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Contents

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Purpose

Originally founded as the *Field Artillery Journal*, the *Field Artillery Professional Bulletin* serves as a forum for the discussions of all U.S. Army and U.S. Marine Corps Field Artillery professionals, Active, Reserves and National Guard; disseminates professional knowledge about progress, development and best use in campaigns; cultivates a common understanding of the power, limitations and application of Fires, both lethal and nonlethal; fosters Fires interdependency among the armed services, all of which contribute to the good of the Army, joint and combined forces and our nation. The *Field Artillery Professional Bulletin* is pleased to grant permission to reprint; please credit *Field Artillery Professional Bulletin*, the author(s) and photographers.

Cover

Blockhouse at Signal Mountain, Fort Sill, OK. (*Photo by Judith Oman, Field Artillery Public Affairs*)

COL (P) Shane P. Morgan
Field Artillery School Commandant

CSM Michael J. McMurdy
Command Sergeant Major of the Field Artillery

The Compass of our Branch

By COL Shane Morgan

Throughout our warrior history, one thing remains clear — the value of any military force lies in the quality and quantity of its Field Artillery. No other branch is held in such high regard nor has such a long and distinguished history as ours.

As we move into an era of modernization we cannot forget where we, as Redlegs, came from. We need to celebrate those traditions and customs that have made us the King of Battle for the past 247 years. We trace our origins to Henry Knox, the first Colonel of the Field Artillery. Our colors today remain red and yellow, paying homage to our early uniforms and plumage. Every year, we appreciate the contribution and fighting spirit of Molly Pitcher.

As our Army transforms to face the future, we also honor those traditions with our annual Saint Barbara celebrations. This is a time meant to inform and inspire future generations of Soldiers and leaders about our heritage even as they seek to create new paths of their own. It showcases the elements of our chosen military profession — The Field Artillery — distinguishing Redlegs from other branches and conveys the richness of our history and the experience of our units.

The foundation of all things Artillery is Blockhouse Signal Mountain, here at Fort Sill. Once used as an observation post in old Cavalry days, the building is now the north compass of every Redleg around the globe. Within the dusty confines of the old stone structure is hidden a canister containing a base charge. The terrain is steep and the journey to retrieve it each year is demanding. The charge itself represents our line of selfless service and those who made the ultimate sacrifice in the call of duty. It serves as the base ingredient, a connection between the old and the new. Retrieved for the Saint Barbara's Ball, each year a portion is saved returned afterward for our next leaders to reclaim again and continue our traditions.

As we continue to grow and modernize, CSM Michael McMurdy and I ask you to remember and honor where we came from, embrace the future of our branch and be the empowering compass for current and succeeding generations to follow.

Happy Saint Barbara's Season Redlegs!! Zero mils!! KOB!!

Background:
Senior leaders from around Fort Sill hike up to Blockhouse Nov. 29, 2022, to retrieve the base charge for the grog ceremony of the Saint Barbara's day celebration.

Right:
COL(P) Shane Morgan and CSM Michael McMurdy pose for a photo in front of the historic Blockhouse on Nov. 29, 2022, after the rigorous hike up Signal Mountain.

Far right:
The survey marker in front of Blockhouse, placed in 1948, gives the exact location of Blockhouse.

(Photos by 1LT James Marshall, FA CMDT Aide de Camp)

Below:
The survey marker in front of Blockhouse, placed in 1948, gives the exact location of Blockhouse.

Bottom:
The foundation of all things Artillery, where every Redleg learns to cut a charge — Blockhouse Signal Mountain. Built in 1917, it was settled as a signal station and weather observatory providing communications between Signal Mountain and the Medicine Bluffs.

(Photos by Judith Oman, FA CMDT Public Affairs)

CW5 Rolando G. Rios
Chief Warrant Officer
of the Field Artillery

Greetings fellow ***Redlegs,***

It is my distinct honor and privilege to work for you as the fifth Chief Warrant Officer of the Field Artillery Branch (CWOB). Rest assured that I take this obligation seriously and commit myself to doing the absolute best for the Field Artillery and our 131A Cohort. This is truly the greatest branch in the Army.

As the CWOB, I structure, align, and energize my entire effort to the Army's "People Strategy" Lines of Effort:

1) Acquire

2) Develop

3) Employ

4) Retain

The premise behind the strategy centers on the Army's WO Stabilization Plan to **acquire** people with both talent and potential for expertise, and future longevity of service, **develop** WO-specific talents through experiential and expert development programs, **employ** WO talent to meet the Army's readiness requirements, and **retain** WO expertise and talent for the betterment of the Army.

While my determination is driven by the Army's "People Strategy" and the FA Commandant's priorities, I do not undertake these tasks alone. I rely heavily on the Field Artillery Proponent Office's WO, the Warrant Officer Basic Course Manager, the 131A Branch Manager, and input from commanders and senior leaders in the branch. Collectively, we all have a role to play in safeguarding this awesome branch.

To each one of you, I will give you 100% of my effort and will find every strength available to me to do the very best that I can for the cohort and the branch.

We must become scholars of our profession!

King of Battle!

Trust in Your MTOE to Gain Trust

By MAJ Joseph G. Jankovich

During History 102 at the Command and General Staff College, my classmates and I chuckled as we watched a video depicting engagements during the Revolutionary War. The idea that people wholeheartedly lined up, bounded, and traded volleys with an enemy formation seemed too absurd to be a military paradigm of any era. Our instructor noted that the compliance to the process occurred because each Soldier knew they would be shot as a deserter at the slightest flinch. Several months later, during the Advanced Operations Course, the same classmates very seriously huddled around a map of Eastern Europe. We based phases, and movement triggers on our actions and the assessed enemy reactions. Blue Forces (BLUFOR) took objectives with a fair certainty that the opposing force (OPFOR) would take complementary objectives. It was a dance and predictable counter-dance of combat power. In effect, hundreds of years after the Revolutionary War, the military paradigm of lining up, bounding, and letting each side take a turn had not changed; only the weapons had changed. To win on future battlefields, artillerists must know their enemy's capabilities and employ their own well-maintained organic capabilities while emphasizing survivability and digital communications. Simplicity in this employment results in a commitment to the effort through trust.

Know Your Enemy

Field Artillery personnel must know enemy capabilities. The weapons will continue to change in future battlefields. We have seen in recent warfare the heavy employment of drone use for reconnaissance, target validation, and direct kinetic effects. The United States military employs lethal drones consistently without often considering the enemy's capacity to do the same. For example, Russian-backed separatists creatively utilized drones as observers with destructive fire effects during the Zelenopillia rocket attack in 2014, long before the current Ukrainian campaign. The Ukrainian Army had shot down an inexpensive drone earlier in the week but continued to mass forces in a congested area only 9 km from the Russia-controlled border. The rocket attack lasted just over three minutes but killed or injured over 100 personnel while making multiple armored brigades combat ineffective.

Just as Ukrainian military leaders did not synthesize that enemy forces could observe utilizing drones and could fire rocket artillery once those targets were known, somehow, many military theorists did not overly note the event at the time. This was a paradigm change to warfare, all of which came from open-source media. The near-peer threats we prepare for in a large-scale combat operations (LSCO) fight have open-source programs or news reports of material focus areas. We have access to this information and can assess the military paradigm beliefs of our enemies to enable a proper counterplan. Just as with Intelligence Preparation of the Battlefield, analyzing and assessing the conventional and unconventional tactics and means utilized by the enemy form the foundation for all operations that follow.

Beyond the open-source intelligence, units should regularly employ all organic equipment. Army policy requires us to inventory and service this equipment, so it should be used regularly and fully. Just as Russia has fully embraced the use of drones, most units have RQ-11 Ravens that could make the difference in initial Reconnaissance, Selection and Occupation of Position (RSOP), local enemy detection, and triggering the need for

Background: Survivability: *The light medium tactical vehicle in the wood line has the tools to survive and move quickly: it is obscured from enemy detection, dispersed from other equipment, and light enough to exfiltrate immediately. Above, left to right:* ***Terrain Model:*** *Soldiers who are part of a process that utilizes all resources available to complete the mission and preserve personnel and material readiness show better trust and commitment to the plan.* ***Rocket Attack:*** *The aftermath of Russia's Zelenopillia attack in 2014 shows the negative side of many points of this article: an inexpensive observer drone was used by Russia to neutralize an immobile and undispersed formation.* ***NVG:*** *Just as the Army provides equipment to maneuver in all conditions, such as Night Vision Goggles, units have MTOE Ravens that could provide critical protection information.*

survivability moves. FM 3-90-2: Reconnaissance, Security and Tactical Enabling Tasks Volume 2 in chapters 1-7 outline a fundamental requirement of reconnaissance operations: never keeping reconnaissance assets in the rear. The material readiness involved in maintaining and servicing the equipment proves crucial to its effectiveness. While time-consuming, using Ravens or similar devices on the battlefield directly puts equipment rather than personnel in harm's way while also providing intelligence for survivability. The smart use of that material to preserve the personnel readiness of our Soldiers also builds trust and commitment to the team effort.

Survive through Mobility

Artillery units must have high survivability through mobility and dispersion to win on the battlefield. In an LSCO environment, static positions get friendly forces killed. There simply is no operational need to lay too much concertina wire or set up a "TOC Mahal" that leaves a unit susceptible to counterfire. Indeed ATP 3-09.50: The Field Artillery Cannon Battery chapters 5-6 heavily emphasize continually hardening a defense unless "emergency displacement is anticipated." However, as a Field Artillery unit in LSCO, there is an inherent necessity to displace hastily.

Mentally agile leaders must assess the enemy situation and find the proper balance. Most of us have experienced a Combat Training Center rotation where each survivability move or jumping off a main command post resulted in a far smaller foot-print during the next occupation. We should always strive to be light and mobile. Most units embrace the idea of mobility and survivability with the initial setup of a tactical command post but then make themselves targets as they build in more command post functions. The mantra to die in place while delivering fires does not mean to make it easy for the enemy.

Minimal TOC: *This simple command post is already light, but the same functionality could be achieved with the mission command nodes operating out of vehicles that can easily complete survivability moves.*

The simplest counter to any indirect fire threat is through the dispersion of combat power to prevent one enemy round or small arms attack from neutralizing the unit. Position Areas for Artillery consume a large amount of space that needs full utilization to avoid placing multiple fires delivery assets within enemy fire for effect ranges. However, the best counter to holistically survive while gaining initiative for the offense comes through operating lightly while employing all equipment. Many senior 13Js in heavy artillery units have, at some point, configured a regular HMMWV to power an AFATDS and a whole fire direction center (FDC) to stay mobile when dealing with M1068 issues. This same mindset of mobility and creativity should apply to all equipment. Units have a significant quantity of generators on hand to provide power to a handful of systems. Employing combat power in unique ways that show leaders care about their Soldiers also builds trust and commitment to the effort.

To tie everything together, employing assets in decentralized but coordinated and dispersed ways helps keep artillery on the offensive. High dispersion and high mobility result in high survivability. Utilizing the full array of organic sensors or enablers also assists in knowing the enemy's situation; if the enemy employs drones, perhaps a support platoon sets up a Listening Post/Observation Post to identify threats early. None of this occurs without the material readiness from maintaining the equipment coupled with ready personnel entrusted to take the initiative. Knowing the battlefield and having the capacity to swiftly move directly enables survivability, the preservation of combat power, and the capacity to provide lethal fires to win.

Communicate Quickly and Effectively

Digital communications similarly enhance survivability. A long-winded voice fire mission places an enormous target on all nodes in the kill chain. Even concise voice fire missions provide an exponentially greater amount of location indication to the near-peer threats of an LSCO fight. ATP 6-02.53: Techniques for Tactical Radio Operations in chapters 10-52 highlight that "the most effective preventive [Electronic Protection] technique" is minimizing transmission times and power outputs. Digital communications, enabled by utilizing MTOE Field Artillery unit equipment, accomplish the mission with minimal electromagnetic output.

Leaders and young Soldiers must have a fundamental understanding of how to properly utilize that Mission Command equipment. In garrison and far too often in the field, military units rely on cell phones rather than thoroughly troubleshooting and gaining proficiency in operating their digital systems. We must not rely on a handful of 25Us to handle a unit's troubleshooting issues. The fundamentals also encompass proper servicing and cleaning of the end items and basic issue items; anything that stands between the Mission Command nodes and delivering lethal fires puts our Soldiers at risk.

With well-maintained and serviced equipment in the hands of quality Soldiers who trust their leaders and the process, the United States Army has myriad capabilities. At the lowest echelons, an FDC can send fire missions to the gun and win at the point of contact. Done properly at higher echelons, the interoperability of functioning systems facilitates friendly radar detecting and beginning the process of counterfire. We only know and place trust in the systems when we have repetition in their proper employment.

Simplicity Earns Trust

Finally, simplicity in operations will win on future battlefields. Everything comes down to fundamentals. Per FM 7-0: Training in chapters 4-8, "units must master the basics" before assuming more complex tasks. If we are moving our formations at the speed of trust, we must ensure our tactical plans are not so clever that we miss out on the basics. Moving faster than subordinate units' knowledge and training base results in culmination. This occurred when the Russian invasion of Ukraine halted near Konotop in February 2022 after supply lines and fuel were overlooked. Some leaders surely identified these issues but feared pointing out the lack of support. A simple, understandable plan alleviates confusion and provides more achievable shared understanding. An environment conducive to candid talk of concerns builds trust and commitment. Even when someone's idea is not utilized, they trust the process when they can influence the process in even small ways.

Another concept of simplicity and trust to enable winning comes down to the concept of ownership through trust. The Marine Corps Rifleman's Creed states the idea well when stating, "This is my rifle. There are many like it, but this one is mine." Leaders should self-assess if they allow subordinates to truly own their equipment and problem sets. Too often, units that do the right thing with full inventories do not take the time to teach and allow subordinates to understand the importance of that equipment. When Soldiers look at their combat platform similar to how they look at their privately owned vehicle, their commitment and investment into the material readiness and training for combat grow exponentially.

Conclusion

To win on future battlefields, artillerists must know enemy capabilities and employ well-maintained organic capabilities while emphasizing survivability and digital communications. When executed with simplicity, this results in commitment and developed trust. Despite the complex ideas of new battlefields and paradigms, focusing on the fundamentals and building personnel and material readiness provides a simple solution to win. It enables us to build and lead dedicated teams that will own the battlefield, the equipment, and the process.

MAJ Joseph G. Jankovich currently serves as the executive officer for 2-4th Field Artillery Regiment, 75th Field Artillery Brigade at Fort Sill, Oklahoma. His previous assignments include S3, Observer, Coach/Trainer, battery commander, and fire support officer during Operations Iraqi Freedom and New Dawn. He is an undergraduate alumnus of George Mason University ROTC and has Master's degrees from George Mason University, the University of Oklahoma, and the Command and General Staff College.

Fires in Support of

Division CAB Deep Attack

"Success in Large-Scale Combat Operations (LSCO) is dependent on the Army's ability to fight with fires (FM 3-0)."

Introduction/ Problem: Army Attack Aviation's ability to conduct a digital call for fire (D-CFF) from the AH-64D Apache to an artillery firing battery can have a significant impact in the deep fight. However, over the last two decades, it has relied solely on its organic fires capabilities rather than its sensing capabilities. As the Army continues to move away from the Counter Insurgency (COIN) fight and toward LSCO, we must continue to focus on the "any sensor to best shooter" concept. One key component moving forward is the ability of AH-64s to provide D-CFFs, significantly decreasing mission processing time and the risk of human error. Up until May of 2022, AH-64 pilots relied on the free messaging capabilities of the Blue Force Tracking (BFT), increasing both time and inaccuracies. Thanks to the efforts of the Fires Concepts & Development Integration Directorate (CDID), Aviation Program Executive Office (PEO), and 1st Armored Division, Combat Aviation Brigade (AD CAB), there is now a streamlined solution that will allow for timely and accurate indirect fires in support of the division's deep fight.

"If you can't talk, you can't fight."

Communication capabilities between the CAB's AH-64s and the Fires and Effects Coordination Cell (FECC) may degrade by the depth and breadth of the division's area of operations. This degradation is especially true when conducting operations long of the coordinated fire line (CFL).

Historically, conducting calls for fire from Army Attack Aviation has proven inefficient and not conducive to delivering timely and accurate fires. Pilots conducting calls for fire would send free text messages via BFT to their operation cell's Joint Battle Command Platform (JBCP). Operation cells could process fire missions; however, pilots had no established means of receiving digital confirmation of prosecuted missions. This lack of information left pilots with no situational awareness regarding their requests and hindered the sensor-to-shooter process. Additionally, calls for fire could easily be lost or overlooked in the vast number of messages transmitted from different staff sections to their higher-echelon counterparts. Furthermore, many operators manning the JBCP have not received training to identify and process fire missions.

The 1AD CAB, Fires CDID, and Army Aviation CDID have identified a solution by routing BFT calls for fire directly to the Advanced Field Artillery Tactical Data System (AFATDS). While the process is still in its trial period, the future looks bright. The ability to send D-CFF from the AH-64 BFT directly to AFATDS drastically shortens the kill chain process,

By MAJ Christopher Walker, CPT James (JJ) Howse, CPT Joseph Dami, and WO1 Kory Engdall

Previous page: The 1AD CAB FECC routes a fire-for-effect mission from the AH-64D through 56th Fires Current Operations and Integration Cell to the "Ghost Gun" where the mission is processed and executed.

providing timely and accurate calls for fire while reducing human error and limiting transmission times. AH-64s can provide laser-designated targets and request accurate effects while simultaneously conducting manned and unmanned targeting on high payoff targets (HPT). In addition, pilots can either reserve their munitions for future engagements or remain undetected while lasing targets for division artillery to prosecute. All these points will prove to be force multipliers when conducting LSCO. While AH-64s drift away from the "over the shoulder" mindset exercised during COIN operations, CAB fire support elements (FSE) can use this capability to multiply their lethality in the division deep fight.

AFATDS and AH-64 BFT Integration: The process of establishing digital communications between the AFATDS and the AH-64's BFT is relatively streamlined. Aviation CDID released a draft (Digital Variable Message Format [VMF] Call for Fire Network, AFATDS Setup, and Procedures for AH-64Dv14 & AH-64E), which pinpoints the process of initializing the AFATDS database through reconstruction of the Master Unit List, building the AH-64 in the unit's workspace, and constructing the communications workspace appropriately.

Some of the troubleshooting procedures taken to link the two systems incorporated the AFATDS desktop command prompt window and required conducting several TRACERTs of the Anycast IP to determine where breaks in the digital routing chain were occurring. As VMF messages left the AFATDS, they were routed through 23 different IPs through the network operation center and regional hub node. Routing through that many IPs resulted in a system "timeout" and failure to deliver the D-CFF.

Identifying where the timeout occurred allowed the Network Warrant Officer to coordinate with the Mission Command Support Center, which reduced the digital routing chain from 23 IP addresses to 8. Furthermore, when operating at the echelon of a brigade FECC, the AFATDS unit role is set to FSE/FSCC/SACC with the selected Attack Analysis set as FS System Level. This setting allows calls for fire to be processed and routed at the appropriate level. To be executed promptly, the System Attack Parameters must build in aviation. This enables the AFATDS to send and receive missions from the AH-64.

For this exercise, the pilots' call-for-fire messages were "pre-cut" messages, allowing little room for user variation. However, in the future, pilots will have the necessities regarding the types of missions they can transmit. The 1-501st Attack Battalion successfully transmitted an observer-ready report, which must be the first report sent to the AFATDS before receiving any other mission. Other types of missions included: when ready, adjust fire, at my command, check firing, cancel check firing, and a request for copperhead. A few peculiarities occurred throughout the testing process. For example, the type of munition will default to dual-purpose improved conventional munitions (DPICM) unless the pilot requests a munition. Without identifying, such as requesting copperhead (which no longer exists in the Field Artillery's arsenal), FSEs must continue developing standard operating procedures to avoid unnecessary complications and streamline the AH-64s digital calls for fire.

What this means for firing units: The Fires community must prepare for this new capability and its effect on the targeting process. Specifically, division must include the CAB in the priority of fires. AH-64s often act as reconnaissance elements, answering information requirements for the ground force commander. Just like ground reconnaissance units, artillery will serve as aviation's biggest asset while remaining undetected. Traditionally CABs do not receive priority of fire. However, with the new D-CFF ability, AH-64s must receive top priority in the initial phases of an operation.

As reconnaissance teams begin scouting prior to the division's line of departure from the tactical assembly area, Field Artillery battalions will need to be more aggressive in positioning their batteries. Because AH-64s are operating forward of the CFL, planners must either push batteries further forward or supply them with long-range munitions. Batteries would have to be in position, ready to fire, before the Air Calvary orienting on the recon objective. Division FSEs could decrease fire mission processing times by establishing a "quick fire net" between the CAB FSE and a firing battery.

Moving Forward/ Conclusion: During the "detect" portion of the "D3A" targeting methodology, AH-64s can serve as highly mobile

and accurate observers. Furthermore, using AH-64s in developing named areas of interest/ target areas of interest (NAI/ TAI) will allow the division to reallocate information collection assets better. AH-64s provide the unique opportunity to unmask themselves from behind terrain, lase a target, mask, and then conduct a call for fire in a matter of seconds. This ability to move quickly and silently while calling for fire could prove detrimental to the enemy as AH-64s can reposition multiple times on the battlefield, destroying HPTs in support of the division's deep fight.

While the testing of this process is still in progress, the successful completion of trials has proven that FSEs can reliably assign AH-64s as observers for preplanned targets. Reducing target location error ensures first-round effects when engaging targets beyond the CFL. The process of fully understanding the communications architecture is still underway. Future tests must include live munitions from Field Artillery units affecting targets. Both division FSEs and CABs can begin preparing for the future fight. The enemy will no longer feel safe from artillery while operating far from our forward line of troops.

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CPT Joseph Dami is the Assistant Fire Support Officer for the 1st Armored Division, Combat Aviation Brigade. His most recent assignments include 10th Mountain Division Artillery as the Command Group Operations Officer, and 2nd Battalion, 15th Field Artillery Regiment as a Fire Support Officer, Platoon Leader, and Executive Officer.

WO1 Kory Engdall is the Targeting Officer for the 1st Armored Division, Combat Aviation Brigade. He is a recent graduate of the Warrant Officer Basic Course.

The 149th Field Artillery Battalion:

A Case Study of LSCO in the SWPA during World War II

By Dr. Chris Rein

As it had been in the Great War, Field Artillery (FA) remained an exceptional arbiter of battle in World War II. While new technologies, including much more mobile and heavily armed tanks, medium and heavy bombers, and self-propelled artillery, entered the Army inventory in the decades before the war, towed howitzers remained ubiquitous on battlefields across Europe and Asia. Army history privileges accounts of World War II in Europe, especially the D-Day landings, the liberation of France, and the final defeat of Nazi Germany, but the recent Pacific pivot and the threat an expansionist China poses across the Pacific has historians reexamining the Army's significant contributions to the defeat of Japan. Especially in GEN Douglas MacArthur's Southwest Pacific Ocean Area (SWPA) that spanned from Guadalcanal in the Solomon Islands across New Guinea to the Philippines.[1] The experiences of one unit, the 149th Field Artillery Battalion, originally part of the Florida National Guard, highlights the Army's

1 See, for example, John C. McManus's trilogy on the Army in the Pacific, which includes *Fire and Fortitude: The U.S. Army in the Pacific War, 1941-1943* (New York: Dutton Caliber, 2019); *Island Infernos: The U.S. Army's Pacific Odyssey, 1944* (New York: Dutton Caliber, 2021); and the forthcoming third volume covering the final year of the war, including the Philippine and Okinawa campaigns.

successes in adapting to a challenging physical environment, the value of well-trained and long-serving National Guardsmen in the Total Force, and the enduring importance of indirect fire in achieving success on any battlefield, whether the fields and forests of Europe or the tropical jungles and sunbaked atolls of the Pacific.

The 149th Field Artillery Battalion came into existence in February 1942 after Florida's 116th FA Regiment (FAR) spun off its second battalion into a separate unit. The reorganization was part of the belated "triangularization" of National Guard divisions, which reduced the two infantry brigades of two regiments each and three FA regiments into three "regimental combat teams" (RCT) composed of a single infantry regiment, a supporting FA battalion, and attached engineer and medical companies. Throughout the process of mobilization as part of the 31st Infantry "Dixie" Division in November 1940, the 116th and its sister regiments, Mississippi's 114th FAR and Alabama's 117th FAR had retained the core of their pre-war National Guard officers while adding new levies, initially from their home states, but eventually from across the country. When the 149th FA entered combat in New Guinea, LTC Werner Eugene Jones, a pre-war guardsman from Haines City, Florida, still led the battalion, but most of his battery officers were newly commissioned lieutenants and captains from the rapidly mobilizing Army's expanding manpower pool. Upon arrival in New Guinea, the division's artillery faced the same tests they had completed before deployment stateside, but a quick inspection of combat conditions in the theater revealed new challenges.

Shortly after arriving in the SWPA in New Guinea, the 31st's Division Artillery (DivArty) commander, BG Sumter Lowry wrote to the XI Corps Chief of Artillery to propose a new training regimen that consisted of practice embarking and disembarking from landing craft, firing from beach positions, and training forward observers (FO) to work in the jungle and with the pilots of the artillery's attached light liaison aircraft, rather than completing the generic course of training prescribed stateside.[2] Despite being overruled, Lowry more accurately predicted his units' requirements, as his batteries engaged primarily in the activities he described. Pre-war guardsmen still led all four of the division's battalions (three of 105 mm howitzers and one of 155's) as they completed a rigorous, eight-week training course, capped by an inspection by Sixth Army from June 5-10, 1944, and formal battalion tests the rest of the month.[3] Under LTC Jones's direction, the 149th FA even built a miniature range at Dobodura in Australian Papua to provide additional training for each battery in adjusting fires.[4] Unfortunately, the 149th never completed the tests: Sixth Army alerted it on June 22 as part of the 124th Infantry RCT's movement to reinforce the Allied line along the Driniumor River, protecting the newly-won airfield at Aitape.

Aitape was just one outpost in MacArthur's island-hopping campaign along the northern coast of New Guinea. Aircraft based there provided additional protection for the much larger airfields and base area at Hollandia, seized against light opposition in early May, eventually launching MacArthur's famous return to the Philippines in Leyte in October 1944. But the leap along the coast bypassed the Japanese 18th Army (a U.S. corps equivalent containing the 20th and 41st infantry divisions) at Wewak, almost 100 miles from Aitape. Rather than see his bypassed forces wither on the vine, as was MacArthur's intention, GEN Hatazo Adachi embarked on an ambitious offensive to attack the American forces protecting Aitape. Aware of this plan, GEN Charles Hall, commander of XI Corps, directed elements of the 32nd (Red Arrow) Infantry Division to establish an outpost line behind the Driniumor River, a small stream running north from the Torricelli Mountains to the sea, to keep Japanese light artillery (primarily 70 mm "mountain" guns) far enough away from the airfield to prevent them from interfering with flying operations. BG Clarence A. Martin, the 32nd's deputy commanding general, posted elements of his own 127th and 128th RCTs behind the river, with the 112th Cavalry Regiment, an independent formation was anchoring the southern end of

2 Lowry to George Keyser, March 27. 1944, Box 14, Sumter Lowry Papers, Special Collections, University of South Florida Library (USF), Tampa, Florida.
3 Lowry to George Keyser, July 13, 1944, Box 14, Lowry Papers, USF.
4 Julian Myrick, "History of 149th Field Artillery Battalion from Camp Pickett, Virginia to Morotai, NEI (St. Augustine: Florida Department of Military Affairs, 1985), 8-9.

the line. Rather than just wait for the Japanese attack, Sixth Army Commander, Walter Krueger, ordered Martin to conduct reconnaissance-in-force from both ends of his line to develop Japanese intentions. Martin faced thinning out his defensive line to provide the attacking force, which prompted the 124th RCT's rapid dispatch to Aitape.[5]

Unfortunately, Krueger's order, while sound, was ill-timed, and Adachi struck the center of Martin's thinned line just as the reconnaissance-in-force prepared to depart. After almost suicidal assaults, Japanese forces broke through. They threatened a second defensive perimeter around the airfield itself, prompting Hall to send the newly arrived 124th RCT with the 149th FA in support to reestablish the line. The 149th moved by sea to a position east of the Nigia River and took up firing positions on a sand spit at the mouth of Akanai Creek. At 0752 on July 13, Battery B of the 149th FA fired a concentration ahead of the Third Battalion, 124th Infantry attack. SGT David Ballard of Plant City, Florida, pulled the lanyard, marking the battalion's entry into combat.[6] The 149th FA fired over 1,300 rounds during the day, providing essential support for the advance.[7]

Walker Assault on Red Beach Morotai.

Once the infantry reestablished the broken line on the Driniumor River, the gunners quickly registered fires to defend the hedgehog position against expected Japanese counterattacks from both directions. LT Stephen Harding, an FO with Battery B, supporting the 124th's Third Battalion recalled,

"[LTC George D.] Pappy [Williams] organized our occupation as a complete perimeter from the west bank of the Driniumor and gave me and my crew a nice bunker right on the bank where we had a full panorama of the river bed which had to be at least 200 yards wide…Pappy Williams had such confidence in the 149th that he kept at my elbow and saying, 'bring it in, Lieutenant,' until my final bursts were in the middle of the river."[8]

Over the next two weeks, the 124th repelled repeated Japanese counterattacks, with the 149th FA firing multiple fire missions at all hours. Just after midnight on July 23, the Japanese made one last attempt on the Third Battalion's lines but suffered devastating causalities to concentrated artillery, mortar, and small arms fire. Throughout the night, the 149th FA fired concentrations of forty rounds on at least three different occasions, and the 124th RCT's regimental history recorded, "When daylight came, the riverbed was clogged with crawling, groaning, wounded and dead Japanese Soldiers." The defenders counted over 300 bodies, which fouled the river for days.[9]

With the river line restored, the 124th RCT received a new mission: to counterattack across the Driniumor and swing south behind the Japanese forces still besieging the 112th Cavalry at Afua. The change from defensive to offensive operations was a morale booster for the troops, but it also highlighted the difficulties of moving through the jungle, not to mention coordinating fires through the dense canopy. On the morning of July 31, the attack jumped off against light opposition. Preparatory artillery barrages had largely done their work, though one round later fell within Second Battalion's perimeter and killed

5 For more detail, see Edward Drea's excellent Leavenworth Paper, *Defending the Driniumor: Covering Force Operations in New Guinea, 1944* (Fort Leavenworth, KS: Combat Studies Institute, 1984), available online at https://www.armyupress.army.mil/Portals/7/combat-studies-institute/csi-books/drea.pdf

6 Robert Hawk, *The Florida Guardsman* (Fall 1987), 16.

7 Battalion History, 149th Field Artillery Battalion, Box 414, World War II Unit Records, Dwight D. Eisenhower Presidential Library (DDE), Abilene, KS.

8 Harding to Marion Hess, Aug. 28, 1996, Marion Hess Collection, Institute on World War II and the Human Experience, Florida State University (FSU), Tallahassee, FL.

9 Regimental History, 124th Infantry Regiment, Box 1339, World War II Unit Records, Dwight D. Eisenhower Presidential Library (DDE), Abilene, KS.

one man and wounded two more. MAJ Edward Logan, regimental S-2, described the difficulties of just moving in this terrain:

"The climate in this area is hot, humid, and suffocating; troops stay wet 24 hours a day, either from rain or perspiration. The dank, wet air makes breathing hard after an hour's march, and troops tire quickly as the water is pulled from their body, sapping their strength. It was not uncommon to have five- and ten-minute halts for every 20 minutes of moving … the rate of advance was figured to be not more than 100 yards per hour. Each yard had to be cut—lead platoons were changed every hour—squads every fifteen minutes, and lead companies were changed every three hours."

Overhead, the artillery's light liaison aircraft helped with ground navigation by measuring the distance from overhead marks to the beach and back to the river, enabling the companies to plot their positions.

To keep pace with the infantry's advance, on Aug. 2, the 149th FA displaced forward to the mouth of the Driniumor. The artillerymen soon learned that their new position on the beach was not as secure as they expected. Early in the morning of August 3, an estimated six to eight Japanese infiltrators armed with explosives slipped into the battalion's perimeter, during a driving rainstorm. Several reached Battery A's ammunition dump and detonated their charges, killing two men instantly. The blast threw loaded shells in every direction, and only a miracle spared the entire Battery A dump from destruction. On their retreat, the infiltrators threw a grenade under LT Robert Powers' cot, injuring him seriously and highlighting the dangers of sleeping above ground. Though the initial group of attackers escaped, the by-now fully alerted defenders detected another infiltration effort several hours later and killed another saboteur armed with explosives just yards from a Battery B howitzer.[10] The attacks prompted more patrols from the artillerists, but this was dangerous as well: two days later a Japanese booby trap claimed the life of CPL Ray West, while he scouted the battalion's perimeter. LT Harding, now back at the battery after rotating out of FO duty, recalled "night infiltration was our biggest security problem," and it hampered the battalion's ability to provide supporting fires in other ways. After Japanese infiltrators cut communication wire laid along the beach, the battalion had to use "Buffaloes" (an armed version of the Landing Vehicle, Tracked, or LVT, a "swimming tank" with bulldozer treads running along each side of an amphibious hull) to lay wire weighted with sandbags just offshore, hiding the wire underwater and preventing disruption to vital communications.[11]

The 149th FA continued to support the 124th RCT through its advance as part of a massive preparatory barrage by four artillery battalions to clear the area. The 149th FA alone fired 593 rounds. The 124th's Third Battalion jumped off again on Aug. 4 and reached the trail to Afua around noon, cutting the Japanese main supply line and route of retreat. But coordination problems continued to plague the troops in the dense jungle. Aug. 8 saw one of the most tragic episodes of the campaign: a friendly artillery barrage from the 32nd Division's 120th FA fell on Company B, 124th Infantry's position. Throughout the night, the battery had fired prepared concentrations in front of the river line at Afua that fell close to the 124th RCT's perimeter, demonstrating the risk inherent when two friendly forces converge. Two days earlier, the 149th FA established a fire-control line that limited fires east of the Driniumor River, but the 120th FA either did not receive notification or violated the requirement for controlled fires in the area between the two forces. Robert Wright remembered that nine rounds killed four men (another member of the 149th's FO team later died of his wounds).[12] Delbert Paris of Anniston, Alabama, recalled that the men were burning cardboard ration boxes to heat their rations, and he believed that an artillery-spotting aircraft mistook the smoke as a marker for enemy positions and called in fire.[13]

But the successful defense of the Driniumor River line and subsequent counterattack across it

10 149 F.A. History, 16-17, Box 414, DDE.
11 Harding to Hess, Aug. 28, 1996, Hess Collection, FSU; 124th Infantry S-3 (Operations) Journal, July 12, Aug. 3, 1944, Box 1339, DDE; 149th History, Box 414, DDE.
12 Robert Wright to Marion Hess, Apr. 11, 1995, Hess Collection, FSU.
13 http://home.pcisys.net/~pwebber/31_id/text/delbert_parris.txt, accessed July 14, 2020; 149th Artillery History, 21, 24, Box 414, DDE.

brought high praise for the 124th RCT, including the 149th FA. Sixth Army awarded the Third Battalion, 124th Infantry a Distinguished Unit Citation for "conspicuous gallantry" and "outstanding performance of duty" for its attacks to restore the line on July 13 and the annihilation of a Japanese supply party attempting to reach the forces west of the Driniumor the following night, as well as holding the line against attacks from the front and rear for the rest of the week.

Infantrymen became true believers in their supporting artillery who "until the present operation were completely unappreciated," but now "were found to be absolutely indispensable and their accuracy, control, and effectiveness uncanny."

And the praise went all the way to the top. SWPA Daily Summary #871 for Aug. 9-10, 1944, read, "The 124th Infantry's counter envelopment [and] rapid expansion of its drive east to Afua…is possibly unparalleled in the history of military maneuver over this type of terrain."[14]

Infantrymen became true believers in their supporting artillery who "until the present operation were completely unappreciated," but now "were found to be absolutely indispensable and their accuracy, control, and effectiveness uncanny." Seeing up close the effects that the King of Battle could provide converted many skeptics who had resented the truck-mounted artillerymen riding through maneuvers while the infantry marched. In fact, the artillery's FOs shared every hardship with the infantrymen and frequently occupied the most exposed positions to control and adjust fire. BG Lowry testified, "the big men over here in this theater for the artillery are the forward observer and liaison pilots. The forward observers live in the front lines, accompany the combat patrols that we send out, and are in the thick of things at all times. Liaison pilots are in the air almost all day long on all kinds of missions, from dropping food to isolated units on up to the conduct of naval gunfire."[15] In yet another tie to the division's home region and a nod to its troubled race relations, troops dubbed the artillery aircraft the "Alabama Luftwaffe," though they came to rely on their ubiquitous presence.[16] The 149th FA's two liaison pilots, LT Frank Zirblis and LT John Kemp, each received the Air Medal for their efforts in the attack, especially the vital drops of radio batteries and blood plasma and their essential relay of radio messages without which the attacking force could not have communicated.[17]

The 149th FA emerged from the crucible of the Driniumor strengthened by the ordeal, mostly because the test of battle provided the opportunity to refine tactics and replace leaders unable to withstand the rigors of combat. LT Harding, a replacement officer in Battery B, later recalled:

"Most of the junior officers were aware of the character shortcomings of our CO (commanding officer), LTC W. Eugene Jones, even before we left the States. Resultant morale problems were put to one side during our baptism to combat, but when 22 out of 33 officers in the battalion signed a letter to (MG John) Persons (CG of 31 ID) requesting reclassification if Jones were not relieved of command, you can believe there was something seriously wrong. To his everlasting credit, GEN Persons assembled the recalcitrant group, dressed us down for our action, but subsequently, Jones was relieved and sent home under the pretense of incurable "jungle rot" of the feet, something which a whole bunch of us suffered without losing our combat capability … Major Milton "Ed" Hull replaced Jones who disappeared overnight with no fond farewells."[18]

Harding's testimony reveals the lingering tensions between the pre-war volunteer National Guard officers and the now-draftee Army they led. It also highlights MG Persons' skillful use of diplomacy to remove guardsmen who failed to preserve good order and discipline in their units, regardless of their long pre-war association with the division. In his memoir, Persons acknowledged

14 Quoted in Marion Hess, "Baptism of Fire," 1, Hess Collection, FSU; Charles Pearson, "Pappy's Boys at Tadji," *Yank*, Aug. 25, 1944.
15 Lowry to Baya, August 1, 1944, Box 6, Sumter Lowry Papers, USF.
16 "Kilroy," *Atabrine Time* (Philadelphia, PA: Kilroy's, n.d.), 115.
17 149th History, 11, Box 414, DDE.
18 Harding to Hess, Aug. 28, 1996, Hess Collection, FSU. Jones actually became S-3 of the DivArty staff.

that he "read them the riot act and hope I gave them something to think about," but admitted that the "bottom of [the] whole mess is Jones' lack of dignity."[19]

MAJ Hull, another pre-war guardsman from Florida, led the battalion with distinction throughout the liberation of the Dutch East Indies (Indonesia) and the Philippines. Hull insisted on training the battalion in mobile operations and rapid battery emplacement in preparation for operations in the Philippines. In the opening stages of the liberation of Mindanao, the battalion had just crossed the Pulangi River on LCMs (Landing Craft, Mechanized) and was moving up the road in the darkness when FOs made urgent calls-for-fire. Thanks to their training, the battalion quickly and skillfully took up its firing positions, which "required crossing a very decrepit bridge and skidding down a steep embankment into a small clearing next to the road. Although it was raining, the obstacles were surmounted, and the battery was prepared for action and laid in [in] short order." The commander of the lead infantry battalion reported he had hit a substantial roadblock and was running short of machine gun ammunition and needed artillery support. The battery sent a radio relay team forward. The 149th's FO, LT Raymond Marlowe of St. Paul, Minnesota, moved his own radio to an exposed position and began correcting protective concentrations all along the battalion's front and flanks. The battalion fired 99 rounds by dawn, after which a final-54-round concentration cleared the battalion's front.[20] LT Harding later recalled,

"It was the perfect enactment of our old stateside Battery Test I, without the cheating we did then with little secret code words so that the battery would be sure to be in an easy occupation position. This time on the road on a dark night, a "Fire Mission" order came from the Liaison Officer, and our 105s peeled off into darkness, not knowing whether they would disappear in a bog or a large hole. They somehow found room and a fire field. All this was orchestrated by SSG Donald Hall and his section chiefs, and they brought effective fire to break the roadblock and forever endear themselves with our infantry comrades."

Harding concluded, "Dogfaces [the World War II nickname for enlisted infantrymen] and Redlegs always did get along."[21]

The 124th RCT's official history agreed: "this action of the artillery was one of the deciding factors in driving the enemy from his advantageous position."[22]

Throughout its service in the SWPA, the 149th FA effectively built on a core of experienced National Guardsmen to train an Army composed of newly inducted men. It joined an effective combined arms team that was able to master the difficult conditions of the Southwest Pacific. In the process, the battalion became a "joint force" in miniature. It flew its own light liaison aircraft and frequently operated from small landing craft that enhanced mobility along the Pacific's shorelines and inland rivers. In interdicting Japanese attacks or providing preparatory barrages for assaults on prepared positions, the organic fires of the 149th FA were indispensable in the tropical jungles and coral atolls, especially when other forms of fire support, including naval gunfire and close air support, were unavailable or too slowly brought to bear. Though the difficult terrain presented new challenges for both coordination and logistics, the efforts of the Redlegs of the 149th FA ensured that Dogfaces could call on artillery support when they most needed it, cementing the reputation of the King of Battle, no matter where it was employed.

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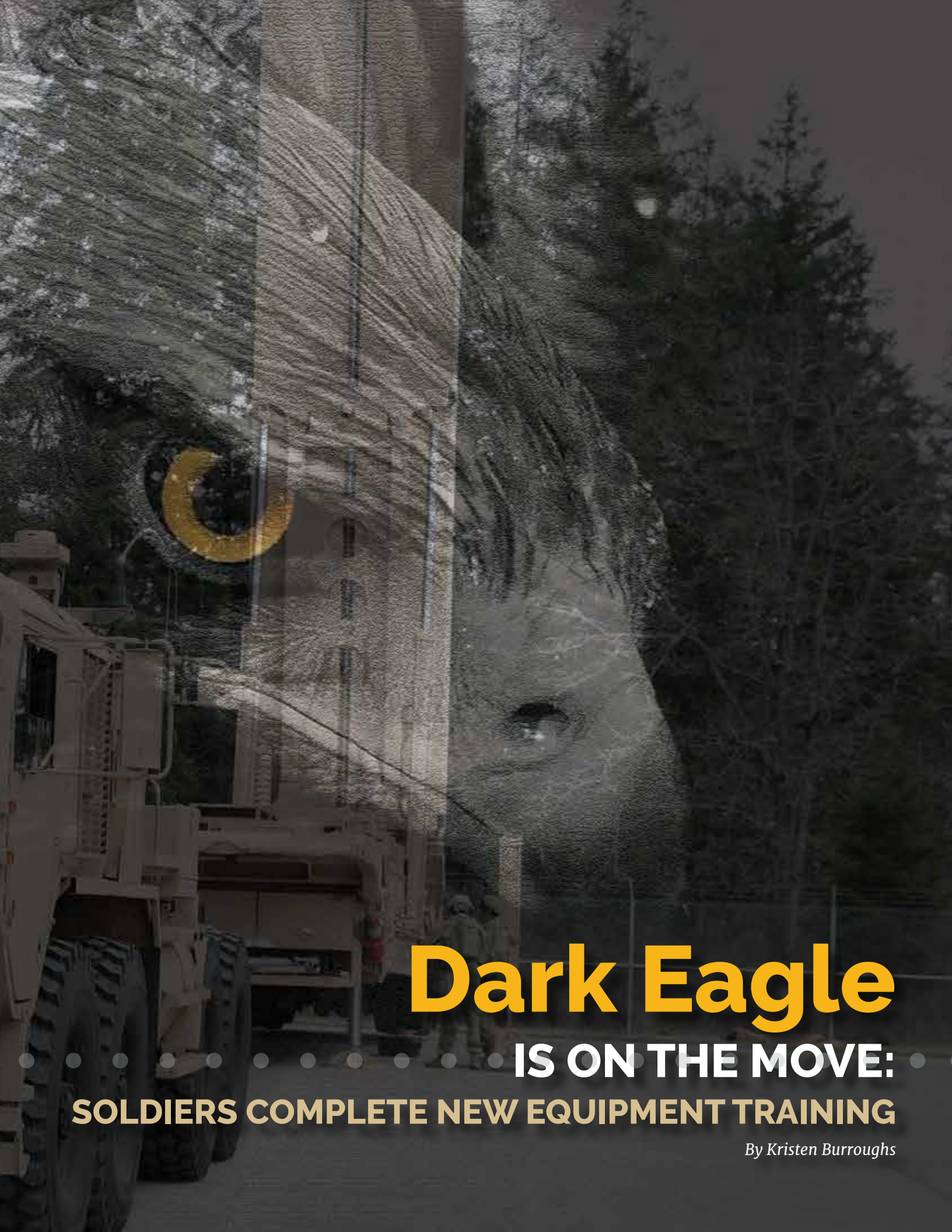
20 149th Field Artillery Battalion, "Report of Action Against the Enemy, Mindanao, P.I. April 22 through June 30, 1945," 9-10, Box 417, DDE. Marlowe earned a Bronze Star for his actions. 31st Infantry Division, General Orders No. 166, Sept. 28, 1945, Box 591, DDE.
21 Harding to Marion Hess, Aug. 28, 1996, Hess Collection, FSU.
22 "Historical Record, 124th Infantry Regiment, Mindanao Operation, Apr. 3 through June 30, 1945," 4-5, Box 1340, DDE.



Dark Eagle

IS ON THE MOVE:

SOLDIERS COMPLETE NEW EQUIPMENT TRAINING

By Kristen Burroughs

hy·per·son·ic | hīpərsänik |
adjective
1 relating to speeds of more than five times the speed of sound (Mach 5).
2 relating to sound frequencies above about a thousand million hertz.

The I Corps' Bravo Battery, 5th Battalion, 3rd Field Artillery Regiment, 17th Field Artillery Brigade, also known as the Dark Eagle Battery, completed their New Equipment Training (NET) with the Nation's first prototype hypersonic equipment.

The Army marked this milestone with a ceremony at Joint Base Lewis-McChord on Feb. 24, 2022.

The Army is creating, refining, and deploying capabilities that bring new solutions to our Nation's challenges. As part of its number one modernization priority, long-range precision fires, hypersonics is the next major strategic weapons capability. It is key to supporting the Army in building a modern, multi-domain operations-ready force by 2035.

NET began shortly after the Rapid Capabilities and Critical Technologies Office (RCCTO) delivered the ground support equipment for the Long-Range Hypersonic Weapon (LRHW) prototype, known as Dark Eagle, in September 2021. From the start of the prototyping effort in early 2019, Soldiers have played an integral part in the equipment's development, testing, and delivery.

"Early hands-on training allows us to develop the pre-requisite tasks and techniques to be successful in the future," said CPT Austen Boroff, Bravo Battery Commander. "The Soldiers have thoroughly validated critical individual and collective tasks that will enable operations post-fielding."

NET was broken down into four iterations, each lasting three weeks. The first week of each iteration allowed Soldiers to gain a basic understanding of the functions and capabilities of the equipment through interactive training. This training took place in a classroom setting, providing Soldiers ample time to train on the equipment in a structured "gaming" environment. This environment, comprised of laptops and an iPad, allowed Soldiers to familiarize themselves with major hardware elements before initiating hands-on training. During the second and third weeks, training provided the opportunity for initiating Soldier feedback, which plays an influential role in the prototyping effort. This feedback has enabled equipment modifications to include alternative equipment storage solutions and more efficient ways to mount the GPS antennae on the battery operations center, thus saving time while loading an aircraft.

The first two NET iterations concluded in December 2021, with the last two ending in February. The training primarily focused on air transportation drills, security procedures, canister reload operations, operational emplacement of equipment, and performing fire missions. Each iteration served a key purpose in preparing them for their final training event.

We've never had a system like this before ...

While training is ongoing, the Fires Center of Excellence is simultaneously writing the doctrine for the unit that will employ the first-ever hypersonics weapon, marking another critical milestone in developing this prototype.

"Our Soldiers have put an incredible effort into developing LRHW expertise. They have trained with extraordinary effort throughout every step

of the fielding process and are equipped for success as we continue to develop proficiency," said Boroff.

After successfully completing NET, Soldiers will advance to post-NET training, which includes the opportunity first to observe and then participate in upcoming joint test events. Soldiers will utilize a "leader-follower" role where they will learn test operations and provide hands-on support. The Army is partnered with the Navy to execute the hypersonics mission through missile commonalities and joint test opportunities.

"We've never had a system like this before," said COL Ian Humphrey, RCCTO Hypersonics Project Manager for Integration. "It was critical that our team could get the hardware to these Soldiers two years before the culminating joint test event in FY23, allowing the Soldiers to train, learn, and provide feedback."

Upon completion of prototype-battery fielding, Dark Eagle will transition to the Program Executive Office for Missiles and Space.

"I was once a young, enlisted Soldier, and I can appreciate all the hard work and dedication each Soldier in this battery is putting forth," said LTG L. Neil Thurgood, Director of Hypersonics, Directed Energy, Space, and Rapid Acquisition, who leads the RCCTO. "Hypersonics is our number one priority right now, and we remain on track for executing operational capability in FY23."

Photos: Using the Nation's first prototype Long-Range Hypersonic System, Bravo Battery Soldiers with the 5th Battalion, 3rd Artillery, 17th Field Artillery Brigade executed ground movement, round transfers, and established firing capability at Joint Base Lewis-McChord Feb. 22-24. (US Army photos by SSG Casey Hustin, 17th Field Artillery Brigade)

All models are wrong, but some are useful.
George E.P. Box[1]

THE KILL WEB: Dynamic Targeting in Multi-Domain Operations

By COL Mike Stewart

As the joint force faces increasingly complex threat systems[2] and develops linked capabilities across all domains to counter those threats, we must also address our underlying processes and our ability to target those threat systems with the entire suite of tools available at any given moment. Specifically, we must adapt our model for dynamic targeting to meet the needs of current and future environments. The model imposed by the term "kill chain" is both incomplete and obsolete in reference to the dynamic targeting process. This model no longer accurately captures the complexities required to complete a dynamic targeting process in a contested electromagnetic environment. Instead, the dynamic targeting process for multi-domain operations must evolve into the concept of a "kill web," which provides multiple paths along multiple axes from a myriad of linked capabilities to attack the associated system that comprises the target. Further development of the kill web concept and its integrating capabilities should lead the joint force to a doctrinal definition of the term "kill web" for future incorporation into joint doctrine and applications.

The term "kill chain" has long been associated with the dynamic targeting process. This process is described by the steps of find, fix, track, target, engage, and assess (F2T2EA), as shown in Figure 1. That is, F2T2EA describes the chain of events in a process that leads from locating a target to creating desired effects on that target. Each step of the process can occur on a discrete platform linked to other platforms, as when a counter-fire radar acquires a rocket launched against friendly forces and then passes the location of the acquisition to a Multiple Launch Rocket System launcher or strike aircraft to engage. All the steps of the kill chain can also occur within one platform, such

1 This aphorism is frequently used in statistical analysis and is generally attributed to George E. P. Box, FRS. He specifically states this quote in his 1987 work co-authored with Norman Draper, entitled *Empirical Model-Building and Response Surfaces,* p. 424.
2 Such as Anti-Access and Area Denial (A2/AD), Ballistic Missile (BM), and Weapons of Mass Destruction (WMD) systems, to name a few.

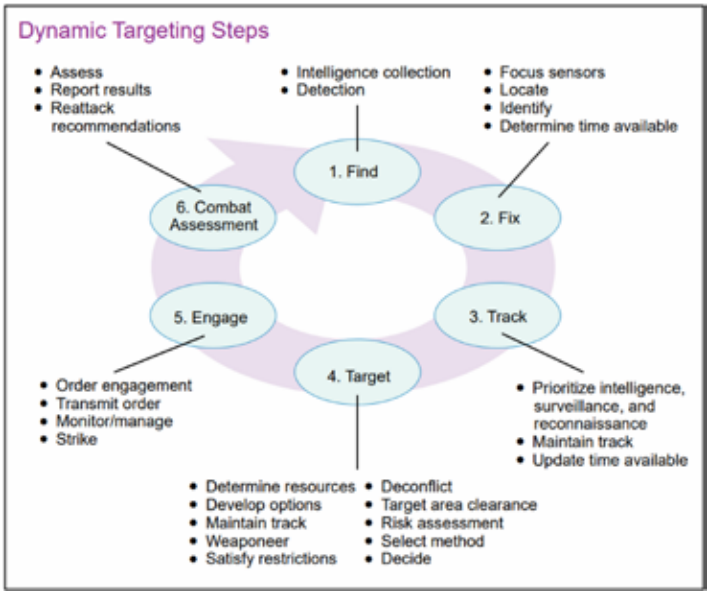


Figure 1. Dynamic Targeting Steps (Source for Figure 1) JP 3-60 (28 September 2018), II-23 (Figure II-10).

as when a strike aircraft on an air interdiction mission with its radar, pilot, and munitions on board completes every one of the dynamic targeting steps internally. While the term "kill chain" has never been doctrinally defined as the dynamic targeting process, most of the joint targeting community understands the association, and several publications describe the colloquial association of the term "kill chain" with F2T2EA.[3]

Emerging concepts criticize the notion of a kill chain as being "linear and monolithic."[4] While it was likely never intended, the metaphorical association of dynamic targeting with a chain does imply that the process is linear. Further, it follows that a break in one of the steps will disrupt the entire process, as a broken link makes a broken chain. Since the dynamic process should not be considered linear or monolithic, and a disruption at one node should not break the process, we find that we may have reached the logical limit of using a chain as the model to describe a process that actually spans multiple paths across capabilities and domains through the steps of F2T2EA. Such a process can be more accurately described as a kill web, not a kill chain. Using the model of a kill web to integrate capabilities through a dynamic targeting process, we can also build a more enduring concept to incorporate emerging technologies and capabilities in information, artificial intelligence, and machine learning.[5]

Two Kill Webs: Target-centric and Capability-centric

Kill web analysis facilitates a multi-domain approach to target analysis and weaponeering. To effectively achieve the desired effects, the joint force is faced with the challenge of layering lethal and nonlethal effects to create convergence across domains to achieve operational objectives. This analysis drives defining a kill web in two approaches that are not mutually exclusive.

The first approach is target centric. It describes the linkage of key nodes within a target system that, when attacked, can exhibit compounding second and third-order effects. The target-centric kill web is essentially an application of Center of Gravity, or Target System Analysis (TSA), which is normally associated with deliberate targeting. Pulling the concept of TSA into the kill web for dynamic targeting helps conceptualize how we can detect and differentiate high-payoff targets within a selection of multiple acquired targets that may be simultaneously exposed. A diagram of this kind of analysis, which can be adapted as a target-centric kill web, is shown in Figure 2 (next page.)

Deliberate analysis of a target system as a kill web reveals the relationships between critical capabilities, requirements, and vulnerabilities. These relationships, overlaid against an array of detected targets in a common operational picture, help refine a high-payoff target list

3 *AFDP 3-60: Targeting* specifically associates kill chain as the colloquial description of F2T2EA. *JP 3-09: Joint Fire Support* also mentions the term "kill chain" a few times in its section on dynamic targeting, but *JP 3-60: Joint Targeting* does not use the term "kill chain" at all. The only actual doctrinal definition of a kill chain is in Army *FM 3-01: Air and Missile Defense*, which describes the kill chain as "the successive linkage of commanders who can authorize engagements of air and missile threats." The FM 3-01 definition is not relevant to a discussion on dynamic targeting, aside from providing the only doctrinal burden to the phrase "kill chain."

4 David Deptula et al., "Restoring America's Competitiveness: Mosaic Warfare," (The Mitchell Institute for Aerospace Studies, September 2019), 30; and Clark, Bryan, Dan Patt, and Harrison Schramm, "Mosaic Warfare: Exploiting Artificial Intelligence and Autonomous Systems to Implement Decision-Centric Operations," (Center for Strategic and Budgetary Assessments, 2020), 28-9.

5 Clark, Patt, and Schramm, "Mosaic Warfare."

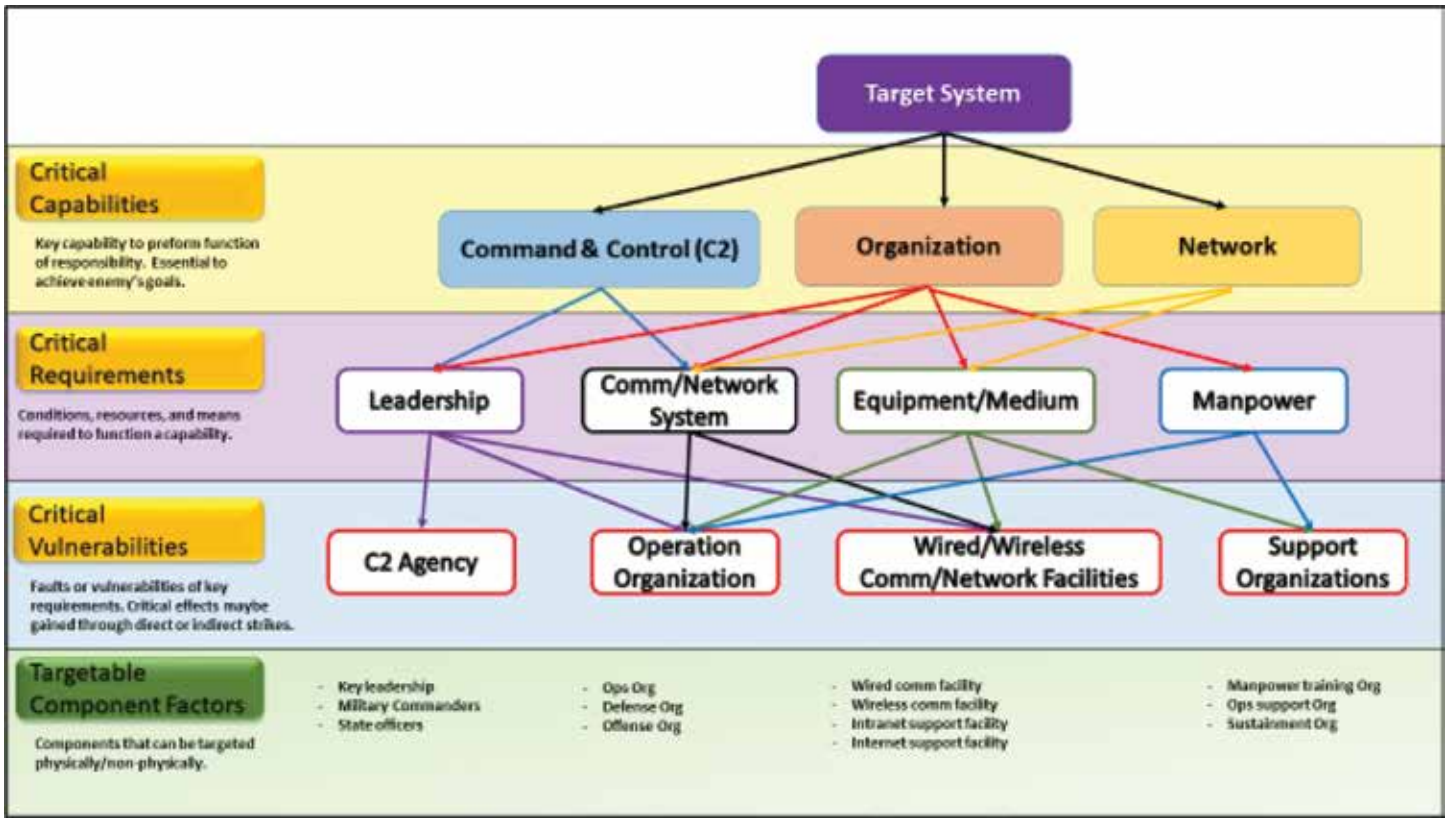


Figure 2. A target-centric kill web describes the linkage of key nodes within a target system that when attacked can exhibit compounding second and third-order effects.

and associated attack guidance in stride with a developing situation. Anticipating second and third-order effects from a strike on one node or link within a target-centric kill web keeps the targeting effort synchronized to create the desired effects and achieve operational objectives efficiently.

For example, analysis of a target-centric kill web would reveal the links and nodes of a target system like a Field Artillery battalion. Using this kind of deliberate analysis could reveal that the most effective point to strike to break the target system may not be the howitzers or their support vehicles but rather the link from the Fire Direction Center (FDC) to their guns. To locate and isolate the FDC, we can utilize a multi-domain approach. Within the Electromagnetic Spectrum, we can locate the FDC, jam the tactical network, and, if required, cue and execute a kinetic strike on the FDC. By disrupting or destroying this one link, we could render the system ineffective while limiting the friendly assets needed and eliminating the need to hunt and kill every gun and support vehicle. As the target system adapts to the loss of its FDC, continuous monitoring and analysis are required to conduct F2T2EA on the next vulnerability to keep the system from regenerating.

The second approach views a kill web from domain-centric capabilities. In this approach, we describe a linked system of detection and delivery assets, providing multiple paths on multiple axes along which the critical steps of F2T2EA can flow across domains and capabilities. (See Figure 3).

As described in the Joint Concept for Fires 1.0:

Each dot represents a functional component of the F2T2EA process. The black lines linking these dots represent the kill chains from various domain capabilities. The blue lines represent alternate kill paths across different domains in kill webs. By linking any of these functional components across different domains, kill webs offer different combinations of sensors to shooters from all domains to complete the entire process of servicing a target. The scale and tempo of these kill webs require new processes or pre-authorized actions that supplant or augment current Joint Targeting Boards.[6]

6 Joint Concept for Fires 1.0 (September 2021)

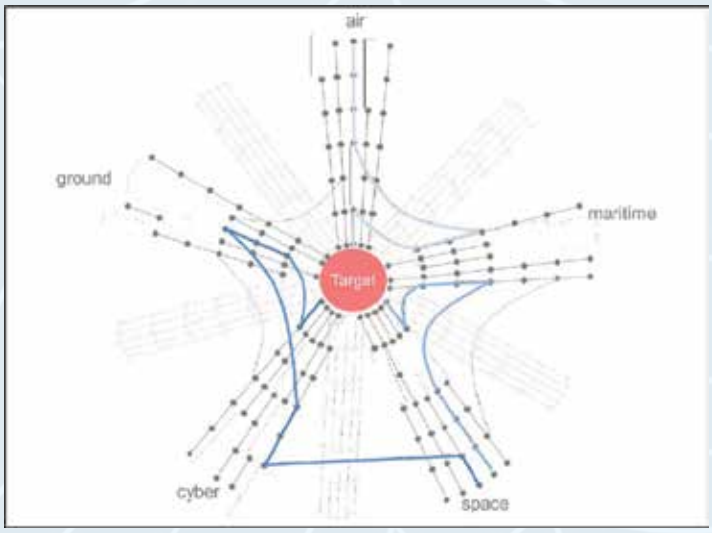


Figure 3. A capability-centric kill web describes a linked system of detection and delivery assets providing multiple paths on multiple axes along which the critical steps of F2T2EA can flow across domains and capabilities.

(Source for Figure 3) As described in the Joint Concept for Fires 1.0: Each dot represents a functional component of the F2T2EA process. The black lines linking these dots represent the kill chains from various domain capabilities. The blue lines represent alternate kill paths across different domains in kill webs. By being able to link any of these functional components across different domains, kill webs offer different combinations of sensors to shooters from all domains to complete the entire process for servicing a target. The scale and tempo of these kill webs require new processes or pre-authorized actions that supplant or augment current Joint Targeting Boards.

A capability-centric kill web describes how we disaggregate linear kill chains for specific capabilities and domains to create more resilient and adaptive paths from the "find" step through to the "assess" step. Constant awareness and links across capabilities become critical in applying a capability-centric kill web. The disaggregation and distribution of sensors and shooters and the linkage across domains allow the joint force to find and follow an optimal path through the kill web. This also builds resilience across our targeting process by eliminating the notion that a break in any one node or link necessarily disrupts the kill web.

By combining the target-centric and capability-centric approaches, we can arrive at a functioning definition of a kill web as the linked capabilities that provide multiple paths along multiple axes across domains to find, fix, track, target, engage, and assess effects against an associated system that comprises a target.

The Way Ahead

The evolution of weapons to incorporate networked warfare changes the targeting methodology. Each new system has built-in resilience that challenges the old concept of a kill chain and single-point vulnerability.

This evolution changes our lexicon. If the kill chain model is limited because of its implication of a linear and monolithic process, then a new model is necessary. Further, the term art associated with dynamic targeting should be more formally established than a colloquial association; it should be a doctrinally defined association. The dynamic targeting process should be doctrinally associated with a kill web, not a kill chain. Concepts are emerging now that link an expanding network of sensors and shooters to create effects against increasingly complex target systems. These concepts fundamentally challenge the existing model of dynamic targeting as a kill chain. Instead of using a chain, the idea of a kill web implies a correct model of both capabilities and the target system as a linked series of nodes with multiple paths and points of attack.

Further discussion and experimentation on a kill web concept should refine the proposed definition above into a doctrinal term associated with the dynamic targeting process. With such a doctrinal evolution, the emerging concepts and capabilities can begin to link the nodes of the kill web together using an integrated network enabled by artificial intelligence and machine learning. Our fundamental understanding of a target as a system in its own right, with associated nodes and vulnerable points, can also be captured in the model of a kill web. The method we use for conducting target system analysis can adapt to emerging sensors and networks.

COL Mike Stewart is a Field Artillery officer currently serving as Commander of 434th Field Artillery Brigade, with recent experience as Chief of Fires for U.S. Forces Korea. His fire support and targeting experience span over 24 years, including experience from Brigade Combat Team through to theater level. He has previously served as Chief of Fires for U.S. Army Cyber Command, U.S. Army Africa, and as the Chief of Doctrine at the Fires Center of Excellence.

Recognized as the most lethal of all the combat arms branches, with the well-earned title "King of Battle," the United States Field Artillery traces its origins to 17 November 1775 when the Continental Congress unanimously elected Henry Knox "Colonel of the Regiment of Artillery".

U.S. soldiers assigned to Bravo Battery, 2nd Battalion, 17th Field Artillery Regiment, 2nd Stryker Brigade Combat Team, 7th Infantry Division, conduct field artillery certifications on Joint Base Lewis-McChord Dec. 8, 2021. The Lancer Brigade is the premiere ready force for the Indo-Pacific region and continues to maintain readiness across the formation. (U.S. Army photo by SGT Beggs)

Paratroopers from B Company, 2-508th PIR in the defense during the 2nd Brigade FTX, Falcon Strike, February 2022.

PUTTING THE "FORWARD" BACK IN "FORWARD OBSERVER"

By 1LT Christopher Lipscomb

BACKGROUND

In October 2021, the 2nd Battalion, 508th Parachute Infantry Regiment (PIR), 2 Fury, participated as the testing unit in the Mobile Protected Firepower Limited User Test (LUT) involving two weeks of force-on-force lanes at Fort Bragg designed to test the suitability of the two finalists for the Army's new light tank. This training was very eye-opening for the battalion for several reasons. First, it revealed a significant manning issue, with the battalion only able to field about 70 percent strength due to numerous factors such as ETS, PCS, and medical. Realistically, this number was likely somewhat lower because of our assuming division taskings within 72 hours of coming out of the field.

Further, the experience of battling tanks as light infantry illustrated how badly our anti-tank (AT) skills had atrophied over the Global War on Terrorism (GWOT) years; squads tended to have excellent riflemen and machine gunners; however other skills were lacking, a consequence of simply not training on skills that squad leaders were less familiar with. We found that we did not know how to effectively engage and kill tanks in a near-peer scenario.

Beyond the technical challenges of using fires against armor, we also struggled with the tactical side of employing our forward observers in a force-on-force scenario with a peer adversary; over the course of the training, we found that the traditional approach of forward observer/radiotelephone operator (FO/RTO) attached at the hip with the platoon leader (PL) was generally not the most effective way to employ the Fire Support Team (FIST). As we went through the lanes, we played around with various methods of employment: for several lanes, we sent out an FO/RTO team with battalion scouts well in advance of the company, and for one lane, we detached the FIST from the company's main body entirely, pushing the team far ahead to scout and call for fire. Neither of these approaches alone solved all our problems; however, each, in its own way, enabled the FIST to provide better fires for the company.

TASK ORGANIZATION REVISION

Following the LUT, our battalion commander, LTC Ryan Bell, engaged with the officers and noncommissioned officers (NCO) of 2 Fury regarding lessons learned and, with their input, re-worked the battalion's organization with an eye toward large-scale combat operations (LSCO). In their conversations, the battalion's leaders identified three key challenges that needed addressing, all of which had been brought to light during the LUT:

Refocusing on fighting a mechanized or motorized peer or near-peer adversary in LSCO.

Addressing persistent manning issues.

Addressing experience issues within the NCO corps.

In addressing these challenges, the battalion significantly reorganized the rifle companies, replacing the traditional three rifle platoons per company with two 30-man assault platoons and one 44-man heavy weapons platoon. Overall, these changes reduced the manning requirements of each company by 31 paratroopers. At the company level, this revision mirrored transformations made organically by each company at various times during the LUT, with lighter sections used to identify armor to mass fires and eliminate the threat.

Key to the revision was enabling the right leaders with the right capabilities. One of the major changes at the company level was pushing FOs down to the squad level, increasing the assets available to the squad. Through this, platoons and squads could operate more independently while simultaneously avoiding triggering the enemy's high pay-off target list and drawing indirect fires. Additionally, it allowed for significant employment of fires to defeat the enemy by more accurately leading with high explosives, enabling greater conservation of the maneuver force.

ASSAULT PLATOONS AND HEAVY WEAPONS PLATOONS

The assault platoons were organized as a 30-man element, with two 12-man sections and a 6-man headquarters element; within the platoon were three FOs, one with the platoon leader and one with each section leader. The diminished footprint of the assault platoon created a smaller, lighter, and faster element that was less likely

to be identified by unmanned aircraft systems or engaged by indirect fire.

The increased number of FOs in each platoon made the platoon FO, in essence, a miniature Fire Support (FS) NCO. Due to the assault platoon's ability to operate more independently, the platoon FO was given a greater role in planning and coordinating fires, as well as serving as another checkpoint in the sensor-to-shooter chain. Professionally, this benefited the platoon FO through increased exposure to the team chief's role and increased opportunities to train and mentor junior FOs.

The heavy weapons platoons were organized as a 44-man element which included all the company's M240s, Javelins, and Carl Gustavs, as well as a Stinger/AA section. Within the platoon, one platoon FO continued to work with the PL in the traditional manner. This FO could be used to great effect from company support by fire positions, identifying targets to prep objectives, and working together with the AT teams to efficiently engage enemy armor.

INTENSIVE TRAINING CYCLE

From January to March 2022, 2 Fury executed its intensive training cycle (ITC) in preparation for assumption of immediate response force (IRF) 1. In addition to training up for Joint Readiness Training Center (JRTC) and eventual assumption of IRF 1, this was when we began experimenting with how we could employ our FOs within the new task org to the most significant effect. The first event of the ITC was a fire support coordination exercise involving all FOs and their PLs. This training helped us set conditions for pushing FOs down to the section level. We could pull them in for the planning process and have them deeply involved, providing them with invaluable repetitions given the increased responsibilities being thrust upon them under the new task org.

The first proving ground for the task org was section live fires. For these lanes, we ran each section with an integrated FO, precisely as outlined in the task org. Through the iterations, we found that this method was effective for battle tracking as well as getting company mortars far more involved than they might otherwise have been. However, we had some significant struggles on the integration side–section leaders were unsure of how to best use their newly-acquired FO, and the FOs were similarly unfamiliar with running with that small of an element and struggled to keep up with the faster pace of a squad versus the familiar platoon-sized operation.

Our brigade field training exercise, Falcon Strike, proved to be our biggest challenge with fires up until JRTC because we were operating at the brigade level for the first time during the training cycle and, by extension, were exposed to the brigade's competing requirements. As a result, we had to be flexible in the execution of our fires plans, acknowledging that we might not get the primary asset requested for a target, especially if it was artillery. Frustrating at the time, in retrospect, this was good training, especially from an FSO/FSNCO perspective–we had to remain flexible and adapt to the situation while also managing expectations within the company, all of which proved to be especially helpful at JRTC. Additionally, the nature of the scenario enabled us to further develop tactics, techniques, and procedures (TTPs) for pushing our FOs to the lowest level.

Our greatest learning point throughout Falcon Strike was on employment in the defense. Having FOs dispersed throughout the company provided vastly greater coverage than would have been the case under the traditional platoon FO/RTO model. Namely, by employing FOs with individual squads, we were able to get broader observer coverage of the engagement area in the form of two to three unique vantage points throughout each platoon's section of the line, as opposed to the single vantage point per platoon that occurs under the traditional model due to the FO/RTO team being always co-located with the platoon leader. Additionally, the broad dispersal of FOs made the commander and platoon leaders more comfortable with pushing out operations, as we could pull two or three observers off the line from across the entire company while still having at least one or two FOs set up within each platoon's sector.

Before leaving for JRTC, we were able to apply our lessons learned from the entire training cycle to our FO employment scheme for platoon live fires. The major issues identified were varied levels of experience across the FIST, manning, and significant equipment shortages; our workaround was simple: in the assault platoons, the senior

B Company, 2-508th PIR FIST at the end of JRTC Rotation 22-06, April 2022.

FO would stick with the PL while a second would be pushed out with a section based on METT-TC, and the weapons platoon would continue to work with their one allotted FO; given the constraints identified, we felt this was the best way to push out our FOs to provide coverage down to the lowest possible level, while still ensuring they were gainfully employed at their level. We were generally successful with this approach, with the assault platoon FOs enabling their platoons to echelon fires and ride the REDs (Risk Estimate Distances) all the way onto the objective, while the weapons platoon FO was able to identify targets better to prep the objective and begin to identify and engage targets beyond the objective.

JRTC

Going into JRTC, we made minor refinements to the TTPs we had developed over the course of the training cycle, based largely upon what we learned during platoon live fires. We kept the assault platoon organization the same, with two FOs, one with the PL and one with whichever element the PL determined made the most sense for the mission. For the weapons platoon, we added a second FO since the platoon rarely fights as a consolidated element and is typically split between the assault platoons; this way, we could get the same consistent results as during the platoon's live-fire exercises (LFX) rather than only if the platoon is fighting as a consolidated company support by fire. We held one FO with the company headquarters (HQ) to serve as an RTO, which ultimately proved crucial during the box as we encountered major comms problems.

Naturally, the gameisms of JRTC inhibited our ability to do fires during the rotation; however, we found that the dispersal of FOs once again provided options to the maneuver elements that might not have existed otherwise, especially in the defense, when we employed the FOs similarly to how we did for the defense lanes during Falcon Strike. Significantly, the dispersal proved fortunate once the company began taking casualties, as it meant the FOs were less likely to be co-located and both taken out of the fight. As a consequence of the casualties taken, junior FOs found themselves having to step up and fill roles they had not before–the newest member of the team spent 24 hours as the FSNCO–providing opportunities for growth and deepening the well of experience that can be brought to the table.

The finest hour for fires during our rotation was undoubtedly company live fires. Through several blank iterations and the final live iteration, we brought all our lessons learned from the entirety of the training cycle, including the box, to bear to great effect. Throughout the iterations, the FOs worked hard to ensure that they were pushing as far forward as possible, keeping the fires steady on the objective, and minimizing the gaps in fires. Although new lessons learned during LFX were negligible, the iterations did hammer home the lessons already learned and provided a final learning point for us to apply as we continue to develop TTPs for how to most effectively push observers down to the lowest level.

Overall, pushing FOs down to the squad level was successful for us at JRTC, even though we could not implement it exactly as prescribed under the revised task org. The nature of JRTC, particularly the challenges of getting fires shot and adjudicated, limited our ability to truly use the FOs to hunt for the enemy; as a result, it would be dishonest to say that having completed JRTC, we have enough practical application to say this is the way forward. At a minimum, putting FOs in squads has the potential to greatly increase our lethality on the battlefield; however, we need more time in the field to play around with it–another ITC would likely provide the ideal amount of field time to come to a final conclusion.

CONCLUSIONS

Although it did not survive long after our return from JRTC, the idea of pushing forward observers down the squad level has great potential, especially as the Army transitions to LSCO. If the ongoing fighting in Ukraine has proven anything, it is that the artillery is still the King of Battle and that the ability to engage with fires in an accurate and timely manner is as important as ever. That being said, several challenges must be overcome in order to make it work:

Experience. In a post-GWOT Army, the bench of experience is much smaller, and the approach we have worked with requires far more experience than simply completing Advanced Individual Training and a training cycle. Gone are the days of getting a year or two on a FIST to master Skill Level 1, then progressing to Skill Level 2, and so forth; given the nature of the 82nd and the IRF mission, if every 13F in the formation is going

to be employed as a true FO, they need to be prepared to perform at Skill Level 2 the day they show up to a platoon. Joint Fires Observer, Target Mensuration Only, Joint Firepower Course, and other specialty schools are going to be needed to greater extents than before. Units will have to take a hard look at their FIST Certification standards to ensure that they are evaluating and certifying Fire Support Teams to a level that is appropriate to the level of responsibility they find thrust upon them. It will ultimately be up to FSOs and FSNCOs to develop creative and challenging training plans that will ensure their FISTs are trained to a high enough standard in the basics to make up for the real-world experience lost with the end of the GWOT.

Manning. Without a fully manned FIST, it is impossible to do what we did over the course of the ITC. At a minimum, 100 percent manning is needed to accomplish this task org effectively. In a perfect world, if we move to this task org as a permanent thing, we need to be manned consistently above one hundred percent. At the company and battalion levels, there is little that we can do to overcome shortages here; this issue ultimately comes down to a Big Army issue, not only in terms of recruiting but also in terms of prioritizing where soldiers are assigned based on their task org. In other words, if the entire 82nd moves to this task org but the 101st does not, does the Army assume the risk as a whole and prioritize assigning FISTers to division in order to fill out our task org while simultaneously short-changing the 101st? What we can control at our level is how we man our elements, ensuring that the right people are in the right seats, even if this means prioritizing rifle companies over delta companies when it comes to filling out FISTs.

Equipment. This was our greatest inhibitor, especially during Falcon Strike and JRTC. Even if all MTOE equipment is fully mission-capable, it is still challenging to effectively distribute it in a way that enables employment strictly in line with the task org as written; this was the major contributing factor to us moving to the organization we ran with throughout JRTC. And how do we equip the section FOs compared to the platoon FOs? We relied heavily on the Joint Effects Targeting System (JETS) at JRTC largely because it is, in theory, lighter and smaller than a Lightweight Laser Designator Rangefinder (LLDR) and more suited to light units. But suppose you are not deliberate about which specific components of the JETS are taken and by whom. In that case, you will quickly find your FOs carrying significantly more weight than they would have if they had just taken the LLDR, defeating the purpose of the JETS. Ideally, every FO in the FIST should have a DAGR (Defense Advanced GPS Receiver), binoculars, and a radio. The platoon FO should maintain the JETS for his platoon FIST while being deliberate about which components he takes out based upon the mission; section FOs should have Vectors, and the FIST HQ element should maintain the LLDR. This is ideal, but the reality is that our MTOE, as it exists today, does not support this distribution. Unfortunately, even if it did, we would still need spare equipment to account for the inevitable occurrence of something breaking. Despite these challenges, we were still able to work towards something very similar to what the task org called for, and we achieved some good results with it.

All things considered, putting FOs at the section level has great potential; however, we lack the reps and sets to say if it is the answer to the LSCO problem for the FIST. We got some good reps in during our ITC; however, the difficulties we had with fires in a training environment, largely stemming from timely adjudication of fire missions, severely hampered our ability to truly do fire support, subsequently leading to our FOs being limited in their ability to go out, hunt for, and kill the enemy. In the end, our successes were a direct consequence of our willingness to be creative, which would not have been possible without our existing relationship with our maneuver counterparts going into the training cycle. This may very well be the way of the future, but until we can figure out workarounds for the challenges previously discussed and further refine our TTPs, it is impossible to feel comfortable with the idea of deploying to combat in 18 hours with section FOs.

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Improved Map Reconnaissance *for* Field Artillery Emplacements

By CPT Cody Gilham

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Current workflows and solutions for site suitability analysis in support of Field Artillery operations are inefficient.

This inefficiency stems from analog processes, dated topographic maps, and human error. ArcGIS Pro mapping platform will demonstrate a more efficient and accurate process compared to the current mission planning processes of a howitzer and battery site selection. This article discusses the Position Area of Artillery (PAA) Finder – a mobile application that applies expert knowledge to the process of identifying suitable locations for howitzer emplacement. This proof-of-concept application will be developed in ArcGIS Pro using satellite imagery and a digital elevation model (DEM) data layer to model the site selection process. Utilizing specific ArcGIS Pro tools such as Slope, Aspect, Classify, Reclassify, and Raster Calculator, locations on Earth's surface that meet the site suitability criteria are identified as suitable for howitzer emplacement. Once these sites are identified, a Field Artillery commander can then make an informed decision when choosing sites to emplace a howitzer battery. Moving the site selection process into a digital platform increases efficiency, reduces human error, and potentially saves Soldiers' lives.

The Problem

Field artillery battalions and batteries routinely struggle with the site selection process for howitzer emplacement. Presently, the site selection process begins by analyzing paper topographic maps for suitable locations. These maps provide valuable information but are often outdated when it comes to showing land cover. The analysis also includes a visual inspection of satellite imagery. In addition to maps and satellite images, the emplacement problem relies on the analyst's accumulated expertise and knowledge of topographic maps or satellite imagery used to select a suitable site for emplacement. That experience and knowledge can be incorporated into ArcGIS Pro[1]. Armed with the results of the emplacement process determined by ArcGIS Pro, RSOP (Reconnaissance, Selection, and Occupation of a Position), commanders and teams will have up-to-date information and site locations at their disposal before departing the battery to find the next proposed firing location. Having demonstrated the proof-of-concept successfully through ArcGIS Pro, the PAA Finder application will be presented.

Analysis

PAA Finder's workflow (Figure 1, next page) includes six steps that start by identifying two criteria: 5-degree side slope and terrain suitability. The first criterion is the 5-degree side slope (cant) or 90 mils limitation of our firing systems[2]. The second criterion identifies areas that provide a variety of terrain and vegetation, including hilly, wooded, flat, and open areas. Optimal howitzer site suitability would include generally flat and open terrain.

The Joint Readiness Training Center (JRTC) at Fort Polk, Louisiana, the National Training Center (NTC) at Fort Irwin, California, and the training area at Fort Campbell, Kentucky, are the study areas for this analysis. These areas were chosen as they encompass a variety of terrain types. JRTC provides a heavily wooded area and gently rolling terrain. NTC provides a desert and mountainous environment. Fort Campbell provides wooded and open areas as well as gently rolling terrain. These terrain types are typical of what commanders would encounter during an emplacement problem.

1 ArcGIS Pro is a computer mapping application intended for GIS analysis developed by ESRI (Environmental System Resource Institute).

2 This proposed analysis does not include the capabilities of the Suspension Lock Out System (SLOS) on the M119A3. Including the SLOS into the analysis, the capabilities of the system would need measured to understand how to include it into the analysis.

The second step is downloading the satellite imagery and DEM from the United States Geological Survey (USGS)[3]. This is the geospatial data used in the third step of the workflow analysis: to create land cover types, a slope layer, and an aspect layer. For example, a digital layer representing the desired land cover types of the study areas will be derived from satellite imagery. The desired land cover types include water, urban roads, forest, and agriculture/grassland and are the more prominent types around the world in which a firing battery will have to operate. The classifier tools in ArcGIS Pro operate to produce a map layer that has classified the original satellite image into four land cover types.

The DEM creates slope (Figure 3) and aspect (Figure 4) layers. The slope layer shows the amount of slope of the area, and the aspect layer shows which direction a particular slope is facing.

The fourth step requires a reclassification of the slope and aspect layers. For example, the reclassification identifies all slopes 5 degrees or less, meeting the manufacturer's limitations for the howitzers. The reclassification also identifies the aspect facing a certain direction, and for this analysis, facing north and south. The north and south-facing aspects provide the perpendicular side slope that the howitzers will be emplaced on and facing across when firing east to west or west to east. This process can then be replicated for any direction of fire on the battlefield. These criteria are discussed further in the limitations section.

With the land cover, slope, and aspect layers reclassified to meet the criteria of the analysis, the fifth step combines the land cover, slope, and aspect layers to identify suitable emplacement sites. The Raster Calculator tool combines these inputs by digitally overlaying them on top of each other. The sixth step produces the combined layer that identifies where a howitzer can fire east to west or west to east.

Results

The same six-step analysis was applied to each study area except for NTC. The land cover classification step was not used with NTC as

Figure 1. *PAA Finder Workflow Analysis Diagram.*

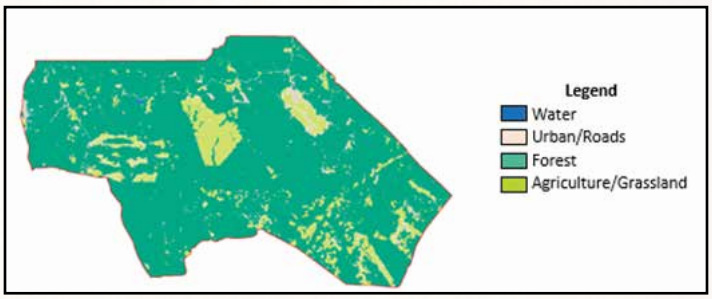

Figure 2. Land cover types of the JRTC study area. The legend explains the color association with the land cover type.

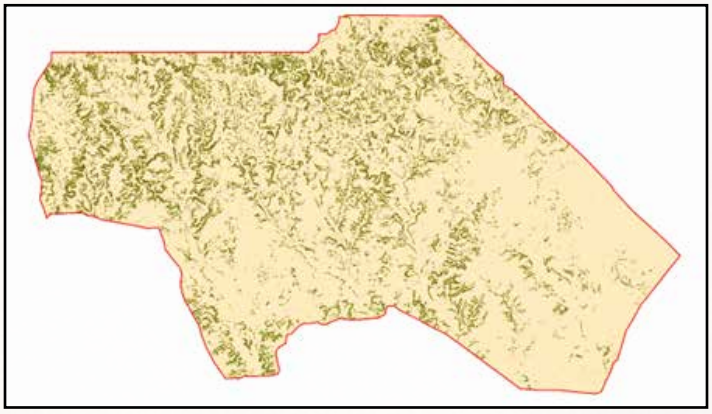

Figure 3. Slope layer of the JRTC study area. Tan represents areas that are less than 5 degrees, and green represents areas greater than 5 degrees.

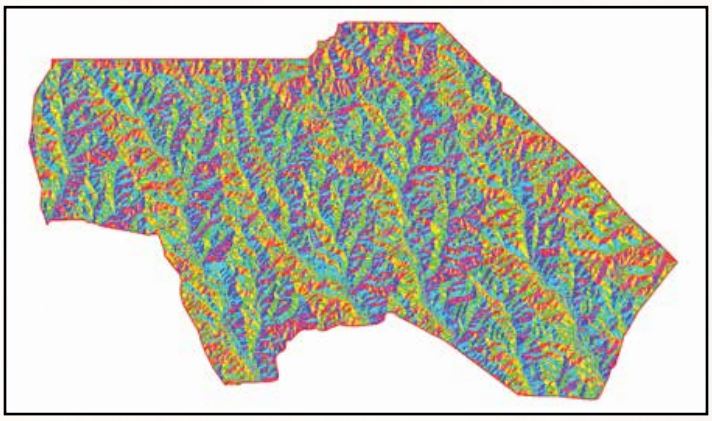

Figure 4. Aspect layer of the JRTC study area. The main cardinal directions are represented by red (north), yellow (east), light blue (south), and purple (west). The remaining colors represent intermediate directions.

3 The USGS Earth Explorer provides several types of data to include imagery and DEMs located at https://earthexplorer.usgs.gov.

the land cover at NTC is mostly an unpopulated desert environment. These characteristics at NTC resulted in the land cover classification not accurately separating the various types of soil from rock and pavement. Figures 5, 6, and 7 show the map layers identifying the areas that are suitable for emplacement when firing east to west or west to east at JRTC, NTC, and Fort Campbell, respectively. In each figure, the areas shown in purple meet all criteria for howitzer emplacement.

Figure 8 (next page) shows two maps. The larger scale map illustrates two land cover categories at Fort Campbell: forested and non-forested. Forested land cover is shown in dark blue, and non-forest land cover is shown in bright green. Based on this land cover classification, the areas that are suitable for firing in all directions are shown in bright green. Figure 8 does not incorporate slope into the firing suitability results. The small inset map shows a topographic map for Fort Campbell dated 1984. This map also shows two land cover types: forested and non-forested. Areas in green are unsuitable as they are covered in vegetation. Many, but not all, areas represented by the bright green on the larger map are suitable firing sites according to the lighter green shades shown on the topographic map. This difference is due to the topographic map being outdated. For example, the area outlined by the dark red rectangle on the topographic map shows no areas suitable for emplacement. The results from PAA Finder in Figure 8 show that the area highlighted in yellow (same location as highlighted in red) provides a suitable area for emplacement.

Discussion

This analysis was a proof of concept that will eventually be converted into a mobile application (PAA Finder) whose interface is shown in Figure 9. The PAA Finder will be based on the site suitability analysis described above and eliminate most of the necessary technical knowledge needed to conduct this analysis in ArcGIS Pro. Once the selected location and an azimuth of fire are entered, the PAA Finder will automatically determine suitable locations. The battalion S2 is being recommended as the shop to oversee the downloading of the appropriate and up-to-date data from USGS and ensure it is pre-loaded into the mobile application for firing units to use.

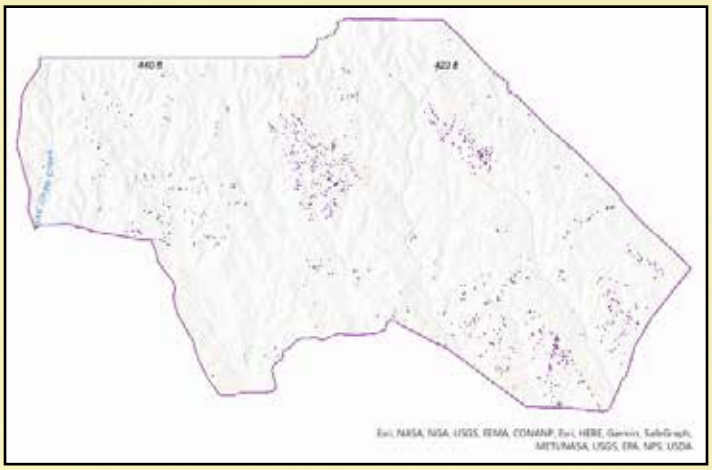

Figure 5. Emplacement areas for firing east to west that meet criteria at JRTC (shown in purple).

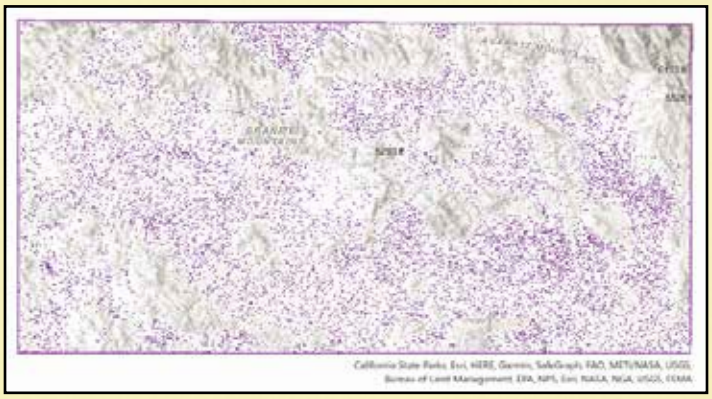

Figure 6. Emplacement areas for firing east to west that meet criteria at NTC (shown in purple).

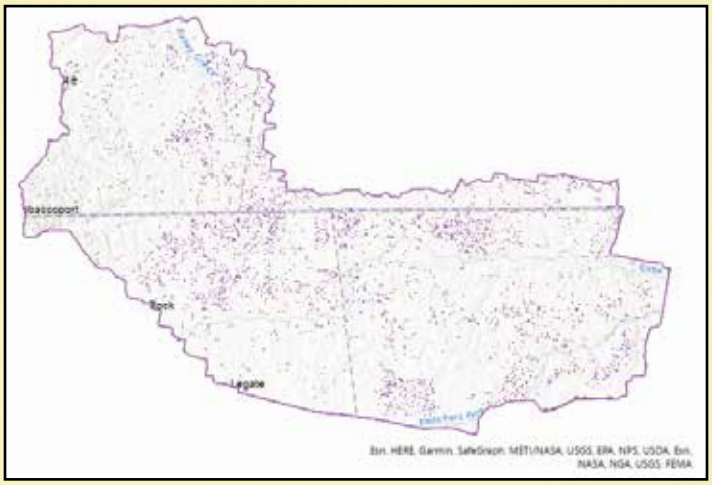

Figure 7. Emplacement areas for firing east to west that meet criteria at Fort Campbell (shown in purple).

The emplacement process in PAA Finder involves three steps. First, a user views a digital topographic map based on Military Grid Reference System (MGRS) to select a proposed location for the howitzer emplacement (Figure 9). The user selects a location by either clicking on a location on the map or by typing the grid location into the MGRS box. Additional parameters that must be entered into PAA Finder include the location, piece, charge, shell, fuze, and AOF (azimuth of fire). The location is derived from user input; the piece refers to which howitzer system is being fired, charge is the type of propellant, shell is the type of round being fired, fuze is the fuze to be fired, and AOF is the direction of fire. If these parameters align, then a green circle appears (shown in the right-hand corner of the PAA Finder interface). A red circle appears if the parameters do not align. This "system check" provides not only a way for the commander to plan where to emplace the battery but also a way for the commander to quickly check, without having to reference a book, if the ammunition available is compatible.

Second, a black line represents a vector (or direction) that corresponds to the proposed AOF (Figure 10). Note that the AOF is in mils but may be switched to degrees if desired.

Third, the final results use all of the inputs located on the top row of the application (Figure 10). If the inputs agree, then a green circle appears, and blue range rings will appear on the map (Figure 11). Inoperable firing azimuths from the selected location will be highlighted with diagonal lines. Incompatible results will display a location error message.

Once the three steps are completed, and range rings are displayed, the operator will be able to save this location along with the AOF and range rings for later use. These locations will be saved based on the PAA naming convention. For example, PAA 30 or a naming convention of the user's choice.

Other functions that could be included in a PAA Finder before it is fielded include friendly radar capabilities and enemy radar and artillery capabilities. Including this data and the ability to visualize the range rings of all systems on the battlefield would drastically improve planning capabilities at the brigade and battalion levels.

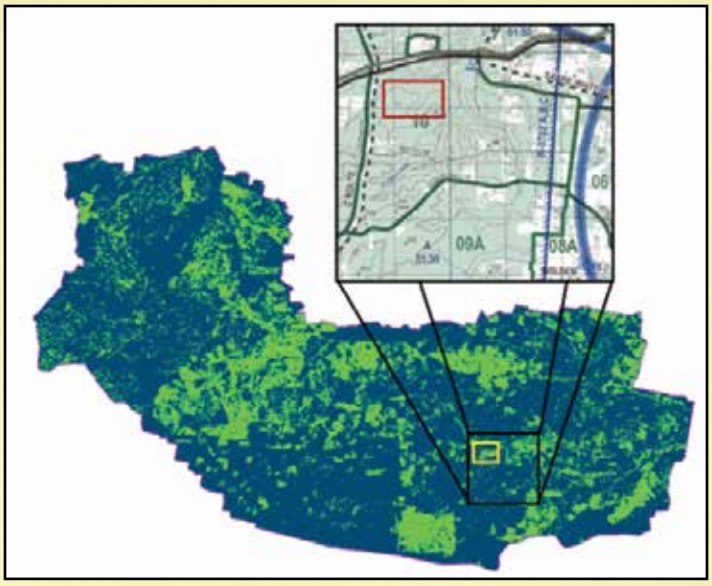

Figure 8. Emplacement areas suitable for firing in all directions are light green, and unsuitable areas for firing are blue. The zoomed-in image shows the difference between the current topographic map and the PAA Finder results.

Figure 9. The screen where the howitzer emplacement location is proposed. The black dot in the center of the screen, training area 20, represents the proposed site location.

Figure 10. Setting the Azimuth of Fire.

Figure 11. Final results based on howitzer inputs and locations analysis. Range rings appear as blue concentric circles (not to scale), and areas not compatible with firing are highlighted with diagonal lines.

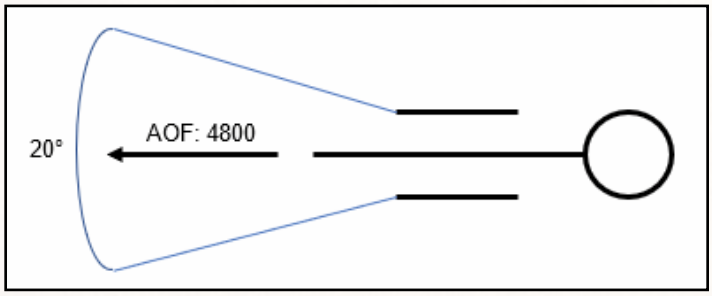

Figure 12. Light howitzer symbol representing azimuth of fire and 10 degrees beyond perpendicular, left and right, of the north and south facing slope.

PAA Finder would be faster than referencing a book or drawing on acetate but is not meant to replace analog products. The efficiency that comes from PAA Finder would identify any gaps between range rings, either friendly or enemy, and could result in winning or losing a battle.

While ArcGIS Pro was utilized to conduct this analysis, there are other software platforms available or platforms that can be developed. These other platforms may be well suited or better suited to perform the analysis and functions behind PAA Finder. ArcGIS Pro was chosen based on familiarity with the program through schoolwork at Stephen F. Austin State University and Penn State University.

Limitations

Addressing two additional criteria will improve PAA Finder's accuracy and efficiency. The first criterion is site to crest. Trees, buildings, and other obstacles may impede a howitzer's site to crest. Incorporating information on the site to crest would ensure an unobstructed view from the howitzer to the target. The second criterion is side slope (cant) validation. While the side slope limitation used for the analysis is 5 degrees (90 mils), the beyond perpendicular angle to the side slope must be verified for each howitzer. The analysis used 10 degrees beyond perpendicular left and right of the AOF (Figure 12) to establish temporary criteria to demonstrate the capability of this analysis. Figure 12 represents the howitzer emplaced on an azimuth of fire of 4800. While the FDC determines the left and right limits, the left and right limits used are 10 degrees left and right of the AOF to demonstrate the capabilities of the analysis.

Conclusion

With today's fast-paced combat operations and the need to make decisions quickly, Field Artillery cannot become a limiting factor on the battlefield. While there are numerous intricacies in the emplacement of the howitzer systems, site selection is the most important step. Expediting this step is a critical measure that can save time and lives on the battlefield. Enabling the site selection process with ArcGIS Pro, through identifying locations that meet the aspect, side slope, and land cover classification can allow commanders to confidently move their units to areas that will provide an emplacement opportunity. With this proof-of-concept analysis successful, the mobile application PAA Finder will be developed, enabling artillery commanders the ability to solve the emplacement problem quickly and accurately in the field.

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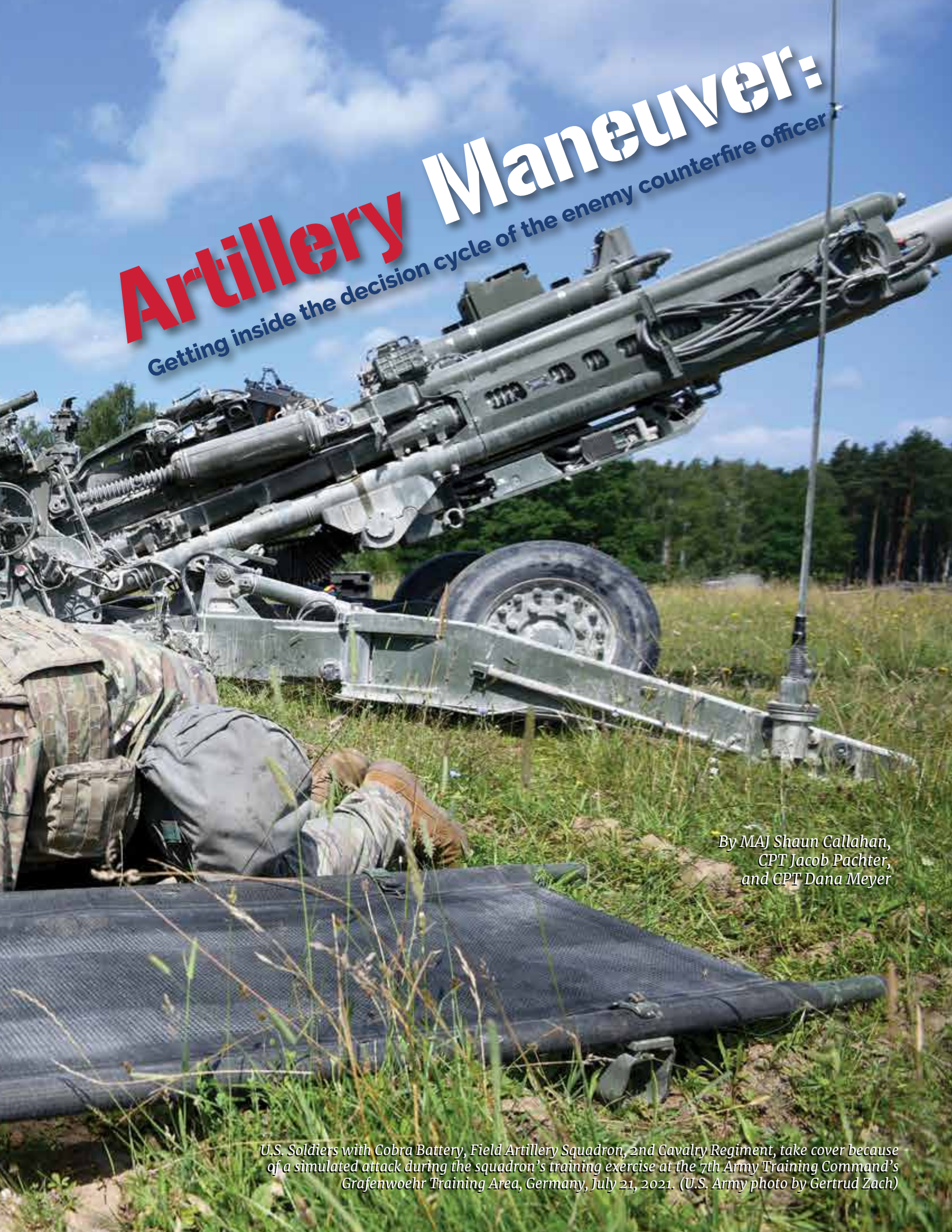
CPT Gilham would like to give special thanks to Dr. Fritz Kessler, Teaching Professor at Penn State Department of Geography, for his efforts in helping make this project possible.

Artillery Maneuver:

Getting inside the decision cycle of the enemy counterfire officer

By MAJ Shaun Callahan, CPT Jacob Pachter, and CPT Dana Meyer



U.S. Soldiers with Cobra Battery, Field Artillery Squadron, 2nd Cavalry Regiment, take cover because of a simulated attack during the squadron's training exercise at the 7th Army Training Command's Grafenwoehr Training Area, Germany, July 21, 2021. (U.S. Army photo by Gertrud Zach)

Five minutes later, the BM-30 unit sends the firing report, "50-round salvo fired. Three minutes to impact. Moving to alternate location now."

The enemy counterfire officer's screen flashes and an accompanying beeping is heard. Six lines on her digital map overlay appear, converging over one of their 2S9 self-propelled artillery units operating west of the command post. The lines draw out to an open field just off an eastern European highway. Each line connects to a blip within a 500 x 500-meter position area. After putting down her coffee, the counterfire officer clicks on the position area and selects the center grid that is automatically calculated from the six firing positions. A list of available firing units in range populates, and she selects a BM-30 Smerch. She sends the fire mission digitally and then radios the Unmanned Aircraft Systems (UAS) Company Commander to instruct him to send two of his Orlan-10 small unmanned aerial systems to the enemy position to collect an assessment of the fire mission. Five minutes later, the BM-30 unit sends the firing report, "50-round salvo fired. Three minutes to impact. Moving to alternate location now."

CPT Higgins sat with his executive officer in the battery command post. They overlooked Bravo Battery, arrayed in a standard "lazy w" formation in the position area. To pass the time, they were teaching their radio operator the game of chess. A board was strewn across the top of their radio stacks, and 1LT Roberts, the executive officer, explained the rules:

The king is the most important piece on the chessboard. Without it, you lose. But it is also the most vulnerable. When the opponent still has their queen, rooks, and knights, it is crucial to protect your king through constant maneuvering on the board. A static king is vulnerable, and you open yourself up to being targeted. You shouldn't wait until the king is directly threatened to move it. If you do that, your opponent has gained the initiative, and they will control the pace of the game and the options available to you. By proactively and unexpectedly moving your king, you can maintain the initiative and prevent your opponent from dictating your actions. Plus, you're more likely to win.

CPT Higgins interjected. "Fire Mission!" His M777A2 Battery Fire Direction Center had just received the fire order "Battery, three rounds, BONUS, Target Number AC1006" and sent it to the gunline. As each piece fired its three rounds, he and his executive officer listened over the battery fire direction net, hearing "rounds complete" after a few minutes of firing. As they waited patiently for the battalion to end the mission, 1LT Roberts asked if she should direct the howitzer sections to prepare to conduct survivability moves. "No, didn't you read the Battalion Field Artillery Support Plan? Survivability move criteria is a Battery four; we've only shot a Battery three. Also, we're standing by for a planned mission. We can't have the guns moving and risk being unable able to shoot. Why don't you go make sure the Howitzer sections have prepared their sector sketches to defend against dismounted attack? Also, ensure they have finished digging their fighting positions."

Just as CPT Higgins finished issuing his orders, the surrounding countryside disappeared in a storm of fire and deafening noise. "Any Bulldog element, this is Bulldog Five. Radio Check. Over. Any Bulldog element, this is Bulldog Five. Radio Check. Over. Any Bulldog element, this is Bulldog Five. Radio Check. Over."

Three minutes later, two Orlan-10 drones circled overhead. Sitting almost 30 kilometers away, the operators watched from their flight control node. The radio operator picked up the hand microphone and keyed the brigade fires net. "Counterfire headquarters, this is Hawk 9. Six howitzers destroyed, no movement, enemy battery destroyed."

Cannon Battery Operations and the "Spirit of the Offense"

The battery commander is responsible for all aspects of battery operations. Our current cannon battery doctrine emphasizes the importance of our battery commanders and their requirements to determine the operational employment of the pieces in their command. While the responsibility for the employment of the battery lies with the battery commander, they are often only able to control the employment of the firing line with the approval of battalion fire direction centers. Battery commanders can control the survivability of their cannon pieces using survivability criteria and thereby determine the level of control to be exercised by the battery or platoon fire direction center. To maximize the capabilities and employment of cannon pieces, towed cannon battery commanders and the Field Artillery branch must move from a mindset of continuous defense to one that meets the characteristics of fire support in FM 3-09, primarily "to always operate in the spirit of the offense."

As Fires professionals, it should be apparent to the cannon artillery community that though we may soon reach parity and exceed our threat artillery piece ranges, we still need to catch up when it comes to the quantity of pieces. Without delving into specific theaters, we as a community should guarantee that in the world of tactical fires delivery in the context of large-scale combat operations, the U.S. Army Field Artillery will operate at a quantitative deficit.

The radio operator picked up the hand microphone and keyed the brigade fires net. "Counterfire headquarters, this is Hawk 9. Six howitzers destroyed, no movement, enemy battery destroyed."

To offset this quantitative deficit, several exquisite force multipliers are on the horizon. From hypersonics to precision-guided systems, the artillery is clearly moving toward improving effects on targets with fewer munitions. That makes each piece in action more valuable and more critical to fires delivery than ever before. From an economic perspective, the greater quantitative overmatch we face, the more damaging the loss of a firing piece becomes to our mission to deliver fires in support of maneuver.

As artillery professionals, we've adapted to the demands of large-scale combat operations through iterative learning at our combat training centers. Notable improvements in camouflage techniques, electronic signature reduction, and survivability have been widely spread through professional channels. However, many of the lessons learned and reinforced at the combat training centers for towed artillery units focus on reducing signature as the primary method of avoiding enemy counter-battery due to towed cannon artillery's movement limitations. Frequent movement strains crews and takes pieces out of action to be available to service targets.

Our current method of preserving pieces centers around the idea of survivability criteria resulting in planned or unplanned survivability moves within a position area for artillery. This is a defensive-minded operation primarily aimed at preserving pieces and limiting damage from counter-battery fire. ATP 3-09.50 describes the assignment of control of survivability moves to the Fire Direction Center within the confines of the battery commander's prescribed criteria. Fire Direction Centers can control movement in either a centralized or decentralized method. Using a Howitzer Tracking Chart or a digital equivalent on a Joint Battle Command Platform or Advanced Field Artillery Tactical Data System can help ensure pieces move in a coordinated manner.

By definition, this movement is defensive in nature. To meet the demands of the future operational environment and the Army's role in enabling Multi-Domain Operations, battery commanders need to approach their Troop-Leading Procedures and command their firing unit "in the spirit of the offense." To accomplish this, we propose a concept called "Artillery Maneuver." Maneuver, as defined by FM 1-02.1, is movement in conjunction with fires. Artillery commanders must start thinking of their enemy during mission analysis within their troop-leading procedures as the enemy counterfire officers. What are we showing to that enemy, and when? How are we coordinating our "movement" with our "fires," and what picture does that resulting maneuver produce?

Imagine a firing battery in a basic lazy w formation within a position area for artillery. The battery likely has camouflage nets and uses terrain masking to reduce their electromagnetic and visual signature as much as possible within the position area for artillery. The battery fire direction center receives a fire order from the battalion fire direction center, "Battery, two rounds, BONUS, Target Number # AC1006," through the AFATDS. The fire direction center processes the mission and sends it all six pieces. All six pieces fire. Did the firing unit meet any prescribed survivability move criteria? Unlikely due to the low number of volleys fired. As a result, no firing pieces are moved from their last firing position.

Would a competent and effective fire support enterprise miss 12 rounds from a single firing position? Would we have appropriately queued and scheduled radar coverage to acquire this fire mission? In this hypothetical scenario, let us assume that, yes, that fire mission was acquired through either counterfire radar or other methods. What would we do with that information? We could place a call-for-fire zone over top of that position to cue our sensors appropriately and possibly lay a firing battery on an azimuth of fire that enables reactive counter-battery fire should we receive another acquisition from that firing position. Another option would be to use that counterfire acquisition to queue another collection asset, like an unmanned aerial system. Either way, when we fire a piece against a capable fire support threat, we should operate under the assumption that that piece has been acquired. The lack of return counter-battery fire should not lead us to believe that we've gone undetected. This is an example of confirmation bias and often leads to battery commanders remaining in place following a mission.

What if the battery commander hadn't issued simple survivability criteria but took the time to develop an artillery maneuver plan as a product of his or her assumptions about the enemy's strength, capabilities, composition, and

disposition within his or her area of operations and area of interest? An artillery commander right now bases his or her scheme of maneuver on essential Field Artillery tasks he or she is designated to support by phase of an operation. For a commander, this requires the designation of ready rack loads, preferred charge based on range to planned targets, and azimuth of fire. Battery commanders need to do more and consider their planned movements within and between position areas for artillery in relation to the enemy counterfire officer and the enemy fire support enterprise. By truly putting on a red hat during troop-leading procedures, a battery commander will quickly see that his or her battery's signature after even a single fire mission has placed the firing unit in the enemy's crosshairs for proactive counter-battery fire and reconnaissance efforts through UAS and ground-based forces.

So, what is on the menu of options for towed battery commanders? Move every piece after every mission? *Bulldog Battery*, Field Artillery Squadron wrestled with this problem at Saber Junction 20 at the Joint Multinational Readiness Center (JMRC). Moving every towed piece after every mission simply strained cannon crews to the point that they became ineffective. The concept of moving following each mission is still a reactive way to look at battery operations. Commanders must plan the variety of fire missions that need to be fired by a battery versus a platoon and possibly, at times, just a section. Minimizing the number of pieces firing could reduce the overall signature of the battery's operating area. By firing with one platoon, keeping the sister platoon in position, and preparing to fire the next mission while the first platoon moves allowed *Bulldog Battery* to reduce crew strain and continue maneuvering the battery within large position areas for artillery. Another alternative method, referred to by *Bulldog Battery* as "the amoeba method," called for firing the battery and moving the middle pieces to the flanks of the position areas for artillery as a method to change the shape of the firing formation between missions from the enemy perspective. This technique proved highly effective at deceiving the counterfire officer and confused follow-on aerial reconnaissance elements. There are undoubtedly other solutions, but we as a Fires community must push battery commanders to think of their units from a fire and maneuver perspective to gain the upper hand against the enemy counterfire officer.

Towed artillery battery commanders need to rethink their responsibilities as part of the combined arms team. Multi-domain operations and restructuring of divisions to meet the demands of a changing threat landscape should cause all artillery professionals to rethink and relook at what our responsibilities on the battlefield have been historically and may be moving forward. Suppose artillery must be available to enable maneuver and deliver munitions at critical points in an operation. In that case, artillery commanders need to think and act in the spirit of the offense and place the enemy counterfire officer in a dilemma every time we fire.

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Illustration of Ivy Mass. (Howitzers photo by CPT Alexander Werden; Apache and HIMARS fire created by the 14th Public Affairs Detachment.)

Training a JAGIC at Home Station

By MAJ Bruce Archambault

Background. The 4th Infantry *Ivy Division* completed Warfighter Exercise (WFX) 23-01 on October 2, 2022 – the first-ever WFX executed within a Pacific scenario. The exercise was divided into two distinct operations. The first half of the WFX consisted of Joint Task Force and Corps shaping as preparation for a joint forcible entry operation which included simultaneous airborne, air assault, and amphibious landing operations. The second half consisted of approximately three days of large-scale combat operations. In all, the *Ivy Division* fought for approximately 120 hours, or five days.

During the five days of fighting, the *Ivy Division's* Joint Air Ground Integration Cell (JAGIC) conducted 240 surface-to-surface strikes (cannon and rocket fires), 40 strikes using armed Gray Eagle, and controlled 42 sorties of close air support (CAS) and air interdiction (AI). Since a majority of allocated sorties conducted strikes against multiple targets, the total number of strikes from fixed-wing aircraft exceeded 100. While the JAGIC engaged targets in the division's deep area, the airspace manager cleared airspace for over 400 strikes, a number which includes the 120 counterfire missions cleared above the coordinating altitude on behalf of the division counterfire headquarters. By all accounts, the JAGIC team excelled at its core competencies, detailed in the *Ivy* JAGIC's standard operating procedures (SOP):

> *a. Conduct dynamic targeting/ determine the best weapon-target solutions available in accordance with the Commander's guidance (target synchronization matrix and the high-payoff target list, attack guidance matrix, and target selection standards [HAT]) to achieve the desired effects.*
>
> *b. Conduct clearance of fires and airspace to effectively support current operations, deliver joint fires and achieve desired effects.*
>
> *c. Determine the best use of available fire support resources during the current operations fight.*
>
> *d. Integrate the targeting and intelligence collection processes by dynamically coordinating fires against high-payoff targets, high-value targets, and targets of opportunity within the division area of operations.*

The success of the joint team comprising the *Ivy* JAGIC is directly attributable to the training plan developed and executed by its leadership – a training plan that was fully supported by both the division artillery (DIVARTY) and division commanders.

Home Station JAGIC Training. *Ivy* JAGIC leaders developed and executed a scalable and tailorable home-station training progression to prepare for WFX 23-01 utilizing a crawl-walk-run training progression. This training progression can be applied to any division JAGIC's train-up, and it can be adjusted for unique mission variables or for personnel, sustainment, equipment and/or facilities limitations and/or requirements.

Training Circular 3-91.1, *Training the Joint Air Ground Integration Center*, lists multiple opportunities for training the JAGIC, including attending the echelons above brigade airspace course (EABAC) and specialized joint air-ground training (SJAT). While these two courses are excellent training for the JAGIC, there are only four short paragraphs in the "Home Station Training" section of the TC, two of which detail individual systems training (Advanced Field Artillery Tactical Data System [AFATDS], joint automated deep operations coordination system, tactical airspace integration system [TAIS], etc.) as opposed to collective JAGIC training. This required the *Ivy* JAGIC and the Fort Carson Mission Training Complex (MTC) to devise a plan that would adequately prepare the JAGIC for both WFX 23-01 and any follow-on missions assigned to the division headquarters.

During the design phase, the DIVARTY commander directed that the training progression's objectives include both doctrinal objectives and objectives unique to the *Ivy* JAGIC. Doctrinally, it aimed to achieve the following training principles from FM 7-0: "train as you fight" (use our own systems, network, and command posts), "sustain levels of training proficiency over time" (execute training at least once per quarter), "train using multi-echelon techniques" (incorporate the DIVARTY and brigade fire support elements when possible), and "fight to train" (this training was made a priority by the division and DIVARTY commanders). Other training objectives were to incorporate elements of the multidomain operations operational concept (place cyber and electromagnetic activities space team personnel in the JAGIC), to utilize the MTC to provide simulation support to the training, and to incorporate the *Ivy* "Strike Cell" to train information collection plan execution as well as the intelligence support to targeting function.

Crawl Phase. The first training iteration relied wholly on the Fort Carson MTC for physical space, command and control (C2) systems, and network services. Only Army personnel participated in this phase; however, the senior air director and senior air technician visited during the execution days to both identify where they would fit into future training (white cell and training audience requirements) and advised the JAGIC chief on how the air support operations center (ASOC) fit into the JAGIC battle drills. The MTC organized a room to reflect the JAGIC layout within our command post integrated infrastructure mission command platform (MCP). (Figure 1)

The white cell consisted of a brigade fire support element with an AFATDS, a DIVARTY fire control

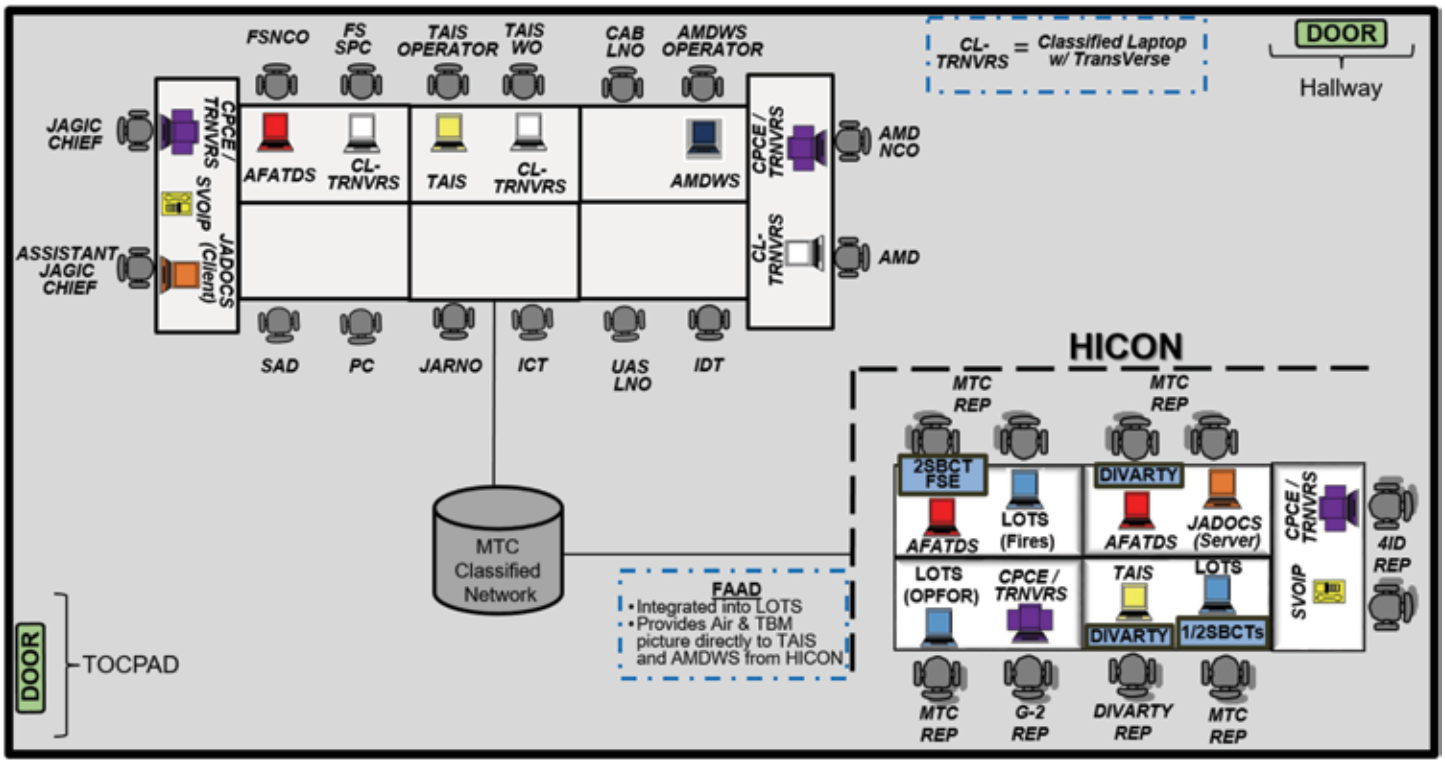

Figure 1. MTC Room Layout for Crawl Phase

element (FCE) with an AFATDS, a DIVARTY air defense and airspace management (ADAM) cell with a TAIS, firing battalion fire direction centers with an AFATDS, a G-2 strike cell representative with a master scenario event list, and the JAGIC Field Artillery intelligence officer (FAIO) with a Joint Automated Deep Operations Coordination System (JADOCS). The MTC utilized the low overhead training system to provide simulation support to training. These simulation drivers were used instead of Warfighter's Simulation (WARSIM) due to no maneuver units taking part in the training (targets and firing units were static, and other friendly units were not built), making terrain effects on maneuver that WARSIM provides not required. The tactical scenario used for the training was a European Command-based scenario from the last WFX that the *Ivy Division* executed.

The primary training objectives were to 1) validate individual C2 systems training across the JAGIC team, 2) refine JAGIC battle drills, and 3) validate the JAGIC's digital and analog common operational picture. The training was scheduled to last one week - two days for setup and thread testing and three days for training. During execution, the FAIO sent targetable intelligence data (TIDATS) to the JAGIC targeting officer via JADOCs. For each TIDAT sent, the JAGIC team executed its battle drill (figure 2) based on assessment of the high-payoff target list, attack guidance matrix, target selection standards, or HAT, and the commander's targeting guidance. The team spent approximately an hour at a time processing strikes before pausing to conduct hot washes, adjust and go again. Following this training, the JAGIC team and the MTC transitioned to planning for the next iteration – the walk phase.

Walk Phase. For this training iteration, the division ASOC participated in the training along with all Army personnel in the JAGIC. The team executed training in the division main command posts' MCPs (see figure 2 for the updated layout following the original training iteration). In addition to the JAGIC, the G2 strike cell set up their MCP (layout shown in figure 3) in order to execute the division's information collection plan and conduct intelligence support to targeting within the simulated training environment. The DIVARTY established their FCE, counterfire element, and ADAM cell in their main command post on the MTC Tactical Operations Center's pad.

White cell support for this iteration did not require the DIVARTY or G2 strike cell personnel, as they were now included in the training audience. The white cell still required the cannon and rocket fire direction centers to execute fires in the simulation. It added the requirement for an ASOC

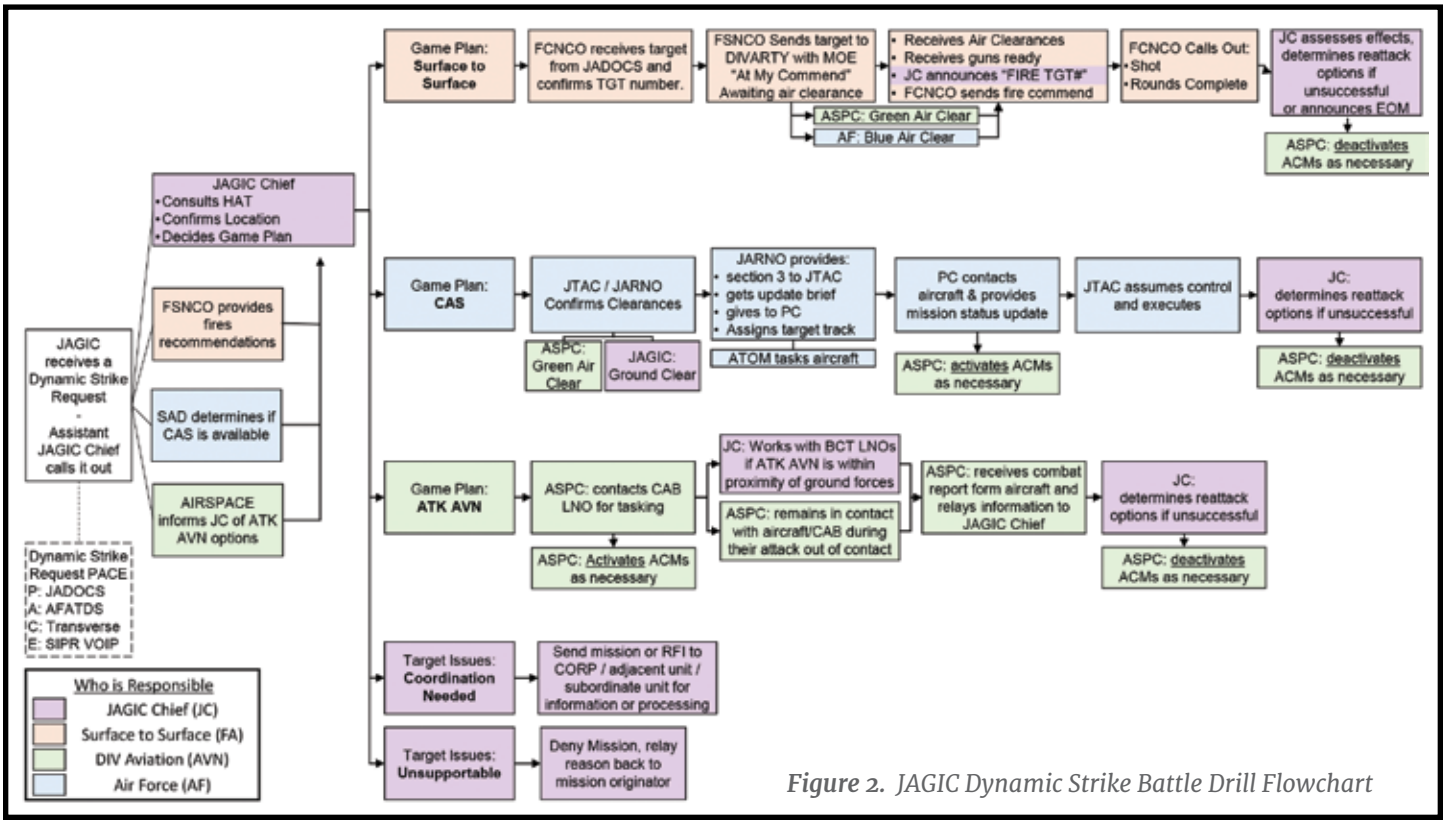

Figure 2. JAGIC Dynamic Strike Battle Drill Flowchart

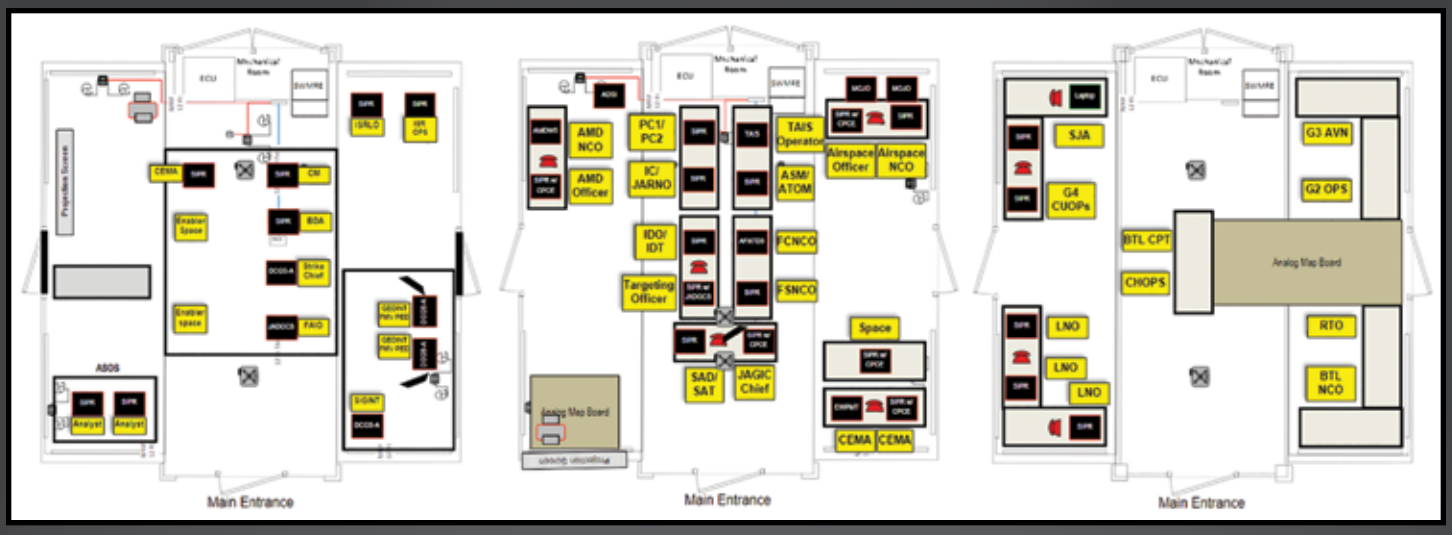

Figure 3. *Current Operations Integrating Cell MCPs (L to R – All-source Collection Element, JAGIC, Chief of Operations, connected by catwalks)*

> ***Convergence*** **is an outcome created by the concerted employment of capabilities from multiple domains and echelons against combinations of decisive points in any domain to create effects against a system, formation, decision maker, or in a specific geographic area. (FM 3-0)**

representative to act as the tactical C2 agency and as pilots for the division's allocated CAS and AI sorties (this required creation of an air tasking order and airspace control order for the training). For this iteration, the MTC employed WARSIM, the modular universal simulation environment, and warfighter intelligence module to stimulate the training audience. The map set, enemy order of battle, and threat tactics were identical to those employed during the crawl phase.

The primary training objectives were to 1) validate the JAGIC battle drill that was refined during the crawl phase and 2) integrate information collection and intelligence support to targeting into the training. This training was scheduled for two weeks – one for setup and one for execution. During training, the strike cell identified targets using ground-moving target indication and simulated Gray Eagle feeds. Once identified and built into the Distributed Common Ground System - Army (DCGS-A), the strike cell chief passed TIDATS to the FAIO from DCGS-A to JADOCS, at which point the FAIO validated targets and passed them to the JAGIC via JADOCS. Once game plans were determined, the strikes were executed in accordance with the JAGIC SOP. On training days, the team executed approximately two hours of training in the morning and three hours in the afternoon, with a hot wash conducted after each training session. This training paved the way for the JAGIC and DIVARTY's culminating training exercise ahead of moving into the command post-exercise progression for WFX 23-01.

Run Phase. The *Ivy* JAGIC, with 4th DIVARTY, executed Operation Ivy Mass in June 2022. Concurrent with the WFX 23-01 "command post exercise 0" for the rest of the division staff, the exercise incorporated traditional observers (fire support teams, joint terminal attack controllers, Shadows and Gray Eagles) as well as electronic intelligence collection assets (ground, air, and space-based), and employed 155 mm cannons, High Mobility Artillery Rocket Systems (HIMARS), army attack aviation, fixed-wing support and electronic attack (space control electronic warfare). Both the JAGIC and the strike cell operated from the MCPs within the division's main command post.

> ***Multidomain operations*** **are the combined arms employment of joint and Army capabilities to create and exploit relative advantages that achieve objectives, defeat enemy forces, and consolidate gains on behalf of joint force commanders. (FM 3-0)**

The objective of Ivy Mass was to execute a live-fire multidomain exercise (simulation support was not required or used), thereby demonstrating the JAGIC's ability to employ

joint fires, control airspace, and integrate all available kinetic and non-kinetic detect and deliver systems. This included assets organic to the division and others that were allocated for division's use by higher headquarters. DIVARTY planners created a synchronization matrix that served as a schedule of fires for the exercise control team. Over a 12-hour execution window, the ASOC procedurally controlled the airspace over Fort Carson. During this 12-hour window, the JAGIC processed strike requests from ground-based observers (multiple fire support teams/subordinate fire support elements, joint terminal attack controllers, Versatile Radio Observation and Direction [VROD], and VROD Modular Adaptive Transmit), aerial observers (Shadow, Gray Eagle, Air-Rod) and space-based collection assets. The JAGIC achieved convergence by employing both kinetic and non-kinetic effects simultaneously and sequentially. The combination of lethal and non-lethal effects defeated enemy air defense, indirect fires, and maneuver formations - the first two replicated by emitters placed on the edge of the impact area and the last replicated by vehicle hulls in the impact area. The JAGIC successfully executed the operation in accordance with the synchronization matrix - with zero missed strikes or time on target fire missions. The ASOC procedurally controlled airspace with simultaneous use by multiple unmanned aerial vehicles, fixed-wing aircraft, rotary-wing aircraft, cannon fires, and rocket fires - with zero incidents or airspace conflicts.

Recommendations. Based on the *Ivy* JAGIC experience while developing and executing a home-station training progression, the following should be considered when developing JAGIC home-station training plans:

1) Build relationships with ASOC leadership early and often engage during train-up. While *Ivy* JAGIC soldiers were at EABAC and SJAT, Army Joint Support Team personnel shared that Army JAGIC personnel often meet their ASOC counterparts for the first time during SJAT. This was not the case with the *Ivy* team, as the *Ivy* JAGIC trained together prior to SJAT. As a result, the team transitioned to the lab portion of SJAT with an established team that was focused on executing the training, not team building. During the WFX, the JAGIC Observer, Coach/Trainers shared with JAGIC leadership their surprise at how efficiently the Army and Air Force worked together. JAGIC leadership

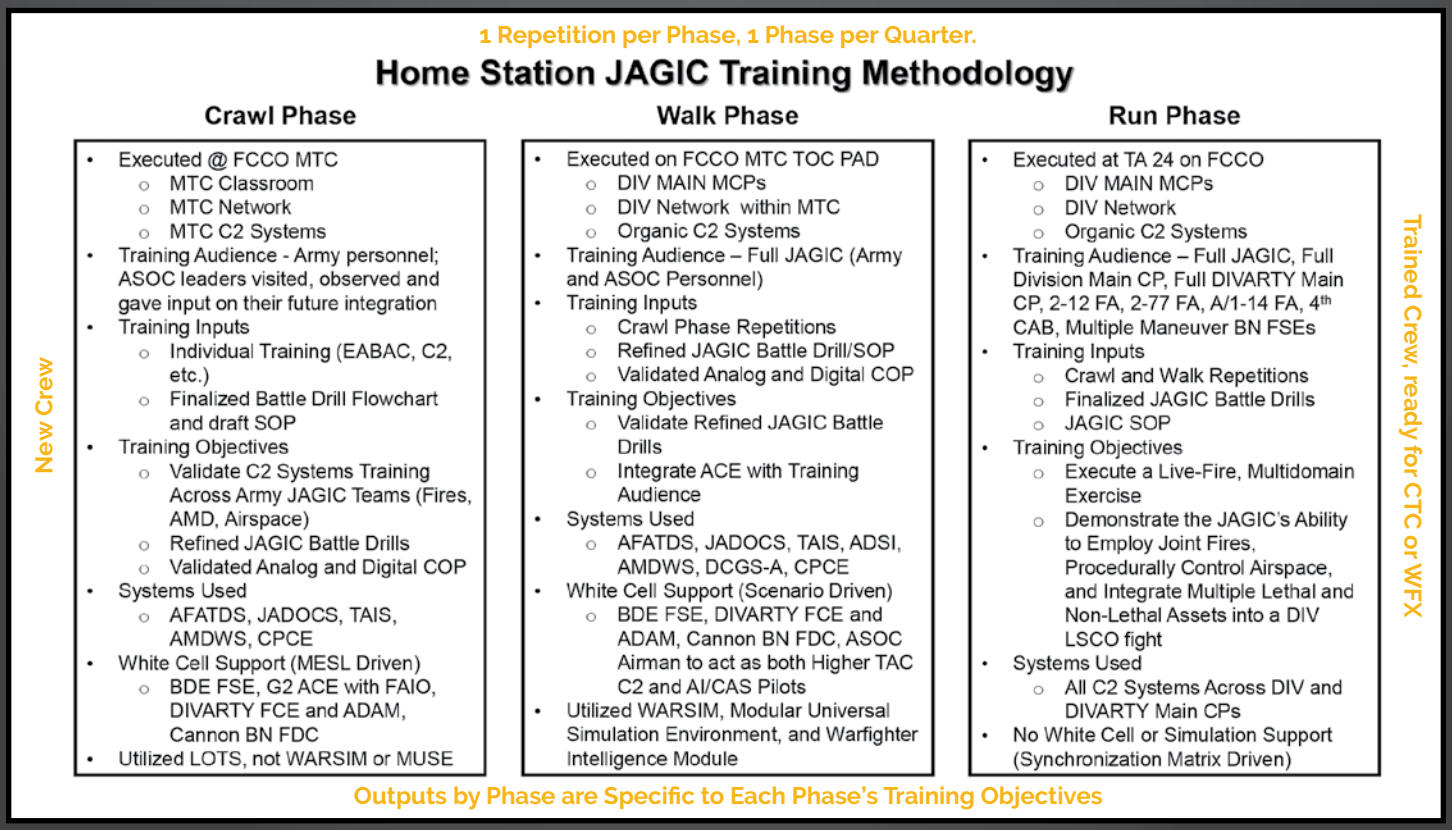

Figure 4. *Crawl/Walk/Run Progression.*

(Army and Air Force alike) attributed this to the joint training prior to the WFX – training that helped build relationships and establish a common understanding of everyone's roles, responsibilities, and expectations.

2) Get buy-in and support from division leaders. During initial planning discussions for every training iteration, multiple elements of the division staff usually had some form of conflict with the training timelines. However, support from senior leaders in the division allowed for the tasking of staff sections using a division-level operations order written by the division fire support element. This prioritized the training across the division staff and ensured that the staff supported the training.

3) Trust the TC regarding timing of EABAC and SJAT. While excellent training opportunities, this training best serves new JAGIC teams that have not already executed collective training. TC 3-91.1 depicts training timing in figure 1-3 (EABAC, then SJAT, then home-station training), but the *Ivy* JAGIC developed and implemented home-station training prior to attending in-person training due to how far out WFX 23-01 was once the team was formed. Looking back, instead of waiting until the team had executed multiple home-station training repetitions, it would have been best to send the team to SJAT as an introductory exercise.

4) Pre-execution communications exercise. Build ample time into the setup phase of any training iteration (i.e., - do not rush to execute substandard training or training that does not reflect how doctrine/SOP says you should fight). The *Ivy* JAGIC team, during the first iteration (crawl phase), spent part of the first execution day continuing to troubleshoot digital systems. This enabled the digital link between JADOCS and the JAGIC AFATDS and between the JADOCS and DCGS-A servers. This digital link ensured that the digital sensor-to-shooter chain was not broken, eliminating a potential ingress point for error during mission processing (such as an AFATDS operator typing in an incorrect grid). In hindsight, it would have been beneficial to allocate more time to set up and avoid using training time to work on communications issues.

Conclusion. The JAGIC is a complex hub within the division's main command post that must regularly train as a combined team to maintain proficiency. Any training plan that aims to produce a fully trained JAGIC must be deliberate in its approach and progressive in nature (crawl, walk, run), and, importantly, must begin very early in the training progression. It must also be flexible enough to be tailored to any combination of mission variables a division may face. This type of approach ensured that the *Ivy* JAGIC team was trained on all individual and collective tasks and was prepared to execute WFX 23-01, during which the team excelled at performing its core competencies.

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Ivy Mass is a live fire exercise that demonstrates and validates the 4th Infantry Division's ability to converge multi-echelon operations alongside joint service partners to engage a simulated enemy at all levels of the battle space: on the ground, in the air, in space, and cyberspace. (U.S. Army photo by SPC Collin MacKown)

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SGT Paul Grillot, left, and PVT Brandon Kramer, center, Soldier assigned to 2nd Battalion, 2nd Field Artillery Regiment, 428th Field Artillery Brigade, Fort Sill, OK., feed 'SSG Big Deuce' sugar grass in an open field on Fort Sill, April 24, 2020. 'Big Deuce' is one of two iconic livestock mascots associated with Fort Sill. *(U.S. Army photo by SGT Dustin D. Biven / 75th Field Artillery Brigade)*

The 2023 submission deadlines for the

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Spring edition, Jan. 6
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