance flow or movement.

This broad law applies to nearly everything we see on the planet, and most of the book illustrates how constructal law is present in all systems. Bejan, who is a mechanical engineering professor from Duke University, starts with a discussion of heat dissipation—a topic well known to him.

Bejan uses the human circulatory system as a practical example to highlight the relationship between constructal law and heat dissipation. The human circulatory system transfers heat and enhances flow with only a few major arteries that branch off into smaller capillaries, which continue to branch into smaller alveoli. This design consists of only a few large media (arteries) for flow connected to more numerous but smaller media (capillaries) that are further connected. This pattern is repeated throughout the book.

It is easiest to compare this pattern to the design of a tree. The trunk of the tree represents the largest path of flow, and the trunk is connected to smaller branches. The branches then connect to thousands of twigs, and the pattern continues. The author uses trees to illustrate constructal law on multiple levels. An individual tree within a forest is analogous to a water pump playing a role in a region's water flow system. The most efficient way to get water from the overall area to an individual point is via a system such as the aforementioned hierarchical structure of the tree—with a few large passageways that branch into thousands of smaller passageways.

On a macroscopic scale, Bejan cites research that determined how trees are distributed according to their size. This study shows that in a defined geographical area, there are only a few very large trees but more medium-size trees and even more smaller bushes. These can be compared to water pumps in a region with the same large-to-small hierarchy, but on a larger scale.

The author applies this same theory to river basins and their tributaries; lightning bolts; traffic and airport design; and animate movement in fish, land animals, and birds. Bejan writes that he can predict the most efficient movement of animate life through constructal law. He also writes that constructal law predicts the hierarchy of military structure. However, he simply puts into theoretical terms what humans have already learned through hundreds of years of warfare: that a chain of command is the most efficient way of communication in militaries. We have also learned that a planned grid is the most efficient urban design for traveling from a point an to area, an area to a point, or a point to a point. Bejan simply gives reasons for past occurrences. These reasons are very important in understanding nature, and they make the book interesting; however, the theory is difficult to apply to the modern-day Soldier.

Constructal law is a baseline for maximizing efficiency and could be applied to the Army in lines of communication networks and road patterns; but again, this only tells us why and how things *should* be. Unfortunately, things are rarely as they should be. The constructal law demands a perfect world, a world in which the Army will never operate. Constructal law takes place over the course of hundreds of years, not days. As such, it can do little to predict the future in hopes of staying a step ahead of our enemies.

Captain MacGibbon is the commander of the 569th Engineer Dive Detachment, Fort Eustis, Virginia. He is a graduate of the Engineer Captains Career Course, Joint Dive Officer Course, Stryker Leader Course, U.S. Army Airborne School, Infantry Basic Officer Leader Course, and U.S. Army Ranger School. He holds a bachelor's degree in systems engineering from the U.S. Military Academy–West Point, New York.

The Army is Always in Need of Water

By Dr. Robert E. Tucker, Dr. Jianmin Wang, and Mr. Stephen H. Tupper

In the spring of 2015, Frontier Environmental Technology, LLC assembled the Tricon deployable Baffled Bioreactor (dBBR)© at Fort Leonard Wood, Missouri.[1] The system removes nitrates, phosphates, and biomass from sewage and releases incredibly clean effluent. System highlights include ease of deployment, ease of operation, and minimal energy use. The dBBR performed as expected, producing effluent that surpassed Army requirements.

The dBBR was selected for further testing at Fort Bliss, Texas, during the fall of 2015. Using newly trained Army personnel, the innovative dBBR treatment capability performed wonderfully and exceeded Army test requirements.

A larger–size dBBR, made from a 20-foot-long shipping container, is currently being demonstrated in the 15-home Southwood II Subdivision in Rolla, Missouri. This dBBR operates only 8 to 10 hours per day and is on "sleeping" mode (a unique feature of the dBBR to save energy during low-flow periods) the rest of the time. The effluent from this 20-foot dBBR meets Army standards for discharge as well as the more stringent requirements set by the Missouri Department of Natural Resources. The permit requirements and actual dBBR effluent data are provided in Table 1.

Date	BOD_5 (mg/L)	TSS_5 (mg/L)	Ammonia (mg/N/L)
11 October	2.0	1.8	0.45
25 October	2.0	1.8	0.16
9 November	2.4	1.8	0.11
24 November	2.4	5.0	0.10
7 December	2.5	5.6	0.37
21 December	1.3	0.6	0.05
Permitted	**30**	**30**	**2.9**

Legend:
5 - five-day average
BOD - biochemical oxygen demand
mg - milligram
L - liter
N - nitrogen
TSS - total suspended solids

Table 1. Concentrations of biological oxygen demand, total suspended solids, and ammonia from the dBBR operating in Rolla, Missouri.

The deployment of this technology should fit well with the base sustainment strategy developed by the Contingency Base Integration and Technology Evaluation Center and the Construction Engineering Research Laboratory. It is important to realize that many communities across the Nation that were hit with devastating floods and hurricanes could benefit from the dBBR as a means of emergency wastewater treatment. The dBBR could also be deployed to refugee camps.

". . . harvesting water can be a significant contribution to the water budget. . . the placement of gutters on buildings to harvest rainwater is the next engineering feat to be championed."

Currently, our deployed forces are typically provided with water produced by reverse-osmosis (RO) technology. This energy-intensive technique supplies potable water for cooking and nonpotable water for showers, laundry, and latrines. This process of water production is extremely costly in a monetary sense. Given certain assumptions of generator size and efficiency, about 200 gallons of diesel fuel are required to generate the electricity needed to produce 2,500 gallons of water using RO.

RO systems must be back-flushed, releasing highly saline water that must be stored in a holding pond on base. The pond must be dug and secured. The water is then allowed to evaporate or slowly migrate into groundwater systems, where it can become an environmental hazard. More importantly, the number of causalities inflicted on troops bringing fuel and water to a base is very high. Therefore, there is a desire to reduce the fuel and water requirements on base.

There is no requirement to provide water that has been treated with expensive RO technologies to a latrine. The dBBR can produce this water. The

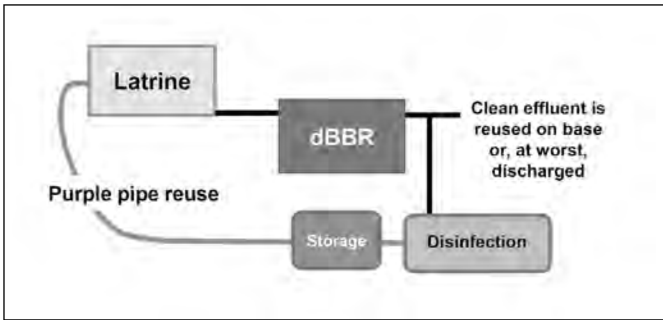

Figure 1. A simplified diagram of a "purple pipe" system of water reuse demonstrating a sustainable wastewater recovery system that saves thousands of gallons of processed water.

dBBR produces effluent that can be used directly or disinfected to meet the health requirements for consumption. The use of recycled water is termed "purple pipe" reuse. Figure 1 shows the typical purple pipe base camp system for the reuse of water. The average person uses a latrine 10 times a day. It takes about 1 gallon of water to flush a urinal and about 1.5 gallons to flush a stool. So, if we assume an all-male unit with 100 personnel, the water use should be from 11 to 15 gallons per person per day, or a total of 1,500 gallons per day, that are not required to be produced by RO technology. Purple pipe reuse creates a nearly closed-loop, self-sustainable latrine water system. Although a certain amount of dBBR water must be wasted through the sludge-producing process, this water loss is minimal because nearly all the sludge is digested within the dBBR. For some field dBBR installations, sludge has not had to be removed for several years, resulting in no waste. In addition, make-up water from other sources such as gray water from the laundry room, black water from the dining facility, and harvested rainwater is added to the treatment system. Therefore, the dBBR can supply enough water for a camp's latrine use.

In many areas, harvesting water can be a significant contribution to the water budget. Therefore, the placement of gutters on buildings to harvest rainwater is the next engineering feat to be championed. In some arid locations, this may have limited utility but would still be useful to minimize erosion from sudden intense storms. In other areas, the water harvest could be significant. For example, a barracks hut (B-hut) has a footprint of 512 square feet. If we assume a 1-inch rain, the single B-hut harvests some 300 gallons of water. Although B-huts hold 10 enlisted Soldiers, senior noncommissioned officers (NCOs) and officers are allowed more space. Therefore, per space requirements, 100 Soldiers equates to some 14 B-huts. Given about the same number of square feet for work and equipment storage, 35 B-hut equivalent structures (sleeping, mess, maintenance, latrines, laundry, storage, and work areas) would be required. This roof area would harvest about 10,000 gallons of water. This engineering solution is shown in Figure 2.

Now, let's assume that the command restricts showers to 3 to 5 minutes; given a 2-gallon-per-minute flow rate, an individual uses 10 gallons of water per shower per day at most. This is a 1,000-gallon-per-day requirement. Given a 10,000-gallon rain harvest, the camp has some 10 days of nonprocessed water or "free water" showers. This saves a lot of water, which saves energy and requires fewer convoys on the road. Fewer convoys reduce Soldier causalities related to moving materials to the base.

Laundry also consumes large amounts of water. Washers typically use 15 to 30 gallons of water per load. Let's assume that the typical male Soldier does two loads of laundry per week. Let's further assume that the Soldier uses 25 gallons of water per load, or 50 gallons of water per week per Soldier. For 100 Soldiers, this would be 5,000 gallons of water per week. 5,000 gallons divided by 7 days per week yields 714 gallons per day. Other typical water assumptions include: 1 gallon per day per Soldier for personnel hygiene, or 100 gallons total; 1 gallon per day per Soldier for drinking, or 100 gallons total; at least 400 gallons total per day for food preparation and clean up; 100 gallons total per day lost to leaks and dripping pipes; and some 200 gallons total per day for mopping and latrine cleaning. This equates to an estimated water budget that hovers around 26 gallons per day per Soldier. If shower length and quantity of laundry are not strictly controlled, the water use rate will quickly approach 50 to 60 gallons per day per Soldier. If we consider a unit with females, water use goes up due to the use of stools rather than urinals and an increase in laundry loads per week.

Studies show that using a dishwasher is generally more water-efficient than hand-washing dishes. The use of

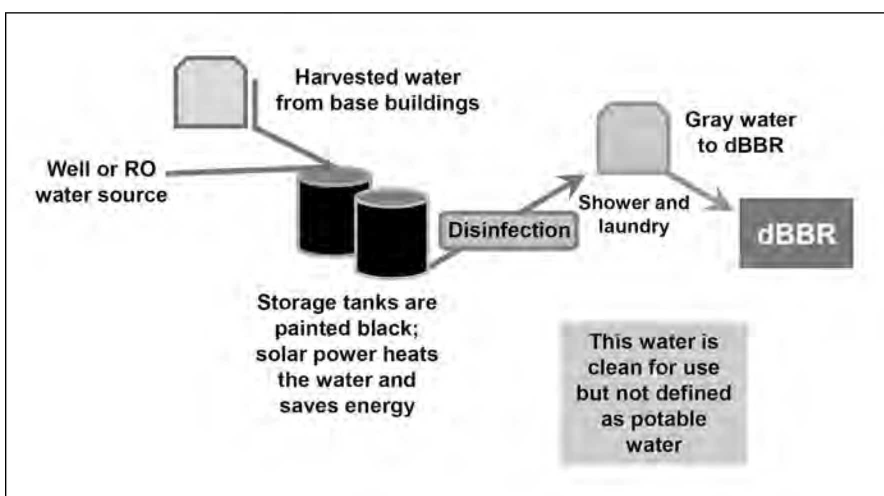

Figure 2. The ability to harvest water on a base greatly reduces the amount of potable water required for daily activities.

lightweight, nearly indestructible plates, bowls, cups, glasses, and metal utensils results in a one-time purchase and haul, whereas a continual influx of nonreuseable paper, Styrofoam products, and plasticware requires repetitive buying and resupplying. Nonreuseable products also require a large amount of covered storage space and a considerable labor force to stock and move the items. Furthermore, the solid waste generated by mess operations must be either hauled away and burned off-base (at some expense) or burned on-base in an open burn pit. The burning of No. 3 plastic or polyvinylchloride (PVC), which make up a significant portion of product packaging, is hazardous. These materials react with soot in low-temperature burns to create dioxins and furans—both of which have been shown to cause cancer and are surely contributing factors in respiratory illness.[2] Therefore, to reach self-sustainability goals, it is important to plan for the use of dishwashers in base camps.

Figure 3. Daily trash collection at New Kabul Compound, Afghanistan, in 2010. The black trash bags are predominately dining facility paper ware, and the preponderance of cardboard is the packaging for the paper plates.

There is a great benefit in using dishwashers on a base of 100 Soldiers. In such situations, dishwashers alleviate the generation of nearly 300 pounds of solid waste in the form of nonreuseable plates, bowls, cups, glasses, and packaging per day (Figure 3).

The water that is used on a base is either produced from a well or from a surface source—and then it is usually run through an RO process. However, the 1,200 gallons needed to flush the toilets on a 100-Soldier base per day is not required to be generated by the costly RO method since that water does not need to be disinfected to meet potable water standards. Instead, assuming that everyone eats every meal and dishwashers and rinse water use are efficient, only some 350 to 400 gallons of potable water are required per day for a 100-Soldier unit. By using the dBBR, the base can recover well over 95 percent of the gray and black water generated and return it to the purple pipe system. One day of dBBr effluent reuse saves enough water to supply 3 days of dishwasher use.

Studies have shown that military convoys typically convey 50 percent fuel, 20 percent water, and 30 percent other material. The metrics vary as to number of casualties generated by gallons of fuel delivered or number of convoys; however, reducing the number of convoys is the ultimate goal. Figure 4, page 28, shows an integrated approach to water use that greatly reduces the amount of fuel and new water needed to be hauled to a base. Using black tanks for water storage allows solar energy to warm the water. Using photovoltaic panels reduces energy needs that are normally met by burning fuel that is convoyed onto a base. Due to the low energy requirement of the dBBR (2–3 watt-hours per gallon of water treated), the electricity produced by a reasonably sized photovoltaic assembly can be used to power the dBBR for water production—at least on clear days.

An innovative method of filtering dBBR effluent water combines Hesco® bastions and engineered piping, shown in Figure 5, page 28. The bastions, which are stacked inside the perimeter for security, are useful for water harvesting, producing electricity with photovoltaic-containing tarps, running pipes under the tarps to heat water, and using solar panels to further heat water.

The dBBR has outstanding wastewater treatment capabilities that greatly exceed Army wastewater effluent standards. It is time to begin using proven technology and innovation to build more self-sustaining bases. Coupling trained, uniformed engineers and geoscientists with innovative technology will improve camp function. The dBBR provides a quality effluent that can be disinfected and reused in a purple pipe system to flush toilets over and over, saving thousands of gallons of water per week on even small bases. This savings removes any excuse for omitting dishwashers from bases. This small policy change would virtually remove tons of paper, plastic, and Styrofoam ware that is thrown out each day, helping to resolve the monstrous solid waste management issue on our camps. Of course, this wasted material must be brought in and stored at a significant cost in money, material, and Soldier casualties. Burning this refuse causes health issues for personnel near the burn pits. The reduction of water use further reduces the need for fuel to

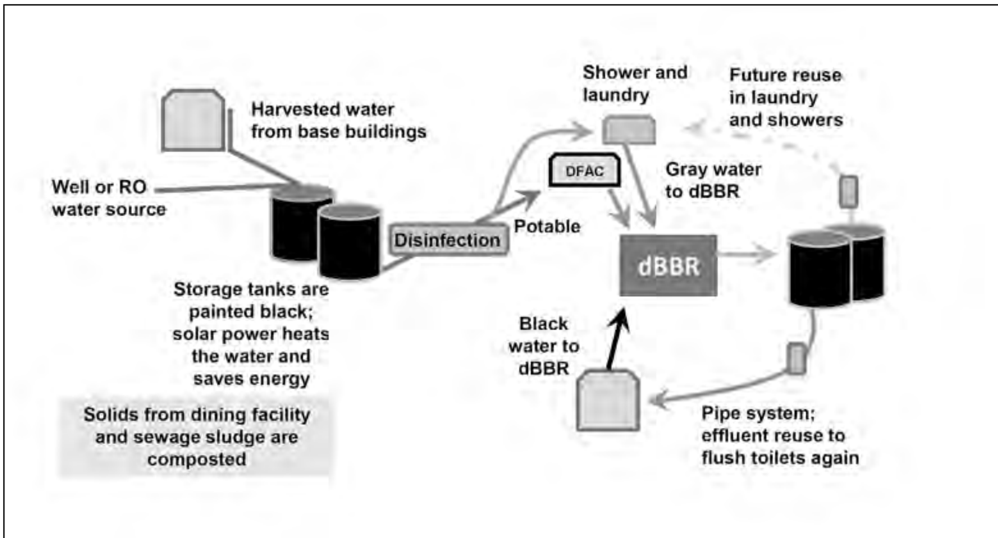

Figure 4. Base camp water treatment and reuse strategies

pump water from an aquifer or treat water through RO. Who would have imagined that deploying a highly efficient, extremely low-maintenance wastewater treatment system could reduce the amount of fuel required on a base while also virtually eliminating the solid waste management issues experienced on our current bases? It is time for the Army to begin to incorporate the dBBR in planning and deployment practices as the linchpin to make more self-sustaining base camp infrastructure a reality. Bringing more Soldiers home without injuries to lungs and limbs must be our goal, and the humble dBBR is that bridge to base camp self-sustainment.

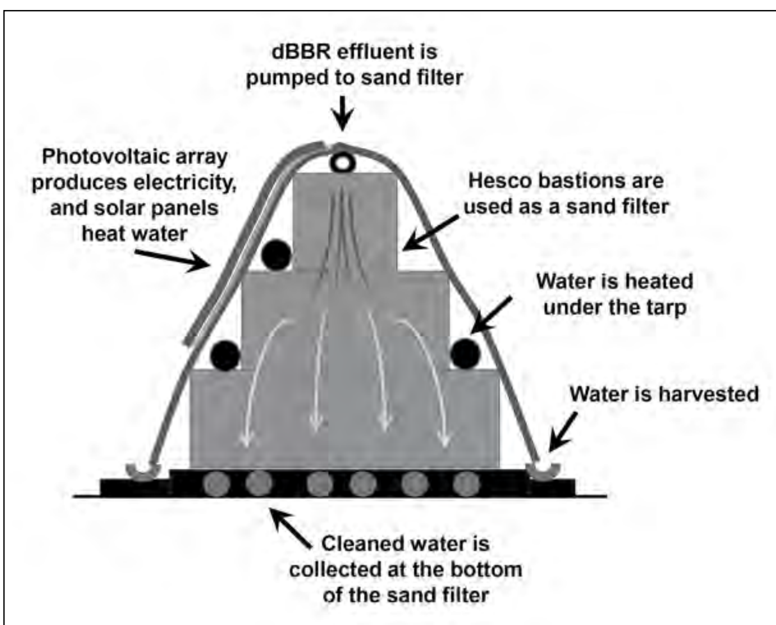

Figure 5. Cross section of a Hesco bastion dBBR effluent sand filter, photovoltaic and solar panel support system, and water-harvesting site.

Endnotes:

[1]Robert Tucker, et al, "Wasting Less Water," *Engineer*, May–August 2016, pp. 46–48.

[2]"Military Toxic Exposure: Burn Pits," 15 April 2018, <https://cck-law.com/news/Military-toxic-exposure-burn-pits>, accessed on 10 May 2018.

Dr. Tucker is an adjunct professor of civil, architectural, and environmental engineering at Missouri University of Science and Technology at Rolla. He was the chief of Environmental Programs for the Afghanistan Theater in 2010 and the chief of the Environmental Branch for the Balkans from 2003 to 2004.

Dr. Wang is a professor of civil, architectural, and environmental engineering at Missouri University of Science and Technology at Rolla. He holds professional engineer licenses in the states of New York and Missouri. Dr. Wang holds a doctorate of philosophy (PhD) from the University of Delaware. He also holds six U.S. patents and has produced 64 peer-reviewed publications. Dr. Wang is one of the university professors supporting the cooperative education program for Army engineers in the Engineer Captains Career Course.

Mr. Tupper is responsible for military education and military research at Missouri University of Science and Technology at Rolla. Mr. Tupper served in the U.S. Army Corps of Engineers for 26 years and held positions as a professor of electrical engineering at the U.S. Army Military Academy—West Point, professor of military science at Worcester Polytechnic Institute—Massachusetts, and chief of staff of the U.S. Army Engineer School.

Regimental Awards

Each year, we recognize the best engineer company, platoon leader, warrant officer, noncommissioned officer, enlisted Soldier, and civilian employee in each component for outstanding contributions and service to our Regiment and the Army. Every engineer unit in the Regiment is eligible to submit the name and achievements of its best to compete in these distinguished award competitions. Only the finest engineer companies, Soldiers, and civilians are selected to receive these awards. Throughout their careers, they will carry the distinction and recognition of being the best and brightest of the Engineer Branch. Following are the results of the 2017 selection boards for the Itschner, Outstanding Engineer Platoon Leader (Grizzly), Outstanding Engineer Warrant Officer, Sturgis Medal, Engineer Soldier of the Year (Van Autreve), and Outstanding Civilian Awards.

Regular Army

Itschner Award: Company A, 249th Engineer Battalion (Prime Power), Headquarters, U.S. Army Corps of Engineers, Schofield Barracks, Hawaii.

Outstanding Engineer Platoon Leader (Grizzly) Award: First Lieutenant Olivia L. Schretzman, Company A, 326th Engineer Battalion, Fort Campbell, Kentucky.

Outstanding Engineer Warrant Officer Award: Chief Warrant Officer Three Teresa K. Crossman, Headquarters and Headquarters Company, Operations Group, Joint Readiness Training Center, Fort Polk, Louisiana.

Sturgis Medal: Sergeant First Class Ronald Ramos Santana, Headquarters and Headquarters Company, Army Geospatial Intelligance Battalion, Springfield, Virginia.

Engineer Soldier of the Year (Van Autreve) Award: Corporal Francis J. Meighan, 618th Engineer Support Company (Airborne), 27th Engineer Battalion (Airborne), Fort Bragg, North Carolina.

Army National Guard

Itschner Award: 310th Engineer Company (Multirole Bridge), 363d Engineer Battalion, Fort A. P. Hill, Virginia.

Outstanding Engineer Platoon Leader (Grizzly) Award: No winner selected.

Outstanding Engineer Warrant Officer Award: Chief Warrant Officer Three Stephen A. Ahrens, 5694th Engineer Detachment (Firefighters), 112th Engineer Battalion, Brook Park, Ohio.

Sturgis Medal: Sergeant First Class Frederick J. Sack, Headquarters and Headquarters Company, 112th Engineer Battalion, Brook Park, Ohio.

Engineer Soldier of the Year (Van Autreve) Award: Specialist Richard W. Buechler, 211th Engineer Company, 153d Engineer Battalion, Huron, South Dakota.

U.S. Army Reserve

Itschner Award: 310th Engineer Company (Multirole Bridge), 363d Engineer Battalion, Fort A.P. Hill, Virginia.

Outstanding Engineer Platoon Leader (Grizzly) Award: First Lieutenant Zoe M. Wuckovich, 310th Engineer Company (Multirole Bridge), 363d Engineer Battalion, Fort A. P. Hill, Virginia.

Outstanding Engineer Warrant Officer Award: No winner selected.

Engineer Soldier of the Year (Van Autreve) Award: No winner selected.

The Outstanding Civilian Award Committee selected the following nominee for the *Outstanding Civilian Award*: Mr. Daniel G. Blaydes, Jacksonville District, U.S. Army Corps of Engineers.

Engineer Regimental Wee

Lieutenant General Todd T. Semonite

Engineer Run

Brigadier General Robert F. Whittle

2018 Best Sapper Winners

Engineer Castle

Memorial Wall

k 2018

Major General Kent D. Savre

Lieutenant General Robert B. Flowers (Retired)

Major General Clair F. Gill (Retired)

Fallen Sapper Tribute

Photos by Fort Leonard Wood Visual Information Center

Maneuver Support: From Concept to Future Employment

By Captain Benjamin Nobles

After nearly 15 years of conducting operations in Iraq and Afghanistan, the Army is broadening its focus to near-peer competitors, engaging the United States in what is called conventional warfare. Consequently, Army leaders and planners are heavily engaged in developing concepts and capabilities to deter and defeat these comparable future adversaries. In the near- to far-term, solutions include upgrading existing equipment, procuring new systems, updating or creating new doctrine in the current force, and developing concepts and capabilities that anticipate projected technological advances and changes in geopolitical realities. This article briefly examines key Army concepts used to guide this fundamental shift and realignment of focus to major combat operations across all domains, details the purpose of the maneuver support functional concept, and highlights the maneuver support community role within that construct now and into the future.

Army Concept Framework

In order to ensure that required capabilities develop efficiently and effectively while exercising stewardship of finite funds, the Army employs the Army Concept Framework (ACF). The ACF provides the intellectual and foundational framework for the institutional adaptations and investments required to enhance the Army's ability to conduct operations.[1] The ACF also provides the conceptual basis for experimentation; wargaming; and doctrine, organization, training, materiel, leader development and education, personnel, and facilities capabilities that guides future force training and development.[2] In essence, the ACF is the genesis for developing future concepts and, as a result, provides direct input to the Army capstone concept.

The Army capstone concept describes the anticipated future operational environment, what the future Army must do based on that environment, and the broad capabilities the Army will require to successfully accomplish enduring missions. Given the future operational environment, the Army capstone concept also describes what the Army must do as part of the joint force to protect the national

Bridge crew members assembling an improved ribbon bridge.

interests of the United States and successfully execute the primary missions of the U.S. armed forces. The contents of the Army capstone concept provide input to the Army operating concept, which addresses how the complementary and reinforcing capabilities within warfighting functions—when combined with leadership, protection and information—generate combat power to accomplish future joint combined arms operations. The Army operating concept, in turn, guides functional concept development across all six warfighting concepts of the Army, which include—

- Movement and maneuver.
- Mission command.
- Fires.
- Sustainment.
- Intelligence.
- Maneuver support.

Chemical Soldiers conduct training operations in a complex (contaminated) environment.

Army Functional Concept–Maneuver Support

Focusing on the Army functional concept for maneuver support, (which builds on the ideas presented in the Army capstone concept, Army operating concept) describes how maneuver support forces, as part of Army forces, provide unique skills and specialized capabilities that enable mobility, countermobility, and protection to accomplish campaign objectives and protect the national interests of the United States. This concept guides future force development and modernization efforts by establishing the conceptual foundation for required capabilities to enable freedom of action across the range of military operations in an uncertain and complex environment. The concept provides a vision of how future maneuver support forces will continuously develop situational understanding, gain positions of relative advantage, and consolidate gains to achieve the commander's intent and accomplish the mission. Maneuver support forces provide unique skills and technical capabilities to understand and shape the environment; mitigate the effects of obstacles, threats, and hazards; and protect the force, population, resources, and activities regardless of the complexity of the operating environment or degradation of systems.

Maneuver support forces provide specialized capabilities that assess key terrain and mitigate obstacles and hazards through a unique technical perspective that augments and enhances the overall situational understanding within the operational environment. Activities such as forensics, police intelligence operations, counter weapons of mass destruction intelligence activities, and geospatial and terrain information and infrastructure assessments all improve planning and add to the common operating picture. Through the conduct of specialized activities and technical tools and skills, maneuver support forces shape perceptions and influence the behavior of the local populous, the enemy, and relevant actors within the operational environment. Maneuver support forces alter the physical terrain through countermobility, general engineering, and police operations. They also mitigate obstacle hazards designed or employed to impede freedom of movement. In addition, they provide enhanced technical protection capabilities against potential or active threats designed to cause harm to our force, military activities, or the civilian population. It takes a collective effort from all maneuver support forces to understand and shape the physical and cognitive domains, and each regiment makes unique contributions toward this end.

Engineer Regiment

The emerging concepts in the ever-changing operational environment do not change the requirement for engineers to provide mobility, countermobility, survivability, and geospatial capabilities in support of enabling freedom of movement and action across the range of military operations to include homeland response and domestic support to civil authorities. In the near-term, to respond to ongoing and new efforts across the globe, the Engineer Regiment will use existing capabilities and apply innovative approaches to the modification and adaptation of existing equipment and formations. It is imperative that we adapt faster than our enemies and potential adversaries. In the mid-term, engineers will evolve capabilities to retain overmatch and enhance expeditionary maneuvers. For the long-term, the Regiment will innovate with emerging technologies and systems to increase and discover efficiencies in its efforts to integrate a versatile mix of robotic autonomous systems with manned and unmanned teaming. A constant effort must be made to continue the modernization of engineer-enabling capabilities while simultaneously staying ahead of threat adaption.

Chemical Regiment

While chemical, biological, radiological, and nuclear (CBRN) threats and hazards have been a condition of the battlefield since World War I, advances in the physical and life sciences as well as the proliferation of advanced technologies have increased the potential for threat development in the future. Countering these and other developments will require substantial cooperation and coordination with Army, joint, interagency, intergovernmental, and multinational organizations, as it is widely understood that weapons of mass destruction present significant threats to the United States and its interests. In order to counter this threat, the Chemical Regiment and the Army continue to build capability and capacity with special operations forces in the near-and mid-term. Future forces will build upon this momentum to prevent and counter proliferation through partnerships and cooperative threat reduction. Finally, science and technology solutions in the near to far term will improve existing CBRN detection capability, integrated early warning, personal protection, and decontamination at the tactical and operational levels.

Military Police Regiment

Military police will continue to conduct policing; investigations; and detention, security, and mobility support operations. The tools and technologies available will grow to enhance effectiveness, efficiencies, and safety. The Military Police Regiment of the future will have a wider array of nonlethal effects as well as robotics and autonomous systems available to enhance job performance. Coupled with a new platform and mission command networks, military police will retain the levels of mobility, survivability, and lethality necessary to detect, engage, and counter criminal, irregular, or enemy threats. Continuing to improve and expand technical capabilities to enhance and operationalize forensics exploitation laboratories and detection tools will increase utility and effectiveness through all phases of the operation as well as support the daily law enforcement mission. Military police will continue to provide critical support to commanders at all echelons at home and abroad regardless of the evolving threat.

Now and in the future, maneuver support forces use their unique technical capabilities to enable movement, maneuver, and sustainment capabilities. The technical competence demanded of maneuver support forces makes them invaluable to commanders throughout the conflict continuum. No other formations can do what CBRN, engineer, and military police forces accomplish; this generates tremendous demand for their capabilities. Yet, the strength of the maneuver support force to provide key capabilities to the powerful force enables the commander to consolidate gains and drive stability operations. It is this support to greater national goals and the long-term needs of the military and populace that highlight the value of maneuver support forces, their mission, and their technical skill sets.

Military Police Soldier performs security operations.

The Army functional concept for maneuver support is predicated on the assumption that engineer, CBRN, and military police units will remain the primary maneuver support forces to support Army formations conducting joint combined arms operations across the range of military operations.

Endnotes:

[1]Technical Publication 525-3-5, *the U.S. Army Functional Concept for Maneuver Support,* February 2017.

[2]Ibid.

Captain Nobles served as a maneuver support concepts officer in the Concepts, Organization, and Doctrine Development Division, Capabilities Development and Integration Directorate, Maneuver Support Center of Excellence, Fort Leonard Wood, Missouri. He holds a bachelor's degree in political science from Auburn University, Alabama.

249TH ENGINEER BATTALION: TRADITIONS BEING MADE

By Chief Warrant Officer Two Steven McGee

The 249th Engineer Battalion (Prime Power) is a decorated unit with a storied history going back to World War II. Participating in four major campaigns across Europe, the battalion was cited in the Belgian Army Order of the Day for actions in the Ardennes in Alsace. Since the 1990s, the Black Lions of the 249th have been identified as the Army's prime electrical power experts working under the U.S. Army Corps of Engineers. The mission of the 249th includes prime power generation; transformer, relay, and circuit breaker inspection, analysis, testing, and maintenance; electrical requirements and battle damage assessments; technical support; and support to the Federal Emergency Management Agency and the National Response Framework. In essence, if it has to do with electrical power, the Army and the Corps of Engineers look to the Soldiers of the 249th to provide expertise. From war in Afghanistan to support for Hurricanes Harvey, Irma, and Maria, the 249th has been there. As prime power specialists, the men and women of the 249th stand ready to provide electrical power support worldwide at a moment's notice.

The 249th is headquartered at Fort Belvoir, Virginia, which provides close proximity to the Nation's capital and

After walking 24 miles from Fort Belvoir, members of the 249th Engineer Battalion render honors at the Korean War Memorial as part of their Black Lions Memorial Day Ruck March.

Soldiers of the 249th Engineer Battalion participate in the Memorial Day Ruck March in the rain.

the many historic sites surrounding it. In honor of Memorial Day—one of the Nation's great holidays honoring Soldiers who have given all for their country—the Soldiers of the 249th continued a tradition that began 5 years ago by committing themselves to the 2017 Annual 249th Memorial Day Ruck March.

This tradition was initiated by First Sergeant Jason Ashurst of Company C. The march was instituted as a means of building esprit de corps in the unit, as well as honoring those who paid the ultimate price in service to our country. First Sergeant Ashurst recalls that the march was originally started in an effort to return ruck marching to his team's physical training sessions. As the distances increased, he and his team decided to hold a culminating event; and in 2012, the original group of 13 started off on the long march, with only nine completing the task. "That first year was definitely the hardest, though it was the one we probably trained the best for, probably because it was a new route and we didn't know what was coming around the next bend," remembers Ashurst. Since then, there were about 33–50 participants in 2013 and 2014, and about 55 participants in 2016 and 2017. The event has been growing and evolving yearly.

The event begins at the unit headquarters on Fort Belvoir, where participants march across post, down George Washington Memorial Parkway, past Mount Vernon, through Old Town Alexandria, past Reagan National Airport, and across the Arlington Memorial Bridge into Washington, D.C. Once this arduous task is completed, the Soldiers stop at the Korean War Memorial, the Vietnam Veterans Memorial, and the National World War II Memorial to place wreaths and honor their fallen brothers and sisters. The route, which is approximately 24 miles long, is completed with packs weighted to each individual's preference. The event is open to Soldiers and their Family members. Last year, the age range was from 11 to 58. The youngest and oldest were Family members, and both performed well, inspiring all who walked with them.

As the command team monitored the weather leading up to the event, it looked like it would be a rainy, difficult trip. One day before the event, there was talk of perhaps delaying the march a day, but everyone was committed to staying on schedule despite the weather forecast. After delaying from 0430 to 0530, the group of 50 Black Lion Soldiers and civilians began the long march to the Nation's capital. The light mist did not dampen spirits as the group energetically moved across Fort Belvoir and out the gate onto the Mount Vernon Memorial Highway. As they passed Mount Vernon, the rain was falling steadily, soaking them to the bone, but never affecting their spirits. When they reached the first break, around the 7-mile mark, the rain had returned to a mist and boots and socks were changed. The march continued, and the participants' camaraderie and esprit de corps were evident throughout the ranks. When asked, Captain Kathryn Rivera, commander of Company B, indicated that she had done several 5- and 6-mile training marches in preparation for the event, while the Soldiers of 4th Platoon, Company C, had prepared with 6-, 10- and 12-mile practice sessions, which gave them an edge, as they stayed close to the front of the group.

As the miles passed, many were grateful for the mist for allowing them to keep cool. Vehicles with attendants were always nearby, providing water, sport drinks, and fruit at the designated breaks along the route. The support staff was definitely instrumental in the team's success on the march according to First Sergeant Ashurst. Staff Sergeant Gino Vitello coordinated a team of vans to support the participants, and the Fort Belvoir Community Hospital provided a medic in case of emergencies. First Sergeant

Ashurst enlisted Sergeant Jarvis Murphy, an outstanding medic, who not only provided medical support, but also encouragement to the Soldiers as they made their way along the route. In addition, Staff Sergeant Keith Quevedo rode his bicycle up and down the group, monitoring and supporting the participants as the distance between them increased. Ashurst indicated that "Quevedo was a life saver. He was literally herding the cats, ensuring no one made a wrong turn on the route and keeping me apprised of the distance between the front and rear of the group."

At about 1000, the group passed under the Woodrow Wilson Memorial Bridge and moved into Old Town Alexandria, with the weight of the march wearing on many. By the second planned rest stop at Daingerfield Island Marina, the clouds were breaking, revealing the clear skies of the day. Many opted for a short rest stop because there was still a long way to go.

From there it would be another hour before the group cleared the Washington National Airport and moved toward the last break, under the George Mason Memorial Bridge. After gathering everyone, the Soldiers, Family, and friends of the 249th moved out from under the bridge, two by two, and continued toward the goal. Crossing the Arlington Memorial Bridge, the Soldiers moved into the crowded plazas of memorials, surrounded by tourists from far and wide. As they arrived, cheers, applause, and thanks greeted the Soldiers. The shouts and cheers from the Van Cleeve sixth graders from Troy, Ohio, kept everyone going. The group stopped at the Korean War Memorial to place a wreath and render a salute to honor all those who fought and died for our country and then at the Vietnam Veterans Memorial to repeat the process. Then came the last painful hike to the World War II Memorial to place the last wreath to close out another successful march for the 249th.

What began as an idea to build esprit de corps in this small unit has blossomed into an annual tradition that motivates not only the Soldiers of the 249th and their Families, but also the tourists and citizens they pass along the route. Captain Steven Perry, commander of Company C, stated, "This is an awesome event organized by the Soldiers. It's completely voluntary, and we still get them to come out and ruck 24 miles." On this day, everyone put his or her body to the test. Some came out just to see if they could do it, while others did it to share the love of country and honor all who had gone before. The march is a once-in-a-lifetime experience for many to honor those who have given all for our great country. If you are in the Washington, D.C., area around this holiday in the future, reach out to the 249th Soldiers and take a walk with them; they would be happy to have you along.

Chief Warrant Officer Two McGee is a former prime power detachment commander with the 249th Engineer Battalion. He is now an instructor/writer at the Warrant Officer Training Division, Fort Leonard Wood, Missouri.

("Risk Management," continued from page 23)

evacuation routes. Additionally, daily coordination was conducted with civilian counterparts to ensure that lookouts were emplaced to monitor fire behavior near all crews. Platoon (fire crew) leaders were responsible for scouting ahead of their crews and evaluating hazards and fire conditions. Likewise, crews reported conditions on the ground to their sister units and higher echelons to build shared situational understanding. Finally, at the squad and team levels, noncommissioned officers identified local job hazards and adjusted the posture of the work site as necessary. Junior leaders who formed the final layer of the task force safety program closely monitored hazardous falling trees and active fires. The daily safety routine, while tailored to the wildland firefighting mission, was a prescient reminder of the importance of establishing sustainable habits and clearly defined roles and responsibilities for managing risk.

Applications

As with any joint, interagency, intergovernmental, multinational mission, we learned a multitude of new practices from our counterparts and have since considered how we might apply them in a military environment. The points below represent a few of the ways that we can apply these beneficial lessons to military units across the spectrum of operations:

- Develop a short list of hazards that are specific to the mission and simple for Soldiers to remember. These watchouts are not meant to rigidly limit a leader's ability to execute, but should stimulate further risk analysis when encountered. An example of a watchout for a unit conducting a route clearance mission might be that easily detected, surface-laid command wires are a hoax.
- Reinforce to junior leaders the idea that risk to mission must be the primary and driving consideration in managing operational risk. Just as firefighters weigh "risk to values," we must prioritize mitigating risk to mission.
- Advise and make on-the-spot corrections based on the safety officer's personal experience. As an Army, we must avoid the habit of pinning this responsibility on our newest lieutenants and limiting their responsibility to draft deliberate risk assessment worksheets.
- Clearly define and articulate responsibilities for monitoring hazards, implementing mitigation strategies, and maintaining a battle rhythm for executing tasks. Much of this is already clear on the deliberate risk assessment worksheet; but all too often, it is not passed down to the level of the individual Soldier.

Captain Tetreau serves as the commander of Headquarters and Headquarters Company, 23d BEB, 1-2 Stryker Brigade Combat Team. He is a graduate of the Engineer Captains Career Course and the U.S. Army Mountain Warfare School, Camp Ethan Allen, Vermont. Captain Tetreau holds a master's degree in geological engineering from Missouri University of Science and Technology at Rolla.

Army Dive Team Gains Invaluable Experience From the Corps of Engineers

By First Lieutenant Joshua N. Voorhees and Staff Sergeant Erik G. Kuhn

The efficiency, knowledge and, most importantly, experience of the divers who make up an Army dive team are directly proportional to the quality and diversity of the challenges that the team encounters while training. To sharpen some of the strongest Soldiers in the Army in such a specialized field, an even stronger experience is required. It takes real-life situations and real-life variables to create unique and stressful challenges that hone the physical and mental strengths of each Soldier so that they can work together to enable mission success.

In August 2017, the 86th Engineer Dive Detachment had a unique opportunity to assist the U.S. Army Corps of Engineers (USACE) while sharpening its skills, gaining invaluable experience, and putting the unit's mission-essential task list to the test.

A diver from the 86th Engineer Dive Detachment steps into the Hoquiam River.

USACE, Seattle District, identified a sunken vessel in Grays Harbor, at the mouth of the Hoquiam River in Washington. One of the Corps hydrographic surveying vessels located the sunken vessel prior to dredging operations. It was determined that the sunken vessel was a navigational hazard and that removal would be required before dredging operations could begin. USACE, Seattle District, requested assistance from U.S. Army engineer divers to execute the salvage and removal of the vessel.

The request for support came down through the U.S. Army Forces Command, to the XVIII Airborne Corps, 20th Engineer Brigade, which owns 80 percent of the Army's engineer diving assets. Soon after, USACE, Northwestern Division, and the 20th Engineer Brigade entered into a memorandum of agreement and the 86th Engineer Dive Detachment was notified of the mission and began planning the operation.

Initially, the task seemed simple enough. The divers regularly train on tasks such as dredging, rigging, and underwater weight management; so, this salvage mission seemed routine. The local training environment of the James River in Virginia provided the experience needed to work in visibility similar to a morning cup of coffee. The significant difference with the mission in Washington was that there was no pre-positioning or staging of the circumstances presented to the team of salvage divers. Every Soldier of the dive team, from the commander to the second-class diver, met challenges to solve a variety of problems and accomplish this mission. Therefore, in reality, the intrinsic difficulties of a unique set of variables outside of the controlled environment provided the dive team with a means to sharpen its skills. The 86th Engineer Dive Detachment took advantage of this opportunity and also provided a service to the Corps of Engineers and the state of Washington by facilitating the improvement of navigational waterways.

A diver's equipment is inspected for leaks as the diving supervisor reviews the supervisor checklist prior to the mission.

The plan was to deploy 14 Soldiers to Hoquiam, Washington, for 10 days. There, they would use a surface-supplied diving system with diving helmets to optimize bottom time at depth. Divers worked in approximately 50 feet of water for 60–70 minutes per dive to prepare to lift the sunken vessel from the bottom. The location of the sunken vessel posed a specific problem to the operation. The vessel sat in a navigational channel of a waterway that experiences a tidal change of more than 10 feet with each cycle, resulting in a swift current of water rushing in and out twice each day. The current during tidal changes in Hoquiam exceeds three knots, an insurmountable force of water against even the strongest diver. Careful planning went into ensuring that the divers were ready to execute during the calm slack tide periods.

Two members of the 86th Engineer Dive Detachment await final dive supervisor checks.

In addition to the strong current and narrow calm periods, other conditions worked against the divers. The vessel was half-buried in mud and silt and littered with derelict timber remnants from the local logging industry. In addition, the vessel was in disrepair and there was concern that it was too structurally degraded to lift using preferred rigging methods. Lastly, the visibility of the 50° F water was reduced to zero by the black, brackish water and turbidity caused from the turbulent intermixing of upstream freshwater with the saltwater of the Pacific Ocean.

Once the work site was established and diagrams were briefed, divers began the preparation work. The first phase of the salvage plan was to use pumps to excavate the mud that had accumulated around the vessel and run lifting slings around the hull for the attachment of the topside crane hooks. Divers spent the first 3 days and more than 15 hours of diving time trying to excavate mud, silt, and debris from under the hull of the fishing boat. With each successful dive, it was soon discovered that subsequent

The 80-ton USACE contracted crane lifts the sunken vessel from the depths of Grays Harbor.

teams of divers could not advance past the keel, or backbone of the hull, for two main reasons:

- The mud and debris reaccumulated in the cavity between dives, reducing efficiency and gainful progress.
- The divers discovered that the vessel rested on several timber logs at the location where the tunnel was to be excavated, and this prevented divers from tunneling past the keel.

In the original mission timeline, 4 days had been alloted to accomplish the excavation of two tunnels and the complete installation of lifting slings. After the third day, the noncommissioned officer in charge decided that a change in the strategy to finish preparing the vessel for salvage was necessary. Since placing slings under the hull was not an option, for the next 2 days, the dive team focused its efforts on rigging nylon straps and buoyancy flotation bags on structural points of the vessel. The purpose of the buoyancy bags was to provide stability and assist the crane in breaking the vessel free from the mud and debris. On one dive, the rigging installed on attachment points at both ends of the vessel tore away and broke free from the degraded fiberglass hull. The vessel was not brought to the surface; however, the lift was a success in that the entire hull was pulled free from the suction-like forces of the deep, soft mud. On each subsequent dive, the hour spent on the bottom was designed to be efficient and methodical so that the next mechanical lift was as fail-safe as possible.

Knowing that the vessel was not in good enough condition to pull free with lifting points, the plan required another key adjustment. With the vessel now completely out of the soft mud, the lifting slings were passed beneath the hull, wrapped around in a choker configuration, and cinched down to squeeze the frame of the boat in two locations. This adjustment needed to be accomplished in the two short windows of calm slack tide remaining on the planned lifting schedule resulting from a solar eclipse over the northwestern United States, which caused more extreme tidal surges and caused slack tide to be shorter and the current to be stronger when moving through the cycle. The 86th Dive Team was up to the challenge. For the last preparation dive, the rigging system needed to be inspected, any issues needed to be fixed, and the crane hooks needed to be connected

The mission noncommissioned officer in charge briefs the divers on the next plan of attack in rigging the vessel.

to the lifting slings, all while leaving enough time to make the lift before the current gained velocity. The final dive was executed with a keen sense of urgency, efficiency, and excitement. Finally, the lead diver in the water squawked, “Job complete” over the communication system. The topside personnel were beaming with enthusiasm. All of the hours of preparation; hours of dragging equipment through black water, sludge, and debris; and time spent fighting the force of water that was determined to knock them off their feet were for this moment—the moment when the Soldiers of the 86th Engineer Dive Team first saw the object that they had been working on for the past 2 weeks as it broke the surface of the water in an intact state. It was an experience that could not be replicated in a classroom, but could only be achieved by exhausting physical and mental energy, battling as a team, overcoming obstacles, and coming away from the battle victorious.

Real-world training, like this salvage mission, allows leaders to account for multiple outlying factors that, if left unaccounted for, may negatively affect—or even halt—the operation altogether. This type of training gives Soldiers the opportunity to think “outside the box” to overcome obstacles and get the job done. The constantly changing water conditions and unpredictable condition of the vessel—including the flotsam and jetsam that lay underneath it—provided just the type of real-life scenario that is instrumental in the development of our dive supervisors, salvage divers, and leaders. The Soldiers who fought together to raise this sunken vessel will never forget the techniques that worked; the techniques that did not work; and how each obstacle encountered can be overcome by exercising creativity, awareness, resourcefulness, careful planning, exhaustive preparation, and teamwork. From the commander to the newest second-class diver or second lieutenant, each Soldier gained mission experience that he or she could not have developed in a controlled training environment.

First Lieutenant Voorhees is a diving officer serving as the executive officer for the 86th Engineer Dive Detachment, Joint Base Langley–Eustis. He is a graduate of the U.S. Army Sapper Leader Course and the Joint Diving Officer Course at the Naval Diving and Salvage Training Center, Panama City Beach, Florida. He holds a bachelor’s degree in business administration from Gordon College, Wenham, Massachusetts.

Staff Sergeant Kuhn is a diving supervisor serving as the operations noncommissioned officer in charge of the 86th Engineer Dive Detachment. He is a graduate of the U.S. Army Sapper Leader Course and the First-Class Diver Course at the Naval Diving and Salvage Training Center. He holds a bachelor’s degree in economics from Florida State University.

We Need Your Photographs!

***Engineer* is always looking for good-quality, action photographs (no “grip and grins,” please) to use on the outside covers. If you have photographs of Soldiers who are in the proper, current uniform and are participating in training events or operations or photographs of current, branch-related equipment that is being used during training or operations, please send them to us at <usarmy.leonardwood.mscoe.mbx.engineer@mail.mil>.**

Ensure that photographs depict proper safety and security procedures, and do not send copyrighted photographs. All photographs must be high-resolution; most photographs obtained from the Internet, made smaller for e-mailing, or saved from an electronic file such as a Microsoft® PowerPoint or Word document cannot be used for print. In addition, please include a caption that describes the photograph and identifies the subject(s) and photographer (if known). Please see our photograph guide at <http://www.wood.army.mil/engrmag/Photograph%20Illustration%20Guide.htm> for more detailed information.

Improved Ribbon Bridge Emplacement in Cold-Weather Operations

By Second Lieutenant Thomas Hazen, Captain Michael Pope, and First Lieutenant Mary Oliver

Seventeen years had passed since the 1438th Multirole Bridge Company (MRBC) had conducted cold-weather bridging operations. As the unit prepared to conduct a 21-day annual training (AT) exercise, the frigid North Missouri winter crept in. Temperatures fell below freezing and remained there throughout the weeks preceding AT. These conditions led to significant ice accumulation on all bodies of water in the area of operations, creating an ice obstacle the likes of which the 1438th MRBC had never previously negotiated. Further complicating the situation was the external evaluation by First Army, which the 1438th needed to pass on the fourth day of AT.

In September 2017, the 1438th MRBC received notification that it was selected as a focus readiness unit. This status significantly condensed the timeline for meeting AT objectives. To achieve this timeline, AT was rescheduled from June to January 2018.

On the first day of AT, the 1438th MRBC established an assembly area in the area of operations and began planning a deliberate wet-gap crossing using an improved ribbon bridge and bridge erection boats (BEBs). Reconnaissance elements pushed out to all identified crossing sites and returned with the same message: thick ice. The ice along the near and far shores of Crossing Site A, the primary crossing site, measured 12 inches thick, while the ice at the center of the 120-meter gap measured 9 inches thick. BEBs can break through quite a bit of ice; however, the ice that the 1438th was facing was unbreachable with a BEB. Additional attempts to break through would result in significant damage to the aluminum hulls of the BEBs, jeopardizing mission readiness. The mission needed to be expanded to include breaching the ice.

In a tactical situation, the ice could be reduced using indirect fires or close air support. These reduction methods were not feasible in the training environment. Alternate methods of bridging on ice were explored. A digital copy of a U.S. Army Corps of Engineers (USACE) publication from 1994, *Cold Regions Technical Digest 94-1*, Clearing Ice for Bridging Operations, was located.[1] The publication covers ice clearance using heavy equipment (bulldozers), demolitions, compressed air, and chainsaws. The idea of using demolitions was originally proposed, but the site did not have proper standoff due to the proximity to a city. Bulldozers were eliminated as a possibility because the training site was located on a former strip mine that had been donated to the state after operations had ceased. The bodies of water on the training site have deep drop-offs that could swallow heavy equipment. There is a 100-foot drop-off at Crossing Site A. Although a bulldozer could not be used, the theory behind its implementation could be. A hydraulic excavator (HYEX) would have limited range due to the drop-off, but it could clear the near and far shores enough to drop a BEB into the water.[2]

Members of the 143th attempt to break through the ice on Day 1 using the weight of a bridge erection boat.

During the planning phase, it was discovered that building a bridge on the ice must be conducted differently than in open-water conditions. Normally, the company standard operating procedure calls for building a 6-float raft that carries an assault force to the far shore. The assault

The completed bridge

A 143th MRBC Soldier and safety guides scroll a line in the ice with a chainsaw in an attempt to break the ice away from the main body.

force secures the far shore to establish a bridgehead and provides security to the 1438th as it begins the anchoring process. The 6-float raft was deconstructed and rebuilt as two separate bridge pieces (one on either shore) that swung together to form a complete bridge, fully closing the gap. Due to the ice coverage, this method of construction did not work. Therefore, the commander proposed a new plan; if the ice could be breached, the breach would be in the form of a narrow channel. Due to the severe lack of mobility, a ramp is launched, followed by a sequence of bays until the bays span the gap, at which time a final ramp is launched. With an untested build plan complete, the only remaining question was how to breach the ice. It was hypothesized that if a BEB could enter the open space created by a HYEX, it could provide upward or downward pressure to the ice, causing the ice to break.

Fragmentary orders and a gap-cropping synchronization matrix were published, spurring the unit into rehearsals for the operation. Late into the third day of AT, the company began the dry run for the external evaluation. Engineer equipment parking and regulating points were established. Approach routes to the near shore were cleared, and the first BEB was lowered into the water. The HYEX succeeded in clearing a 20-foot semicircle of ice off the near shore; unfortunately, that was not enough. A BEB is 26 feet long—too long for a 20-foot area. Despite this, the BEB was lowered to the lip of the ice in a controlled shallow-water launch. The nose of the BEB dipped into the water, under the ice, and provided upward pressure through the boat's buoyancy, failing to affect the ice. Further attempts to breach the ice failed. The 1438th returned to the assembly area to conduct an after action review and seek an alternate plan.

Key leadership convened to formulate a new strategy. The commander outlined a process of using chainsaws to cut the ice and illustrated his plan on a whiteboard. Safety considerations were discussed, and the plan was viewed from every angle for feasibility. Finally, at the end of an exhaustive planning process, the key leadership had a shared vision of the execution. The 1438th would use chainsaws to conduct a mechanical breach of the ice. Troop-leading procedures were once more initiated. The breaching team was organized into saw operators, ice safety guides, and shore support. The unit prepared chainsaws and personal protective equipment; 3,000 feet of 19,000-pound tensile strength, 3/4-inch nylon rope; ice cleats; and harnesses borrowed from a dry support bridge. Saw operators performed precombat checks for wet-weather gear and a life preserver. Deliberate risk assessments and the concept of operations were developed, briefed, and approved by the battalion commander.

The day of the external evaluation, the 1438th set out with an untested plan. First, a safety tether spanning the near to far shores was suspended between a common bridge transport and the HYEX. The safety tether served as a centerline for the channel. Additional lengths of rope marked the lines for the cuts in the ice. The channel measured 30 feet wide to give the 28-foot improved ribbon bridge 1 foot of mobility on each side. The saw operators suited up and were equipped with chainsaws, ice cleats, harnesses, eye protection, and a 20-foot tether rope to secure them to the suspended centerline. In addition, they wore wet-weather gear. Each saw operator had an ice safety guide assigned to control his or her tether and spot for him or her. Ice safety guides wore wet-weather gear, ice cleats, and a life preserver. The shore support team included additional safety guides, a chainsaw-refueling team, two medics, and a field ambulance. The deliberate risk assessment was briefed prior to the saw operators stepping onto the ice. The 1438th rehearsed what to do if an injury occurred or a Soldier fell through the ice.

Finally, saw operators began reducing the ice. First, they scrolled the ice around the opening created by the HYEX. This expanded the opening enough to ensure that a BEB could enter the water and open a workspace to launch the bays and to maneuver the build boat. After scrolling out the work zone expansion, saw operators began making 4-inch scroll cuts in the ice, with additional saw operators following behind to finish the cuts. Cold Regions Technical Digest 94-1 recommended using a skip tooth chain with as little cutting angle as possible, which would yield a cutting rate of 28 feet per minute on ice as thick as this.[3] The 1438th used standard log chain on 18-inch bars, which yielded 15 feet per minute on the scroll cut and 8 feet per minute on the finishing cut. Saw operators began with the left cut and cut from the near to far shore, then came back on the right cut in the opposite direction. Saws could typically run for 15 minutes before refueling, as they were running at full revolutions per minute. The whole operation from start to finish lasted 2 hours.

BEBs and an excavator were used to break and clear large chunks of ice from the channel.

Once the chainsaws finished cutting a larger area in which to drop the boats, the boats were launched into the water. The weight of the boats broke the ice into smaller pieces. Using poles and the BEB jet drives, the ice was moved to the shore for the HYEX to extract it from the channel. It was a slow and deliberate process. The large chunks of ice presented a problem for the boat operators. These free-floating pieces damaged the boat scoops, which control the steering. Due to the damages, boats were rotated. When enough ice was removed for the boats to have maneuvering space, the first ramp and bays were dropped into the water.

The far-side ramp and the first bay hit the water at dusk. The two subsequent interior bays were then dropped. These two interior bays needed to be connected before attaching the far shore ramp due to weight and buoyancy preventing a ramp from connecting to a single interior bay. This process was also slow and deliberate, as the bridge crew had to push small chunks of ice out from between the bays to connect them. By this point, the vast majority of floating ice had drifted to the far shore. The HYEX was moved to the far shore to help extract the chunks of ice. Once it was determined that the gap was nearly closed, the near-side ramp was deployed in a controlled drop, spun around, and attached. The bridge was anchored and verified, officially closing the gap. The process took 4 hours from the time the first bay was dropped into the water until the crossing was verified for traffic.

Conducting a deliberate wet-gap crossing is a highly synchronized, rehearsed process that takes great understanding of the mission, enemy, terrain and weather, troops, time alloted, support, and civil considerations to accomplish the mission. At the end of the operation, the 1438th MRBC demonstrated that, with an equal combination of skill and determination, an improved ribbon bridge could be emplaced in a dynamic and complex environment regardless of the terrain and weather.

Endnotes:

[1]Deborah Diemond, Cold Regions Technical Digest 94-1, *Clearing Ice for Bridging Operations*, USACE, 1994.

[2]Ibid.

[3]Ibid.

Second Lieutenant Hazen is a platoon leader for the 1438th MRBC, 1140th Engineer Battalion, 35th Engineer Brigade, Missouri National Guard. He is a graduate of the Engineer Basic Officer Leadership Course. He holds a bachelor's degree in agricultural business with a minor in military science from Truman State University, Kirksville, Missouri.

Captain Pope is the commander of the 1438th MRBC. He is a graduate of the Financial Management Captain's Career Course and the Engineer Basic Officer Leadership Course. He holds a bachelor's degree in history and a master's degree in sports business administration from the University of Central Missouri, Warrensburg.

First Lieutenant Oliver is a member of the Missouri National Guard. She is a graduate of the Engineer Basic Officer Leadership Course. She holds a bachelor's degree in English from Truman State University.

Engineer Doctrine Update

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

Publications Currently Under Revision

Publication Number	Title	Description	Tentative Publication Date
ATP 3-34.45	*Electric Power Generation and Distribution*	This new publication discusses electrical power support to military operations and defines and discusses electrical power source levels and electrical power transitions.	3d quarter, fiscal year (FY) 2018
JP 3-15.1	*Counter-Improvised Explosive Device (IED) Activities*	This update reflects changes in terminology and updates the counter-IED lines of effort.	3d quarter, FY 18
TM 3-34.56	*Waste Management for Deployed Forces*	This update incorporates current regulations and best practices and techniques for conducting waste management activities while deployed.	4th quarter, FY 18
FM 3-34	*Engineer Operations*	This update focuses on engineer support to large-scale ground combat operations and will nest with, and incorporate topics from, Field Manual (FM) 3-0, *Operations*.	4th quarter, FY 19
Training Tools Under Development			
ATP 3-34.81 Training Tool	*Living Doctrine for Engineer Reconnaissance*	This product incorporates audio, video, and pictures to enhance understanding and training of Army Techniques Publication (ATP) 3-34.81.	4th quarter, FY 18

How can you provide feedback to doctrinal publication reviews?

As Soldiers and civilians, you have the opportunity to provide feedback to our doctrinal publications as well as those staffed across the Army. For existing publications, please e-mail us directly with your feedback. For doctrinal publications that are under assessment or revision, the staffing process includes a 45-day period for comments, which are accepted regardless of rank or position. However, there are requirements associated with the *level* of comment. Below are the descriptions associated with *critical*, *major*, *substantive*, and *administrative* comments. We have added additional notes annotating the rank equivalent associated with the level of comment.

C—**Critical.** Contentious issue that will cause nonconcurrence with publication; requires general officer level backing.

M—**Major.** Incorrect material that may cause nonconcurrence with publication; requires colonel level or above backing.

S—**Substantive.** Factually incorrect material.

A—**Administrative.** Grammar, punctuation, and style.

Regardless of level of comment, we welcome the feedback to ensure that the information we are capturing for the Regiment is current, relevant, and useful for the force.

Engineer Doctrine Update

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

New Engineer Publication Highlights

ATP 3-37.34, *Survivability Operations*, was published to the Army Publishing Directorate on 16 April 2018. Updates to this manual include the following:

- Expanded discussion on survivability threats to align with near-peer threat considerations.
- Added discussion on withstanding chemical, biological, radiological, and nuclear hazard conditions, which affect survivability, and descriptions about how immediate and operational decontamination allow forces to retain the ability to perform their mission.
- Updated engineer equipment construction times for individual and crew-served tables using the latest equipment production rates.
- Updated vehicle dimensions.
- Added figures of examples of individual and crew-served survivability positions as well as air defense artillery firing positions.
- Updated artillery position and radar survivability tables (with the most current systems) and added air defense artillery launcher survivability data.
- Updated roles and responsibilities of the engineer commander, assistant brigade engineer, and staff officers in relation to survivability operations.
- Updated information pertaining to direct- and indirect-fire weapons effects.
- Updated information to align with the latest joint and proponent doctrinal publications.

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

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("Show the Way," continued from page 5)

(map background), specialized geospatial intelligence products and formats, and geospatial intelligence Web-based services. Russ, we wish you well in the next chapter of your career.

In April 2018, 11 Regular Army and Army National Guard, U.S. Army Reserve, Military Occupational Specialty (MOS) 125D, Geospatial Engineers, conducted a critical task site-selection board at Fort Leonard Wood. Technological changes and the growing need for geospatial engineering data have shown that it is imperative that training in WOBC, WOAC, and Warrant Officer Intermediate-Level Education meet the needs of our senior leaders in the U.S. Army. The board spent a week identifying shortcomings and recommending changes to our WOBC, WOAC, and Warrant Officer Intermediate-Level Education Follow-On curriculum.

We continue to seek out talented noncommissioned officers to become engineer warrant officers. If you are interested in becoming an engineer warrant officer, visit <http://www.usarec.army.mil/hq/warrant/WOgeninfo_mos.shtml>. Full job descriptions for MOS WO120A, Construction Engineering Technician, and MOS WO125D, Geospatial Engineering Technician, are posted at <http://www.usarec.army.mil/hq/warrant/prerequ/WO120A.shtml> and <http://www.usarec.army.mil/hq/warrant/prerequ/WO125D.shtml>, respectively.

Thank you, team, for being professional and leading the way; and thanks to all engineer warrant officers for actively recruiting to ensure that our cohort stays Army strong.

The Significance of the First Army Broadening Experience

By Captain Avery D. Fulp and Captain Jeffery R. DeVaul-Fetters

Introduction

The Army National Guard (ARNG), the only military institution whose existence is required by the Constitution, and the U.S. Army Reserve (USAR) are composed of a select group of Soldiers who dedicate a portion of their time to serving our Nation. In the beginning, they were not just Soldiers; they were builders of homes, churches, schools, and businesses. They provided the foundation of what would become the United States. The ARNG and USAR provide citizens with the opportunity to serve in the military while also contributing to the same communities in which they serve. As a vital part of the total Army, these institutions integrate skills, abilities, and attributes from the civilian sector and the battlefield, providing synergy for both.

Often when Soldiers think of broadening, they think of assignments outside of the Army as ideal developmental assignments that build leaders who can interact with individuals outside of the Army, whether they are civil servants, members of other Services, or representatives of governments of other countries. As such, *broadening* in its most effective form expands thought by allowing leaders the opportunity to step outside their primary occupational specialty and understand the concepts and methodology of the way the Army components fight.

It is worth examining the value of assignments that integrate the Army as a total force; and there is no better unit to examine than First Army, whose mission is the integration of Army Total Force Policy (ATFP). ATFP directs the integration of the Regular Army and Reserve Component (ARNG and USAR) as a total force. The partnership construct provides observer coach trainers (OCTs) from Regular Army, ARNG, and USAR the opportunity to gather observations and lessons while advising and assisting ARNG and USAR Soldiers.

First Army provides an intellectually demanding assignment that requires an understanding of both Army components. It is common to see detachments of ARNG or USAR Soldiers integrated into Regular Army teams. In order to effectively integrate the two components, it is necessary to develop leaders who understand both components.

First Army offers several ways to develop Army leaders as they support the organizational development, manning, and training of Regular Army, ARNG, and USAR components as an integrated force.

Accomplishing the Mission as a Team

The Army values great teams over individuals. In order for ATFP to be successful, the star of the team must be the team. However, this is difficult for leaders to achieve. Managing the differences in culture, egos, professional backgrounds, skills, and many other areas is a crucial task in ensuring team success.

OCTs conduct recertification training.

To establish a true team in this environment, leaders must identify entities acting as individual elements of the components and integrate them. Leaders must assist those individual elements to begin thinking in terms of *us* rather than *them*. Teaching those in another component to put the welfare of the team ahead of their own can be a challenge when the natural instinct is to watch out for yourself.

As the Army becomes more complex, freely exchanging knowledge, experience, and new ideas with others throughout the organization is crucial to success in these exceedingly competitive times. First Army provides leaders with the opportunity to gain experience and become comfortable integrating the components.

Developing a Cultural Connection and Respect for Components

The role of an OCT requires that he or she develop the proper tact to effectively inform ARNG and USAR units during after action reviews following training. An OCT is responsible for improving the readiness of ARNG and USAR units. First Army has established the Total Force Partnership Program, which allows its units to become familiar with assigned partners. Partnership enables OCTs to develop lasting relationships with ARNG and USAR units, which facilitates shared learning. First Army OCTs use ATFP and training guidance to connect with their partner units to develop and build relationships.

First Army provides OCTs with an opportunity to promote effective and innovative methods to connect with ARNG and USAR partners and facilitate shared learning across all levels. Integrated training allows ARNG and USAR commanders the ability to provide predictable, recurring, and sustainable capabilities to combatant commanders globally.

One of the overarching goals of an OCT is to reduce the overall number of postmobilization training days for ARNG and USAR units. This is possible by working directly with partner units to help them develop a training plan that enables effective utilization of training time during limited battle assemblies throughout a calendar year. When OCTs understand the challenges and time constraints of their partners, they provide better input and feedback to enhance training plans. Demonstrating an understanding of the supported unit's challenges and strengths allows OCTs to effectively improve readiness, facilitate shared learning, and earn the respect of their partners.

Building the Bond Through Connection

Connecting stimulates imagination and allows Soldiers to see themselves from different viewpoints. The Army's core value of respect is derived from the golden rule, "Treat others the way you would want to be treated." This phrase takes the focus away from an individual and allows him or her to concentrate on what he or she can learn from others. It requires that individuals imagine themselves in the shoes of others. Soldiers are more likely to be part of a team if they feel that their voice is heard and respected. This is especially true of the First Army experience, where Regular Army, ARNG, and USAR Soldiers are working together on a daily basis.

A trainer instructs a Soldier in adjusting the aim on a mortar system.

The commanding general of First Army meets with Soldiers during a combat support training exercise.

The Army requires the development of leaders who understand and can balance the needs of Soldiers in both components. The normal training year for ARNG and USAR units consists of 39 training days. However, those units identified as priority units receive 45 days in the second year and 60 days in the third and fourth years. Although readiness is the No. 1 priority, the increased readiness requirements require leaders who can balance the Army, employer, and Family needs of its Soldiers.

It is important for leaders to communicate in a manner that offers predictability for Families and employers. Leaders in positions that require management of the cultural differences of the components can face challenges that are more art than science and that normally require a high degree of trust, openness, and risk taking. Integrators of ATFP must understand this distinction and plan accordingly. Respect and goodwill strengthen the bond of those being led and facilitate strong communication up and down the chain.

Communicating Effectively

The ability of a leader to communicate effectively with Soldiers in both components starts with trust. And in order to build trust, the message must be consistent. Receiving a constant flood of information can make it hard to distinguish important, relevant, and unimportant information. Consequently, important and relevant messages are sometimes missed. Leaders must identify priorities and eliminate unimportant information to reduce confusion.

Communication is critical to the synchronization of the total Army, particularly in this time of change. Communication must be clear, concise, and relevant. Working in an environment where time is at a premium, understanding the audience, and knowing what to communicate and how to communicate it are key. Although both components have the same mission, each entity is unique. Leaders must be cognizant of barriers in communication—an ability best learned through experience.

First Army provides the opportunity to experience the best communication practices of both components. A breakdown in communication at any point can result in conflict and a decrease in productivity. In a complex and fast-paced environment, communicating developments and decisions within the broader mission of the total Army is not only critical, but also one of the most challenging requirements.

Conclusion

The total force must be a part of the Army strategy and planning in order to fulfill the rapidly increasing and dynamic needs of the military. Integration of all entities requires leaders who practice openness, build trust, prioritize time, and accept prudent risks. Units require leaders who understand and can build teams and integrate units with existing cultural norms and subcultures. Failure to understand the differences in components can have a negative impact on morale and attitudes toward leaders.

Understanding all entities does not make integration easy. It requires leaders who have an appreciation of both components and an ability to identify friction points and who can create solutions to complex challenges. There is no better way to learn the strengths, weaknesses, and nuances of both components than to be exposed to experiences where the rubber meets the road. First Army OCTs are exposed to the friction points and diversity of thought on a daily basis. First Army OCTs are the leaders of ATFP and total force integration. First Army OCTs are "First Indeed."

Captain Fulp currently serves as the Military Intelligence Team chief for the 1-410 Brigade Engineer Battalion (BEB) at Fort Knox, Kentucky, and is a Project Warrior candidate. He is a graduate of the Military Intelligence Captains Career Course, Military Intelligence Basic Officer Leader's Course, and First Army Academy OCT's Course. Captain Fulp holds a master of business management degree from Webster University and a bachelor of business degree in marketing from the University of Southern Mississippi.

Captain DeVaul-Fetters currently serves as the Military Police Team chief for the 1-410 BEB at Fort Knox, Kentucky. He is a graduate of the Military Police Captain's Career Course, Military Police Basic Officer Leader Course, and First Army Academy OCT's Course. Captain DeVaul-Fetters holds a bachelor of arts degree in physical education from Benedictine College, Atchison, Kansas and a master of arts degree in business and organizational security management from Webster University.

An Army Engineer Officer's Deployment to Bahrain

By Captain Ericka Collins

After spending a year deployed as the facilities engineer with the Naval Support Activity in the Kingdom of Bahrain, I feel that it is my duty as an engineer officer to share my unique experience as part of a joint special operations task force. This yearlong deployment was unlike any I have experienced. The command at Naval Support Activity Bahrain is a dual one, including Joint Special Operations Task Force–Arabian Peninsula (JSOTF-AP) and Naval Special Warfare Unit 3 (NSWU-3). Within JSOTF-AP, 19th and 20th Special Forces Groups (Airborne) National Guard units complete 6-month rotations to Bahrain as Special Operations Forces liaison elements supporting the seven Arabian Peninsula countries–Bahrain, Saudi Arabia, Oman, United Arab Emirates, Kuwait, Yemen, and Qatar. In my time there, there were Special Forces units from Colorado, Alabama, and Utah. In addition, there were units of the Regular Army, Army National Guard, and U.S. Army Reserve, which all supported the JSOTF-AP and NSWU-3 mission. The unit mission was to plan and conduct special operations in support of the commander of the U.S. Central Command, leveraging foreign internal defense activities with Arabian Peninsula partner nation security forces in order to improve regional stability and countermalign actors within the area of responsibility.

As the facilities engineer for JSOTF-AP, I was responsible for the maintenance and upkeep of almost 100,000 square feet of facilities on Naval Support Activity Bahrain and Kuwait Naval Base. I was the officer in charge of the J4 facilities and the Transportation Section, which consisted of three Army and three Navy personnel. My duties included overseeing facility maintenance, base operations, and improvement projects. I routed projects through the proper channels to ensure completion.

The types of projects that I managed varied in nature; however, all were in support of improving the facilities. In February 2017, the motor on the variable-speed detector of the air conditioning unit on the first deck stopped functioning properly, causing us to go without air conditioning for about 10 weeks. Bahrain does not have winter, so there were some serious impacts to operations. The server room and the electrical rooms had to be cooled with portable units during this time. As a result, we decided to install a 5-ton split air conditioning unit as a backup for those rooms in case the air conditioning were to malfunction again. My role involved getting a quote, acquiring funding from Naval Special Warfare Group One, approving the scope of work, and facilitating access and the execution of the work through the Public Works Department. We also had other projects in the high bay; one of these consisted of adding circuit breakers in Bays 3 and 4 to accommodate special-operation boats. The command had plans to build a mezzanine in the high bay to accommodate these boats, while still preserving some storage and gym space. The paraloft tower—which was used to hang and dry parachutes during missions and training requiring water landings and for vigorous physical fitness training—saw some improvements during my year there as well.

> ***"The unit mission was to plan and conduct special operations in support of the commander of the U.S. Central Command . . ."***

While in Bahrain, I facilitated the certification of the paraloft winches and hoists, which had been unusable for 2 years. After not being in use since 2012, the rappel tower was certified the week that I left. The canvas that had been covering the tower had blown off and was torn from high winds. The cover was not included in the base operating support contract, which meant that acquiring quotes and developing a performance work statement were required in order to replace it. I ensured that the cover would be added to the new base operating support contract starting in December 2017 to eliminate additional future expenses. I oversaw the funding, installation, and certification of two vehicle lifts and the installation of a shade structure to store two hazmat lockers in our vehicle maintenance shop.

(continued on page 56)

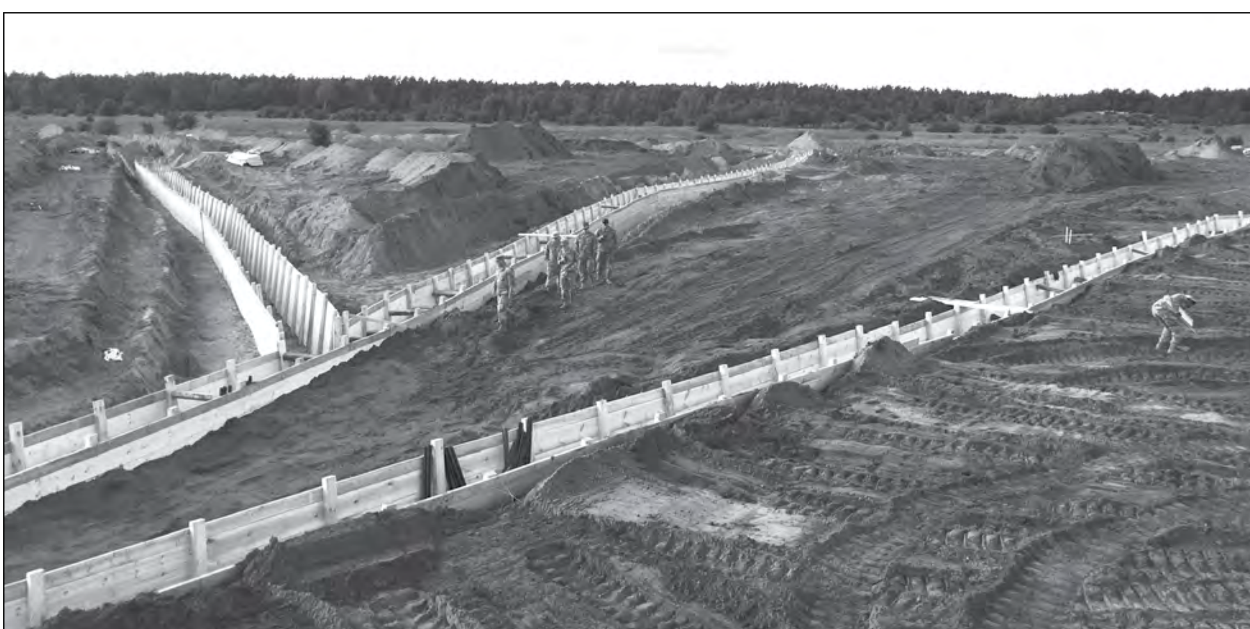
BUILDING THE GREAT TRENCH OF POLAND

By First Lieutenant Dave J. Truong

In March 2017, I took over as the platoon leader for 2d Platoon, Troop A, Regimental Engineer Squadron, to support the first iteration of Enhanced Forward Presence. Sergeant First Class Larry Leach was my platoon sergeant. We planned to provide mobility, countermobility and limited survivability support. The regimental commander, Colonel Patrick Ellis, tasked the squadron with building a large range complex that would replicate a Russian right-flank trench system. The Soldiers at Enhanced Forward Presence would use the range to execute a realistic combined live-fire exercise against a Russian threat.

Sappers from the 2d Platoon, Argonaut Troop, Regimental Engineer Squadron, 2d Calvary Regiment, conduct mechanical breaching of a concertina wire obstacle.

My platoon was tasked to accomplish this mission—with limited manpower, training, and equipment—in 45 days. The scope of this project was beyond what I ever thought I would face as a new platoon leader. Eventually, with help from the regimental engineer, 2d Squadron, 2d Cavalry Regiment, S-4 and the regimental S-4, we procured power tools, 5 tons of wood, and 1 ton of steel. The platoon was made up of 34 sappers, 10 infantry Soldiers, four heavy-equipment operators, one D-6 bulldozer, one High-Mobility Engineer Excavator, and limited horizontal support from the local Polish engineer battalion. Initially, we faced a steep learning curve, as the Soldiers were combat engineers—not carpenters.



The intersection of the trench system after 6 weeks

Soldiers from the Engineer Squadron, 2d Cavalry Regiment, built a trench to create a realistic training environment for a troop size element.

On the first day, the sappers built 30 meters of retaining wall. With coaching from the foreman, Staff Sergeant Jeremy Hudson, and the experience gained from a couple of weeks of work, they increased production rates to 75 meters per day. Through 30 days of work and 10 rain delay days, 13,000 man-hours were dedicated and 859 meters of trench line, six machine gun bunkers, one mission command bunker, six BMP-3 and two T-72 hull defilade positions, 100 meters of antivehicle ditch, and one missile-proof bunker were built.

Construction started on 9 August 2017 and was completed on 23 September 2017. The result was the largest and most complex multinational combined arms live-fire range in Europe. It has been used by subsequent rotations of Enhanced Forward Presence troops and the North Atlantic Treaty Organization.

The first use of the range was by 2d Squadron, 2d Cavalry Regiment, for its troop live-fire exercise with our platoon sappers supporting it with mobility operations. We faced the most complex obstacle that we have ever encountered, which consisted of tangle foot, followed by triple standard, an antivehicle ditch containing triple standard inside, and triple standard on the far side—with more tangle foot behind it. This obstacle stretched our resources and forced us to attack this problem with creative solutions to ensure freedom of maneuver in a timely manner. By the end, we drastically improved our mobility skills through obstacles of increasing difficulty. This prepared us to face a Russian style trench. The *Great Trench of Poland* (as the platoon Soldiers named it) created a training environment that is unmatched in its realism and displays the best of American military engineering.

Soldiers construct a trench.

First Lieutenant Truong is serving as a squadron assistant operations officer (S-3), 2d Cavalry Regiment, Tower Barracks, Germany. His previous assignment was as a platoon leader with the same unit. He is a graduate of the U.S. Army Engineer Basic Officer Leader Course and the Site Exploitation Course. Second Lieutenant Truong holds a bachelor's degree in sociology from the University of California–Irvine.

TROOP CONSTRUCTION: Bridging the Gap in Training

By First Lieutenant Darian Abenes

Troop construction activities can provide an undeniable opportunity for Soldiers and their leaders to learn aspects of engineering that might otherwise be lost. The 610th Engineer Support Company recently experienced a learning opportunity by building a 600-foot running trail and 65-foot-long bridge with a 65-foot-long access ramp on Joint Base Lewis–McChord, Washington, for the 1st Special Forces Group. Murray Creek Trail was to be composed of crushed asphalt, and the bridge was to consist of 65-foot beams. On 10 July 2017, one horizontal-construction and one vertical-construction platoon moved into the project site. Platoon mission-essential tasks (METs) such as "construct combat roads and trails" and "construct wooden and concrete frame structures" were accomplished during the project. Company METs were accomplished by performing construction operations and project management. In addition to accomplishing the METs, the project provided evidence that certain lessons may only be learned by performing troop construction.

The 555th Engineer Brigade leads a class on chainsaw operations to ensure safety and increase domain knowledge.

First platoon, 610th Engineer Support Company, was the horizontal-construction platoon responsible for construction of the Murray Creek Trail. The platoon completed a plethora of tasks, including felling trees, hauling spoils, clearing, grubbing, and installing crushed asphalt. The Soldiers were grateful for the learning opportunities that this troop construction project provided. One heavy-equipment operator stated, "You learn about the capabilities of the equipment, what equipment fits in the space, and what material the equipment can maneuver on." The wetlands were a challenge for which many operators had not previously trained, so there was a lot of guidance provided by experienced noncommissioned officers. An experienced squad crew leader explained that he had had the opportunity to see how development goes; he was briefed on what needed to be done and then was involved in actually doing it. "It's going through the problem-solving process that makes it beneficial," he said. His crew worked with the vertical-construction platoon to pour concrete for bridge abutments. When digging to place the abutment formwork, they hit the water table. This caused the hole for the formwork to fill with water within an hour. They were able to use a sump pump from the hydraulic, electric, pneumatic, petroleum-operated equipment kit. Another noncommissioned officer remarked, "It was really cool to use the piece of equipment and see how it works with the Interm High Mobility Engineer Excavator."

Construction on the Murray Creek Trail and the bridge continued through the battalion field training exercise. The horizontal-construction platoon had two crews working during the day and one crew handling the night shift. Many operators did not have experience with around-the-clock operations. A squad leader commented on construction during the field time, stating, "Management of personnel was very different during the day versus the night. All in all, management of personnel during 24-hour operations was a learning opportunity for leadership."

Third platoon was the vertical-construction platoon assigned to the Murray Creek Trail and bridge construction project. The platoon was responsible for installing the 65-foot bridge and a 65-foot access ramp. A member of 3d platoon spoke about how he learned to make rebar cages for the abutments. Another Service member mentioned that this was his first vertical-construction pour and that Soldiers do not often have the opportunity to work with concrete because it is expensive. He indicated that any time concrete work is available, everyone can learn something. A crew leader went on to discuss the benefits to the Soldiers and noncommissioned officers, stating, "In 9 years of service, I have never done bridge assembly. Working with cranes and taglines was a new experience for everyone, and no one had ever emplaced a 65-foot bridge." Another Soldier agreed and added, "You learn how different levels of experience come together to complete the project. There was a huge value in cross-training." The vertical-construction platoon consists of electricians and plumbers, so performing carpentry tasks was beneficially broadening. The Soldiers continued to build rapport with the horizontal-construction platoon, and each Soldier gained a new appreciation of the others' traits and skills. Overall, the skills that were learned were invaluable and may not have been gained without the troop construction opportunity.

3d Platoon emplaces formwork and rebar for a vertical-construction concrete pour.

As a platoon leader, I experienced a huge learning curve while serving as the officer in charge of the project. I took over the platoon leader position in June, which left a month for planning before the platoon broke ground. I remember sitting with the outgoing platoon leader and looking at the first set of plans—and feeling overwhelmed. At the Basic Officer Leadership Course, construction is covered in the third module, which comprises about 1 month of the 5-month course, so experience is limited. The reconnaissance of the site was even more overwhelming, I remember looking up to see trees more than 30 feet tall (without a clearing) and trying to imagine a trail, access ramp, and bridge in their place. You really do not learn how to manage a project until you are actually doing

Soldiers conduct tree-felling operations.

The fully assembled bridge across Murray Creek

it—counting squares to calculate cut and fill, obtaining a dig permit, or discussing what equipment needs to be dispatched to compete the project. Working through the work rate calculations to determine the timeline of a project provided a refresher I would not have received without the project. The construction planning process provides an opportunity to continuously learn about the resources that are available. The 555th Engineer Brigade construction management team hosted classes to assist in each step of the planning process and answered all requests for information regarding the plan and bill of material requests.

Our chief warrant officer was the biggest asset to planning and execution. His experience enabled the platoon leaders to plan in accordance with construction activity summary sheets. Both the brigade construction cell and our chief warrant officer were instrumental in learning how the quality assurance and control process is incorporated. Overall, the most significant lesson I learned from this troop construction project is just how remarkable our Soldiers really are. Their ability to operate in a new environment with new specifications and changing conditions is outstanding. I am happy to have witnessed their expertise, gains in experience, adaptions to change, and problem-solving skills.

The project was completed on 9 November 2017. I now look forward to working on future projects.

First Lieutenant Abenes is a platoon leader with the 610th Engineer Support Company, 864th Engineer Battalion, 555th Engineer Brigade. She holds a bachelor of science degree in psychology from Augusta University, Augusta, Georgia.

"Deployment to Bahrain," continued from page 51)

My experience as a project manager at the U.S. Army Corps of Engineers, Omaha District, helped me with time and personnel management communication strategies when dealing with contractors, civilians, and the Public Works Department. These skills helped me to remain organized and proactive while dealing with about $500,000 in projects.

Bahrain is a small island state of approximately 293 square miles (about three and a half times larger than Washington, D.C.) in the Persian Gulf. Due to its size, the island could easily be overlooked when looking at the world map. However, this makes it nearly impossible to get lost there. The majority of personnel who deploy to, or are stationed in, Bahrain live on the economy due to the limited availability of housing. The housing consists of luxury flats and villas, some of which include cleaning services. In addition, Bahrain has a multitude of social activities ranging from brunches, city tours, and camel farms to night clubs, beaches, and shisha lounges. Despite the entertainment, it was necessary to remain vigilant while moving throughout the country. To ensure awareness, weekly force protection updates with areas of concern were distributed. Regardless of the type of environment, it was the responsibility of my group to remain aware of our surroundings and report anything suspicious.

Above all, the most notable part my deployment is definitely the people I met and the things I learned from them. The command master chief of JSOTF-AP/NSWU-3 was an exceptional example of a Navy chief. He cared about his Soldiers, Marines, Sailors, and Airmen and the command in general. He always said that everyone chosen to be a part of the command was "varsity"—not just the sea, air, and land forces (SEALs) and Special Forces personnel. We all had a pivotal role, and we were expected to fill it with the utmost professionalism and technical competence. Command Master Chief Lewis knew everything about the command, from operations to facilities, and was an integral part of my section. He inspired me to push harder every day because he always came to work motivated, operating forklifts around the compound and advising junior officers. Command Master Chief Lewis is a mentor who had a huge impact on my work ethic and leadership, and I will always remember him when I think of my time at Naval Support Activity Bahrain.

Captain Collins serves as a project manager on the Acquisition Support Team in the Omaha District, U.S. Army Corps of Engineers. Her previous assignment was as a facilities engineer with the Joint Special Operations Task Force—Arabian Peninsula, Naval Special Warfare Unit 3 in Bahrain. Captain Collins holds a bachelor of science degree in biology from Virginia Commonwealth University at Richmond and a master's degree in engineering management from Missouri University of Science and Technology at Rolla.

A Russian Approach to a Battalion Hasty River-Crossing Assault

By Mr. Charles K. Bartles

Introduction

Large rivers and lakes dominate Eurasia and have served as major shipping arteries of industry and commerce, defensive barriers, lines of communication, and avenues of advance. Due to this geography, most Russian ground force vehicles have some amphibious capability and can ford water. Water crossings, which are practiced regularly, differ by season and weather. In the winter, crossing depends on the strength and stability of the ice. In the spring, there is drifting ice and flooding. In the summer and fall, table of organization and equipment and attached crossing equipment can be used. If the water obstacle is less than 5 meters deep and the riverbanks and bottoms are suitable, tanks can snorkel across. Crossing on a wide front at a quick tempo using a forward detachment or advanced guard is usually preferred.

Specialized Russian Water-Crossing Equipment

Russian engineer battalions (organic to maneuver brigades) have many assets to overcome water obstacles and support river-crossing operations. These assets usually include truck-launched bridges for narrow waterways or TMM-6 vehicle-launched bridge sets. To overcome wide bodies of water such as large rivers and lakes, the battalion has a PP-91 pontoon bridge company that can emplace the bridge in under 1 hour. (A 268-meter-long bridge can carry 60 tons, a 165-meter--long bridge can carry 90 tons, and a 141-meter-long bridge can carry 120 tons.) The pontoon bridge company has six BMK-255-1 cutter vessels to help assemble and maintain the position of the pontoon bridge. The vessels can also function as tugboats to allow the pontoon bridge to function as a ferry if needed.

The battalion also has six PTS-2 tracked, amphibious transports that can haul loads of up to 20 tons on land and 12 tons across bodies of water. The PTS-2 can carry

Open water-qualifying operation

PMM-2M self-propelled ferry vehicle

a wheeled or tracked vehicle, one heavy artillery gun, or 75 troops. Some units may have GSP-55 tracked, self-propelled ferries based on the PT-76 amphibious tank chassis. Working in pairs, they can be connected to carry loads of up to 52 tons at a rate of 6 kilometers per hour in water. The GSP-55 is being replaced by the PMM-2M self-propelled ferry vehicle. The PMM-2M is a tracked vehicle with two pontoon platforms that unfold on each side. With pontoons deployed and in the water, the PMM-2M can move at a rate of up to 11.5 kilometers an hour (unencumbered) and carry loads of up to 42.5 tons. Multiple PMM-2Ms can be daisy-chained together to haul larger loads.

Conditions for a Hasty River-Crossing Assault

The Russian army conducts two types of river crossings—unopposed and opposed. The unopposed river-crossing is conducted against little or no effective opposition. The opposed river crossing is conducted against an effective opposition. The attack from the march (hasty attack) is the preferred method of conducting an opposed river crossing. Should that fail, a deliberate attack is considered. Conditions for the hasty river-crossing assault are usually created while pursuing a retreating enemy. While pursuing an enemy, it is important to keep the enemy from breaking contact, so fording sites may be seized, allowing the pursuing units to quickly cross a river and remain "on the heels" of the enemy.

Theory of the Hasty River-Crossing Assault

Conducting an opposed crossing of a river in combat conditions is one of the most difficult tasks for a unit to execute. As a rule, an opposed crossing of a water

Pontoon bridge system functioning as a ferry

Pontoon bridging operations

obstacle in combat conditions is executed without a halt, demanding significant preparations that include a thorough engineer reconnaissance of fording sites and sufficient cover from enemy fire. An opposed hasty river crossing is inherently difficult to plan and execute because the battalion subordinate units are moving up to the river and crossing it while deployed on line (in combat formation) in combat. This operation is accomplished across a broad front at a high rate of speed, preferably first by the advance force and then by the main body.[1]

A hasty attack across a water obstacle from the march is preferred because it maintains the momentum of the advance, facilitates the seizure of bridgeheads, and allows the rapid occupation of the opposite shore or the securing of an assembly area for an upcoming operation. A motorized rifle or tank battalion can perform a hasty river crossing as part of a regiment or brigade—or on its own. If the battalion is operating as part of a larger formation, it is assigned an assault-crossing sector that includes primary and alternate crossing sites. The commander designs the concept of the operation, designating all fording sites, lines of departure, and loading or preparation areas. Air defense assets are employed to protect fording sites and preparation areas. If possible, an air assault may conduct a landing to seize the far shore. Smoke, air defense, and counterbattery efforts are particularly critical.

Fording Sites and Assembly Areas

Different types of fording sites are organized for the hasty river crossing: amphibious vehicle fording sites for armored personnel carriers, infantry fighting vehicles, or amphibious light tanks (PT-76s); fording sites for fully submerged vehicles with snorkels; fording sites for tracked amphibious transports (PTS-series tracked, amphibious transports), and tracked self-propelled ferries (GSP-series tracked self-propelled ferries) or pontoon bridges functioning as ferry fording sites. In an assault crossing involving the deployment of the main body of a battalion, an assembly area is designated at the water obstacle. The battalion negotiates the obstacle on its own if it is operating as part of a forward (raiding) detachment or in the advance guard.

Motorized rifle subunits conduct the hasty river crossing in their armored personnel carriers or infantry fighting vehicles. Tanks cross by fording, by fully submerging with snorkels, or by boarding ferries (GSP-55s/PMM-2Ms). Artillery and wheeled vehicles that have no amphibious capabilities are transported by the PTS-2 tracked amphibious transports. Typically, the battalion is assigned a line of departure for the assault crossing at a distance of 1 to 2 kilometers from the water's edge and assembly areas for ferry and amphibious transport boarding and loading and tank preparation are located 5 to 6 kilometers from the water's edge.

Ferry and amphibious transport fording sites are commanded by officers from the engineer battalion. However, if the crossing is being made by fording or submerging, or if the vehicles are amphibious (infantry fighting vehicles, armored personnel carriers), then the fording site is commanded by an officer of the unit conducting the crossing. Fording site commanders are referred to as "crossing commandants."

Mission Command

Mission command of the battalion is exercised by the battalion commander in the command observation post during the hasty river-crossing assault. The command observation post is located 100–200 meters from the bank, and the command observation posts of attached artillery and tank units are typically situated nearby. The battalion commander crosses to the opposite bank behind the first echelon companies. During the assault, combat missions are assigned by the battalion commander to subordinate units by radio. Coordinating instructions are issued at the same time.

The width of attack frontage and the make up and depth of the combat missions of a battalion operating as part of the main body are determined in the same way as they are when attacking a defending enemy without conducting a hasty river-crossing assault. When negotiating the obstacle, the immediate battalion objective is to destroy the enemy on the opposite bank in the defensive area of the enemy's first-echelon companies and to occupy their positions. The subsequent objective is to develop the attack and route the enemy in coordination with adjacent battalions throughout the depth of the enemy's defensive area. At the battalion level, Russian commanders are typically assigned an immediate objective, subsequent objective, and direction of farther advance.

The battalion commander must make the decision to conduct the hasty river-crossing assault as early as possible in order to assign combat missions to companies and platoons in a timely manner. The battalion subordinate unit combat formations are established in accordance with the assault-crossing concept and the combat mission that has been assigned to the battalion. This means that the battalion subordinate units are now in combat formation. Russian battalion commanders usually command a combination of companies and platoons—not just companies, as in the U.S. system—that report directly to them. A company is in combat formation when its subordinate platoons are on line, while a platoon is in combat formation when its subordinate squads are on line. There must also be substantial coordination before and during movement to the water obstacle. This coordination includes the preparation of vehicles and equipment for the hasty crossing assault. Preparations begin in the assembly area, with special attention given to ensure that hatches, firing ports, and doors are tightly closed; bilge pumps are serviceable; and all personnel have life vests.

Role of the Engineer Troops

The effective use of terrain features, when moving toward the river, is essential for avoiding enemy reconnaissance strike complexes. The inclusion of engineer troops for the operation is vital for the hasty river-crossing assault. Engineer units conduct reconnaissance of the avenues of approach and fording sites to determine operation viability, prepare routes, place barriers upstream to prevent heavy objects such as logs and debris from colliding with fording vehicles, and support the movement of attacking units and river-crossing equipment to the water obstacle. In addition, they breach obstacles, perform traffic control and salvage recovery service at fording sites, and support the actions of attacking subunits on the opposite bank.

Execution of the Hasty River-Crossing Assault

The hasty river-crossing assault begins when units of the first echelon shove off from the friendly bank. Tanks and antitank units not crossing take firing positions and engage enemy targets on the opposite bank to provide cover to crossing units. Under cover of friendly fire and smoke, motorized rifle units cross the river in infantry fighting vehicles/armored personnel carriers and engage the enemy while afloat. Nonamphibious units in the first echelon cross with the assistance of amphibious transports or ferries. Tank units use bridges, fords, or ferries, as available. Typically, a tank company of 10 tanks can ford a 250–300-meter river in 8–10 minutes or be transported across the river by a pair of GSP-55s or a PMM-2M in 50–60 minutes.

After crossing the river, the first echelon is intended to rout the remaining defending forces in the area and begin to assault throughout the depth of the enemy defense. Artillery, air defense, and antitank units attached to the battalion, as well as the mortar battery, usually cross later by amphibious transport so that they may provide continuity of support and cover for the battalion assets on the opposite bank. Since an enemy counterattack to repel

Tanks conducting snorkeling operations

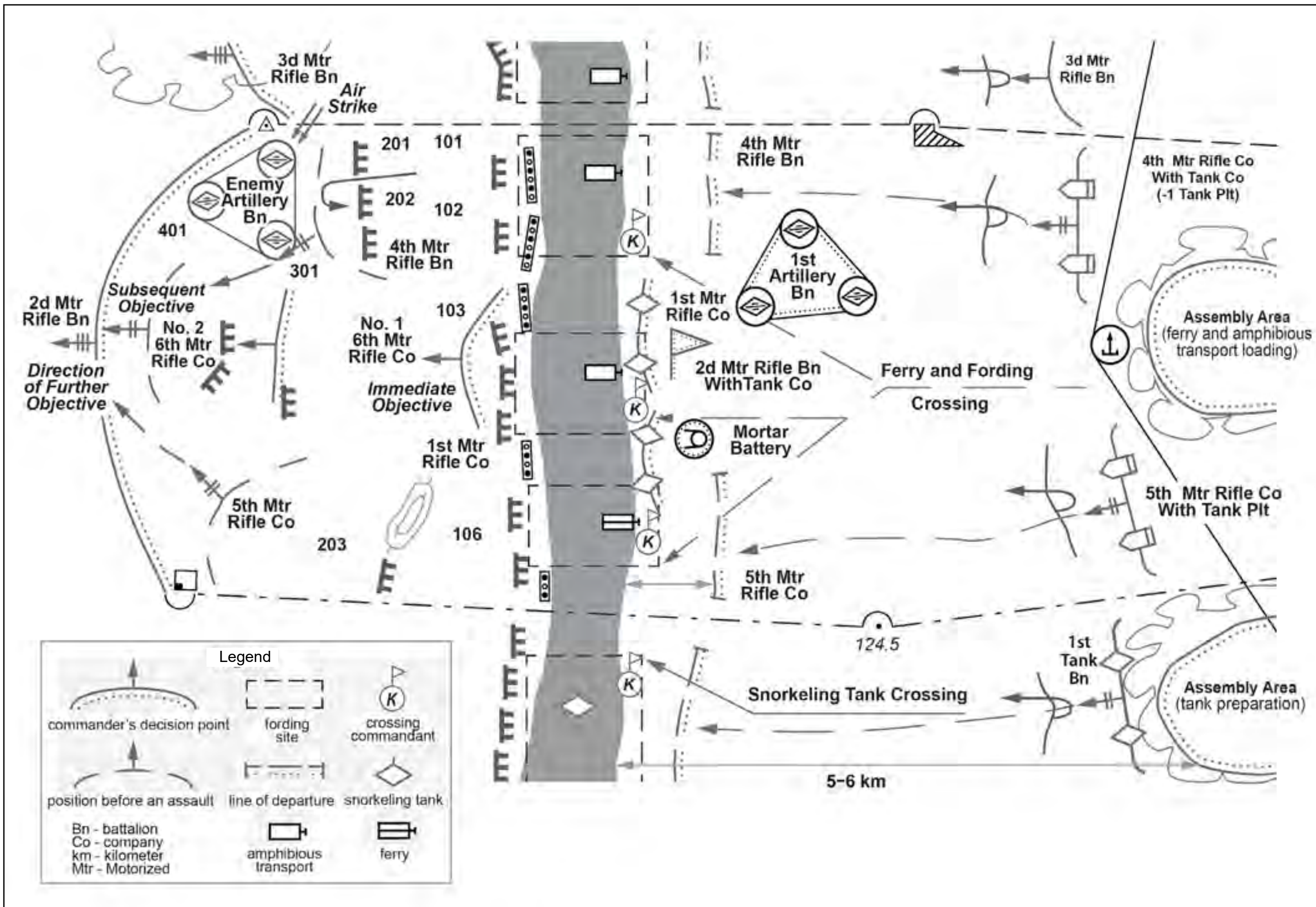


Figure 1. A hasty river-crossing assault by a Russian motorized rifle battalion

the landing force can be expected, it is essential that antitank weapons, tanks, and artillery be available to repel the counterattack. The battalion rear logistic support units cross on amphibious transports and ferries after the artillery and air defense subunits have crossed. Aid stations and ammunition vehicles are the first rear services elements to cross.

A Hasty River-Crossing Assault by a Russian Motorized Rifle Battalion

Figure 1 depicts several Russian maneuver battalions conducting a hasty river-crossing assault while pursuing a fleeing enemy. The battalions begin fording preparations in assembly areas approximately 5–6 kilometers from shore. These preparations include affixing snorkeling equipment for tanks and making amphibious vehicles watertight. Amphibious transports and ferries are loaded at this time. The first echelon, consisting primarily of tanks and infantry fighting vehicles and/or armored personnel carriers, moves to shore and, supported by antitank weapons and equipment, begins to cross.

The three-digit numbers on the graphic represent predesignated target areas for friendly artillery. The enemy artillery has been designated for an air strike that will presumably happen before the crossing begins. After the first echelon crosses the river, it destroys enemy units in the area (immediate objective) and continues to pursue enemy units and disrupt the enemy rear (subsequent objective); meanwhile, amphibious transports and ferries conduct operations to move the rest of the battalion elements across the river. After the immediate and subsequent objectives are achieved and a preponderance of supporting units arrive on the newly occupied side of the bank, the maneuver battalions move toward the direction of farther advance.

Endnote:

[1]Aleksandr Anikeyenko, "The Battalion at a Crossing: From Experience of an Assault Crossing of a Water Obstacle by a Motorized Rifle (Tank) Subunit," Armeyskiy Sbornik Online, February 2007, <http://militera.lib.ru/periodic/0/a/armeysky-sbornik/as_2007-02.pdf>, accessed on 28 February 2018.

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