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On the Cover: Army Paladin M109A7 Artillery System belonging to Delta Battery, 1st Battalion, 5th FA Regiment, 1st Armored BCT, 1st Infantry Division, conceals itself in the tree line prior to a live fire exercise on a range at Grafenwoehr Training Area, Germany, Aug 6, 2019.
Photo by Sgt. Jeremiah Woods

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COL (P) Winston Brooks
Field Artillery School Commandant
Chief of the Field Artillery Branch

Welcome to the 54th Commandant of the U.S. Army Field Artillery School and Chief of the Field Artillery Colonel (P) Winston P. "Phil" Brooks

COL (P) Brooks latest assignment was as Deputy Commanding General (Maneuver) for the 1st Infantry Division. As the 54th Commandant of the U.S. Army Field Artillery School (USAFAS) and Chief of the Field Artillery (FA), he assumes responsibility of the USAFAS and FA branch as they rapidly continue to modernize and shift to fire support for large-scale ground combat operations.

COL (P) Brooks received his commission in the FA Corps from the University of Memphis in 1993. He earned a Master's Degree in Military Arts and Sciences from the Command and General Staff College at Fort Leavenworth, Kan.

COL (P) Brooks served in Baumholder, Germany, from 1994 to 1997 and deployed to Bosnia for Operation Joint Endeavor. Upon completion of the FA Captain's Career Course, he was assigned to Fort Benning, Ga., where he served as a human resources officer, fire support officer, and Commander from 1997 to 2001. He then served as an aviation brigade fire support officer, and trainer at the National Training Center in Fort Irwin, Calif., from 2001 to 2004.

COL (P) Brooks deployed to Iraq in support of Operation Iraqi Freedom three times where he served as the Executive Officer of the Commanding General, Civilian Police Assistance Training Team, Executive officer of the Commanding General, Multinational Division-Baghdad, a battalion operations officer, a brigade executive officer and as a Battalion Commander in Mosul, Iraq. He deployed to Afghanistan twice in support of Operation Enduring Freedom. He commanded battalions in both Iraq and Afghanistan. He also served as the Deputy Chief of Staff in Regional Command East in Bagram. He deployed in support of Atlantic Resolve in Eastern Europe between 2015 and 2017 as a Brigade Commander. In 2017, he served in the Pentagon as the Department of the Army's Chief of Contingency Operations and the Chief of Staff for the Army's Strategy, Plans and Policy Directorate.

While serving as the Deputy Commanding General (Maneuver) for the 1st Infantry Division, COL Brooks deployed to Eastern Europe, where he assumed the command of the 1st Infantry Division (Forward), United States Army Europe on June 3, 2019.

COL (P) Brooks' military schooling includes the FA Officer Basic and Advanced Courses, Airborne School, Combined Arms Services Staff College, the Senior Service College, and Joint Forces Staff College. His awards and decorations include three Legion of Merits, five Bronze Star Medals, the Defense Meritorious Service Medal, five Meritorious Service Medals, the Combat Action Badge, the Parachutist Badge, the Army Staff Identification Badge, and multiple overseas campaign and service ribbons.

COL (P) Brooks is married to Lori, of Fayetteville, Tenn.; they have two children Wes, a recent graduate of the University of Alabama, and Amelia, a sophomore at the University of Kentucky.

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Colonel C. A. Tavuchis
Commanding Officer
US Marine Corps Artillery Detachment,
Fort Sill, OK

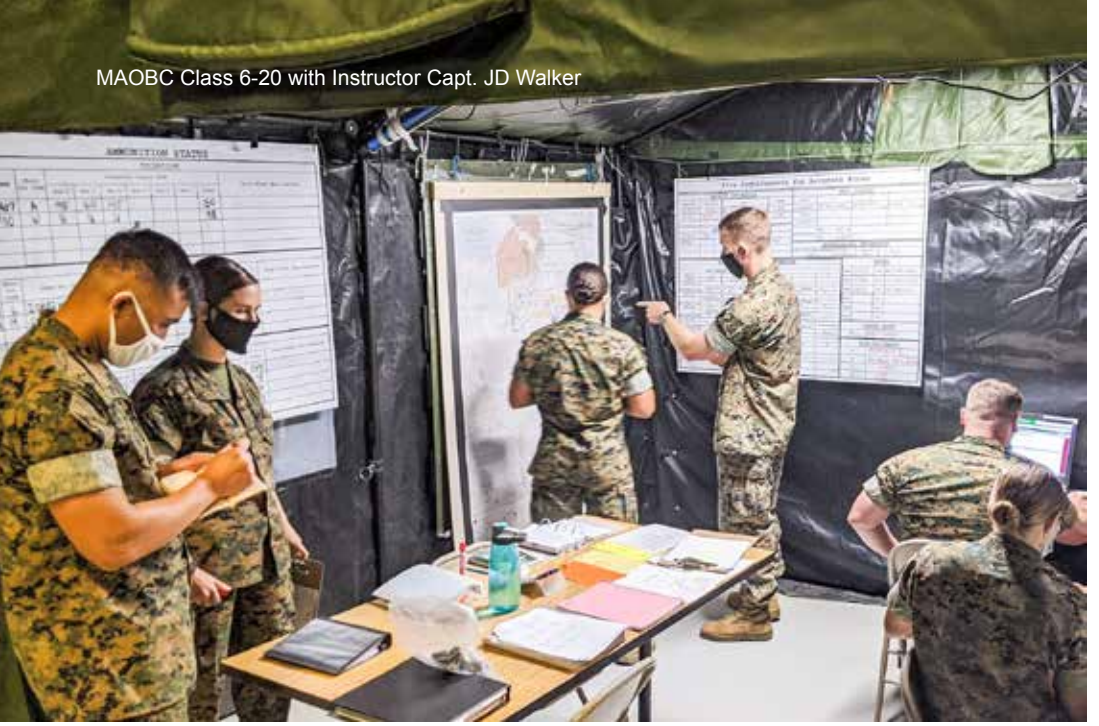
MarDet Learning Modernization

As we adjust to the new training and quality of life adjustments in the face of the ongoing COVID-19 pandemic, the Marine Detachment (MarDet) continues to progress in our work to meet the intent contained in the 38th CMC's Planning Guidance (CPG). The MarDet is diligently working to address the rapid changes to Marine artillery as our Corps positions for 21st century operations against increasingly formidable opponents. Force Design 2030 (FD 2030) envisions a significant change to our organization and represents the most profound pillar towards achieving CPG3 goals. However, the CPG also calls for a renewed focus on enhancing and promoting education and training. The Commanding General, Training and Education Command (TECOM), MajGen William F. Mullen III, took CMC's guidance and intent and published the "TECOM Campaign Plan, FY2020-2025" in April 2020. The TECOM Campaign Plan detailed the burning question, "are these the best means, methods, and tools for the student to learn this material?" Instructors such as SSgt Wesley Brown, Capt Jared Thompson, SSgt Richard Bramhall, and Maj Dan Beck formed this community of practice to share and discuss educational techniques and tools with one another and challenge long lines of effort required for Formal Learning Centers (FLC), such as the MarDet Fort Sill, to achieve the CMC's endstate.

As detailed in the last issue of the FAJ (Q2 issue), the MarDet continues to do its part toward evolving Marine artillery toward the CMC's vision (See "From the Home of Marine Artillery"). After a thorough review of the specified and implied tasks contained in the CPG that the community needs to address, the MarDet adapted and reorganized the staff to fully address and support the FLC's main effort: our instructors. The reorganization ensures the MaDet is equipped to effectively support and resource the efforts of our instructors to meet 21st Century Learning (21CL) goals. The new Operations & Learning Section serves to align the academic functions, staff processes, provide analysis and oversight. It will also serve to ensure our instructors continue to carry the momentum of modernization we gained in recent months.

During the summer and fall of 2019, a key group of instructors from across multiple programs of instruction (POIs) was directed to form a cell to develop solutions to a fundamental question: Are we using the best teaching means, methods, and tools to optimize the student learning experience and outcome? This group of supremely gifted, intelligent and engaged instructors formed a community of practice to share and discuss educational tools, techniques and procedures with the faculty across the MarDet and challenge long-standing and dearly held "traditional" Marine Corps instructional norms. What came to be known as the "Learning Modernization Cell" (LMC) grew from a small, intimate group to a MarDet-wide effort. Starting slowly, the expansion of this effort has grown to examine, discuss, and test – in real time, with real students and instructors – the best practices and methods of learning – for both students and instructors – how to deliver the material to the 21st century student. The results have been remarkable.

Learning modernization is no longer simply an intimate cell of instructors sharing best practices. It is now manifest in every classroom and during every period of instruction: firing charts are being taught using Interactive Multimedia Instructional tools (IMIs) and over distance learning platforms; pre-course assignments drive student engagement; quizzes, homework, video demonstrations, and even exams are being performed on



MAOBC Class 6-20 with Instructor Capt. JD Walker

From the Home of Marine Artillery - Continued

the Marine Corps' online teaching/learning tool, Moodle. Student snow carry nearly all of their course material in their pocket on a personal device or on an issued tablet. Moreover, the student doesn't need to physically be in the classroom. Whether the result of necessary social distancing or simply to provide after-hours POI extra instruction, instructors have learned to stream classes and field questions in real time through Google Classroom, Zoom, Adobe Connect, or simply record their class and upload it to MarineNet Video Service or Moodle. The profession of arms, in general, and artillery, in particular, is a highly technical, reference-based enterprise and, using and evolving these tools and platforms, the MarDet effectively extended that concept from the classroom at Fort Sill directly into the FMF.

The MarDet's evolution into the information age is not simply about technology or convenience. The means and methods of instruction that ensure a student-centric learning environment are fundamental to creating a more capable, adaptable and decisive Marine. As outlined in MCDP-7 "Learning," the Marine Corps must foster the sustained ambition for learning at all ranks in order to prevent institutional stagnation. There are specific TECOM polices that govern how instruction is delivered and evaluated, but MajGen Mullen has acknowledged – and demanded - FLCs to experiment beyond these bounds to measure the effectiveness of new methods.

Another example of our forward progress is the Transformation Enhancement Program (TEP). The TEP is intended to sustain the enthusiasm developed at Basic Training and Marine Combat Training (MCT) for artillery Marines who are waiting to begin their POI. The program was developed and is run by instructors outside of normal duty hours. It is designed to lean into fundamental topics and concepts that form the foundation for what our Marines will learn in their MOS schools. The TEP reinforces fundamental warfighting principles and the Corps' fundamental ethos, while binding these concepts to a broad understanding of how the artillery team works together to accomplish its mission.

Programs such as TEP and tools like Moodle are only a handful of the projects we are instituting and evaluating by decisive action of individual instructors. Through their initiative and drive, these Marines are making a profound and definitive impact "how we teach" and sets the example for other instructors to invest in their personal professional development as educators and seek new training opportunities and experiment with new methods. Remarkably, many of our instructor programs - such as the Marine Corps Master Instructor Model (MInD) - are not new, there is a renewed focus on building the basics of instruction and has driven a number of innovations in MarDet classrooms. We humbly acknowledge that subject matter expertise does not immediately translate into instructional ability without significant and deliberate effort. Happily, these are underway now and continue to meet and exceed our own expectations as we contine to move toward the CMC's intent.

Ultimately, the MarDet instructor cadre and staff fully comprehend the critical challenge we face in the near future is not "how we teach" but "what we teach." By adapting the means and methods we use to meet the student in the 21CL environment, we will set the conditions for implementing new POIs that accommodate the clear and present demand of our adaptive, creative, and decisive students – our Marines.

The MarDet Fort Sill, OK – the Home of Marine Artillery – is thrilled to be leading the movement to adapt new methods of learning and teaching. Sadly, some of these methods have been around for quite some time. As a wise Marine once said, "There is nothing new under the sun" but that won't stop us from continuing to learn what we can do better and underwriting the initiative of our instructors and our staff to experiment and adapt.

As I wrote in the last issue, there is no better time to be a member of the Marine artillery and fire support community. Our instructors are proving this every day!

Semper Fidelis!

Moneyball Fire Support:

Measuring Ourselves to Win the BCT Fight with Fires"

COL Neil Snyder, COL Thomas Caldwell, LTC David Chapman, COL Ian Palmer,
COL Seth Knazovich, LTC Daniel Von Benken[1]

"Know the enemy and know yourself; in a hundred battles you will never be in peril. When you are ignorant of the enemy, but know yourself, your chances of winning or losing are equal. If ignorant both of your enemy and yourself, you are certain in every battle to be in peril." – Sun Tzu The Art of War

Is This Us?

Sun Tzu teaches us that winning requires that we know ourselves and our enemy. This maxim is central to the art and science of fire support: winning with fires in the Brigade Combat Team (BCT) fight requires fire supporters to deliver lethal effects, to find high payoff targets and then attack them quickly and accurately. Lethality requires us to discipline our fires on targets that will make a difference for maneuver forces.[2]

These basic fire support principles are drawn from our doctrine, but articulated in simpler terms. We must engage the right targets because ammunition is precious and commanders provide guidance for fire support: commanders distribute their precious combat power in time, space, and across echelons to affect a combined arms battle. We must engage quickly enough to meet our maneuver commanders' guidance for fire support, because a dynamic enemy will react, displace, and engage us with counterfire. Slow fire mission processing means we risk expending ammunition to no effect, or worse, to the risk of our forces by keeping fire support assets stationary. Finally, if we are engaging the right targets quickly, then accuracy will matter: we must be sufficiently precise and deliver fires with sufficient volume to have effects – all while executing in a way that preserves the legitimacy of our actions.

We have to know the enemy to attack the right targets with the right methods of attack, but how well do we know ourselves? Do fire supporters in our Brigade Combat Teams (BCTs) have an accurate self-assessment of whether we are doing the right things to win with fires in the BCT's fight?

This article offers an objective reflection on the state of our collective ability to execute two basic tasks of fire support, engaging the right targets with sufficient speed, by presenting and analyzing data gathered by the "Wolf" Fire Support Team at the National Training Center (NTC) during the force-on-force portions of 13 NTC rotations during Fiscal Year (FY) 19 and 20.[3] The data shows us that we, as a fire support community, continue to struggle to discipline ourselves in the selection of targets and to attack targets quickly enough to be a relevant factor in the BCT fight.[4] Perhaps more importantly, the data suggests that we do not "know ourselves," that we are not actively evaluating how we are fighting while we are fighting, so that we can focus fires and maximize effects with our fire support resources. The data suggests that winning with fires in the BCT fight will require all fire supporters to recognize these trends in our community (i.e., to "know ourselves"), to implement techniques, tactics, and procedures (TTPs) to help us see ourselves in "real time," and to adapt how we fight with fires. While the data, drawn from force-on-force periods during NTC rotations, cannot speak to how accurately we performed during the selected NTC rotations, the trends are sufficiently consistent across multiple rotations to show that accuracy may not even be a relevant challenge today because we are too slow and may be engaging the "wrong" targets.

Winning with Fires: We Need to Get "On Base"

IIf we want to engage the right targets faster, we might benefit by borrowing a concept from baseball. In Moneyball, a Michael Lewis book that Aaron Sorkin made into a movie, Oakland A's general manager Billy Beane is lionized for taking a data-driven approach to running the A's, an approach that took the A's to the playoffs. The key idea was that a higher rate of getting "on-base" would ultimately produce wins.[5] What is the equivalent of getting "on base" for fire support? We argue that the answer is simple: getting "on base" for fire support is attacking high payoff targets quickly. Building on the insights found in Moneyball, this article presents data showing us that we need to increase the discipline of our fire support. We argue that we need to focus fires on the right targets and to only execute targets that we are executing fast enough for maneuver. We advance several simple cognitive adjustments to how we fight with fires, adjustments that require no new equipment or changes to doctrine. These adjustments, in our view, will enable us to "get on base." Right now, our Artillery is at bat and the bases are empty.

This is foremost an empirical article. That is nerdspeak for attempting an unbiased analysis of our record of performance at the NTC, the "World Series" of training for our

fire supporters. We are going to present data on BCT-level fire support in two sections. First, we ask whether we are engaging the right targets. We analyze results from the NTC and the, data reveals that we are either not engaging the right targets or, worse, that we do not even know what we are attacking with fires. With this objective data in hand, we offer a simple, pre-existing solution drawn from our doctrine: focusing high payoff targets on threat systems (not target categories), transmitting accurate target descriptions in calls for fire, and screening calls for fire with the commander's high payoff target list (HPTL), target selection standards (TSS), and attack guidance matrix (AGM).[6] Regardless of the technology of our fire support systems (sensors, communications, and delivery platforms), the data reveals that the central challenge for fire support today is cognitive: achieving synergy of the fire support system through disciplined use of the HTPL/TSS/AGM. As the data reveals, this fire support discipline appears to be easier said than done.

Second, we ask whether we are engaging targets fast enough; the data clearly shows that we are not. We present some options to help us get fast enough to be relevant in the BCT fight: the BCT "shot clock" (a fire support tool to help us see ourselves while in action) and using priority of fire to align how we execute with the standards that we train to at home station (where units consistently use fire support tactics like the designated observer control method). Finally, we close with a reflection on how we can get closer to Moneyball. By using data in real time to assess how we are fighting with fires, we can make informed adaptations to our fire support tactics and win with fires. Because, "Winning Matters!"

This Is Us

This article is a reflective work on how we are doing as a fire support community and it offers an objective, critical look at our performance; it is not an academic exercise of retelling our doctrine or preaching to the community about fire support. The authors have all experienced significant challenges executing fire support and have scars from our efforts. We accept these defeats with humility, recognize a need to get more lethal in the BCT fight, and are collectively seeking a better way. We are part of the fire support community and hope to contribute by making us all more lethal with fires. This article is also not a plea for material solutions or new systems to solve our fire support challenges; nor is this article an argument about the Army Modernization Strategy and the future for fire support systems. The purpose of this article is how to execute better with the equipment we have by using tactics consistent with our current doctrine. Our greatest gains in performance are likely to come from cognitive solutions: from learning how to fight better, from knowing ourselves, and adapting how we fight with fires.

Much of what readers see in the pages of our professional journals like the Field Artillery Journal is forward-looking: focused on the deep fight, technological innovation, or our roles in the future MDO fight. Our community leans forward with good purpose: the fire support community today is engaged in renaissance. We are fielding new weapons systems such as the Extended Range Cannon Artillery (ERCA) and the Strategic Long-Range Cannon (SLRC), developing new munitions for existing systems (such as the Precision Strike Munition or PRSM), and improving existing systems (such as the Paladin Improvement Program or PIM). We are even seeing movement towards integration of highly technical means, such as applications of artificial intelligence to improve our accuracy or the integration of optionally-manned or unmanned systems. The fire support community is moving towards addressing our ability to fight great power competitors like China and Russia, fights that will require much greater range and speed of action because of our adversaries' overmatch and layered defense.[7] The platforms, munitions, and networks that we fight with will undoubtedly shape how we fight across multiple domains and affect our ability to converge effects at greater distances than we do today. However, the purpose of this article is to provide a reflection on how we fight with fires in the BCT fight today, to help us see ourselves as a fire support community, and to offer some contemporary observations about the practice of fire support among BCTs today to help fire supporters increase their lethality in the BCT fight. Said differently, material solutions alone cannot ensure that we win with fires: we must learn from training and recent performances to make cognitive adaptations, resulting in changes to how we fight with the systems that we have. As General McConville says, "Winning matters" and "people are the Army." Winning with fires starts with people, how we think, and our processes.[8]

Target Descriptions: What Are We Shooting At?

During 13 NTC Rotations across FY19 and FY20, Direct Support (DS) Field Artillery Battalions executed nearly 3,000 fire missions from Paladin or M777A2-based units.[9] On average, Battalions executed over 200 targets per rotation, but there were enormous variations between units of the same weapon type, between units of different weapon types, and by component (i.e., COMPO 1 or 2). Table 1 summarizes this data, gathered by "Wolf" 13J trainers at the Battery Fire Direction Center (FDC) level, and analyzed by the authors. This data consists of all fire missions actually executed by fire supporters during the rotation: the data excludes targets denied by commanders or fire support elements, targets cancelled prior to transmission to firing units, or targets never transmitted from observers because data on those cancelled/denied missions was unavailable.

Given that the data only reflects missions actually transmitted to FDCs and howitzers for attack, our expectation or hypothesis is that the target descriptions should re-

Component	Weapon System	Fire Missions
AC	M777	107
AC	M109	586
AC	M109	204
AC	M777	248
AC	M109	239
AC	M109	217
AC	M109	182
NG	M109	222
NG	M109	108
AC	M777	167
AC	M109	264
AC	M777	222
AC	M109	190
Total Fire Missions		2956
Average per Rotation		227.4

Table 1: Fire Missions by Rotation and Weapon System (13 NTC Rotations, FY19-20)

Target Category	Total Fire Missions	Percentage
UNKNOWN	2261	76.5
AR/MECH	170	5.8
SMOKE	164	5.5
FA/MRL/MTR	119	4
AD	54	1.8
FASCAM	52	1.8
DISMOUNTS	49	1.7
MTZ	30	1
RADAR	25	0.8
C2/EW	10	0.3
ATGM	7	0.2
EXCALIBER	7	0.2
AR MECH	2	0.1
AVN	2	0.1
CLV	1	0
EN	1	0
FA	1	0
STRUCTURE/FACILITY	1	0

Table 2: Fire Missions by Target Category (13 NTC Rotations, FY19-20)

flect the target categories that commanders would normally select for high payoff. It would be problematic from a fire support perspective, and indicate a lack of "focus of fires," if units executed missions unlikely to meet commander's guidance for fires. In the data, we are looking for the percentage of targets that could not meet commanders' guidance under normal conditions. If units are focusing fires and applying target selection standards, executed missions should reflect the set of priorities we might expect for fire supporters in the BCT fight: either supporting the decisive operation in the close fight to converge the effects of direct and indirect fires or to set conditions for the next close fight by shaping targets deep in the BCT's area of operations.

Table 2 presents the overall distribution of target categories prosecuted during the 13 NTC rotations. Observers transmitted 220 different target descriptions in calls for fire, as reflected in digital transmissions over the Advanced Field Artillery Tactical Data System (AFATDS) or recorded by "Wolf" trainers for voice transmissions. To make those manageable, the data is consolidated into 18 different target categories (e.g., "Two T90s in the open" is categorized as "AR/MECH").[10] Though some categories are non-standard for simplicity based on the source data (e.g., Excalibur precision targets are coded as Excalibur targets and not by a threat description such "Brigade TOC"), what is striking from the data is that the overwhelming majority of executed missions were fired against targets lacking a description. The target description was either transmitted as "UNK" or omitted sufficient detail to make a reasonable conclusion about the nature of the target (such as "Terrain Feature" or "Assembly Area").[11]

The more interesting question is why did three-quarters of all executed fire missions lack a target description? One possibility is that observers acquired valid, important high payoff targets and failed to include a useful target description in either their digital or voice call-for-fire. That is either a training issue (i.e., "didn't know"), a discipline issue (i.e., "didn't do"), or both. Another possibility is that the data is incorrect, that there are systematic data recording issues. This possibility is unlikely, given the high detail in the fire mission records for these NTC rotations by the "Wolf" team, and that, in most cases, target descriptions are explicitly extracted from AFATDS.[12] A third possibility is that the initiating observer (or radar operator, for counterfire missions) was uncertain about the nature of the observed threat and acquired a "valid" target but did not know exactly what the target was (e.g., could tell at a distance that there was an assembly area forming, but could not determine whether it was a motorized rifle unit or an armored formation). At first, this possibility might seem reassuring, but instead, as we will argue momentarily, transmitting an ambiguous target description just passes the problem of target selection from the forward observer to the relevant Fire Support Element (FSE) or supported commander facing the decision of whether to attack the target.

The raw data does not tell us why the majority of target descriptions are ambiguous, but it does point to a much larger problem: these "unknown" target descriptions were transmitted through Battalion FSEs, Brigade FSEs, and the direct support Field Artillery (FA) Battalion's FDC without ever having been "stopped" for not warranting the use of the BCT Commander's premier weapon systems. These missions made it to the FDC without anyone stopping to ask, "what are we shooting at…and why?"

The prevalence of "unknown" target descriptions means that fire supporters are probably not deciding well. Observers may be acquiring valid/important targets, but how would FSEs or commanders know by these target descriptions? We might reasonably expect some small percentage of "unknown" targets to be prosecuted, based on commanders' demand for fires or a litany of tactical factors. However, the large percentage of missions without target descriptions suggests that we are not disciplined in our "focus of fires," a term used frequently during fire support rehearsals but, unfortunately, not reflected in our actions. From a data perspective, this is probably a conservative or underestimate of the problem (because we omitted denied targets).

Some readers may question whether these overall target category trends mask or conceal unit-to-unit variation because the data is aggregated across many rotations. Maybe some units do very well at focusing fires on important targets, whereas others do not. Figure 1 shows the distribution of target categories by rotation and the trend is uniform: most units have a similar lack of focus of fires. When examined individually, not a single unit executed more than 40% of their missions against "known"

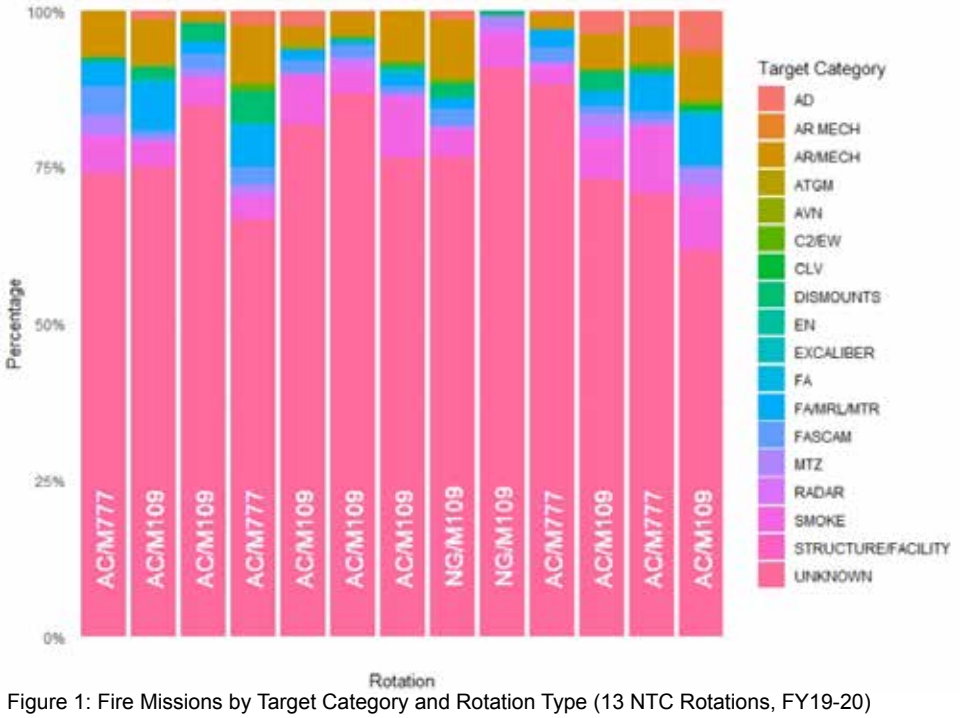


Figure 1: Fire Missions by Target Category and Rotation Type (13 NTC Rotations, FY19-20)

targets. This data raises profound questions for the fire support community. First, how can we focus fires if we do not know what our targets are? Second, the more troubling question is how do we know that we are being discriminant and abiding applicable laws of war and rules of engagement?

Our doctrine provides three solutions. First, units training at the NTC frequently develop HPTLs and TSS during MDMP, but these lists typically prioritize or screen by threat target categories (e.g., "Air Defense") rather than threat systems (e.g., "SA6"). While reasonable in concept, generic categories make it more difficult to properly focus fires supporting the maneuver commander's intent (e.g., commander's want to destroy threat air defense radars, but a man-portable air defense system (MANPAD) will pass the screen if a generic HPTL is used). We recommend focusing the HPTL/TSS/AGM on specific threat systems, rather than categories, a cognitive shift that will demand increased discipline in execution. This is a call for focus in planning. Second, commanders and fire supporters at echelon (Company/Troop, Battalion, and Brigade) must demand coherent target descriptions in calls for fire (CFFs). This is a call for focus in execution by both observers and responsible leaders. Finally, in what is perhaps the most controversial argument, fire supporters need to be disciplined in focusing fires on the threat systems that maneuver commander want destroyed, neutralized, or suppressed. We recommend that units rigorously apply the HPTL/TSS/AGM and decline targets that do not meet the commander's guidance for fires. This ensures efficiency and that fires are focused on the right targets to support the scheme of fires in a combined arms operation.[13]

Speed: Are We Engaging Fast Enough to Have Effects?

During NTC rotations, "Wolf" trainers actively record fire mission times at the battery level, per TC 3-09.8 timing standards. While the battery is only one part of the kill chain, the timing data gives us insight to how quickly we are firing without introducing complicating variables likely to have inconsistent effects on our ability to deliver responsive fires (e.g., tactical maneuvering by observers to acquire targets or clearance of fire procedures). Similar to the target category analysis presented earlier, this section presents fire mission times that are conservative estimates for how long it takes us to deliver fires (actual times are likely much longer, because total time includes more steps in the "kill chain" than battery/platoon time alone). The bottom line is that the data suggests there are too many steps in our "kill chain" and that we are not fighting like we train.[14]

Figure 2 shows the distribution of fire mission times in seconds for every fire mission during 13 NTC rotations. Average fire mission times were approximately 6 minutes and 50 seconds, but the shape of the distribution is telling: the data is skewed right, with the mean increased because of the number of fire missions with very long processing times. Readers might be concerned that this average time is somewhat meaningless, because all types of missions are grouped together and some missions, like FASCAM or Excalibur, can expect longer processing times. To address this, Figure 3 shows the distribution for only High Explosive (HE) missions. Here, the mean is actually higher, at over 7 minutes.[15] This means that the average time executed at the NTC is over four times greater than the standard. Some readers might argue that standards do not account for the conditions experienced by rotational units at the NTC. However, the data is an objective measure of how responsive fire support has been for maneuver commanders during recent rotations at the NTC.

Figure 4 shows just counterfire missions, which again has a mean of just under 7 minutes. The data shows us that fire mission times were fairly similar, regardless of the type. Finally, the question again might be whether some rotations (or units) are faster than others. Figure 5 shows the average fire mission time by rotation and by unit type (by component and weapons system). Though there are some rotation-to-rotation variations, the average mission times were never better than 5 minutes, 27 seconds, suggestive that all units at the NTC were challenged to deliver responsive fires.

This timing data raises an obvious question: if fire missions are taking a long time, why do units not cancel

missions after designated standard cutoff time? Threat targets displace, observer positions become tactically vulnerable, and guns are left idle. Given the risk to force from counterfire and the risk of tactically ineffective fires (that squander ammunition, thus passing more tactical risk onto sustainment elements), we argue that it must be a deliberate decision to continue the process of executing a fire mission once a unit standard has been exceeded. Figure 6 presents the results of a thought experiment: estimating the average mission time (for all mission types) at the NTC if all fire missions were cancelled after six minutes of "waiting on the guns." This "6 minute" discipline alone, with no other changes to TTPs, reduces the average mission time to just over four minutes. While a four-minute average is still more than the standard for most mission types, it is nonetheless a dramatic improvement.

The cliché is that doing the same thing over and over, and expecting the same result, is the definition of insanity. Many fire supporters have experienced similarly slow fire mission times at the NTC. We cannot reasonably expect to do the same things and get faster results at the NTC. Instead we must ask ourselves what we can do differently to solve the problem.

First, we recommend that units employ a BCT "shot clock," actively tracking the elapsed time since the observer's initial call for fire. The FSE in the supported unit should maintain a track of how long every "in execution" mission is taking and regularly announce elapsed time (e.g., "attention in the TOC" at prescribed time intervals). FSEs at echelon, along with the FA TOC, should actively track mission times with a shot clock and track average fire mission times by firing unit. The "shot clock" can be operationalized in different ways, using analog solutions or embedded functions of the AFATDS. "Knowing yourself" can enable disciplined execution and accounts for realistic fire mission processing times in planning. Missions exceeding a designated unit standard or, better yet, exceed-

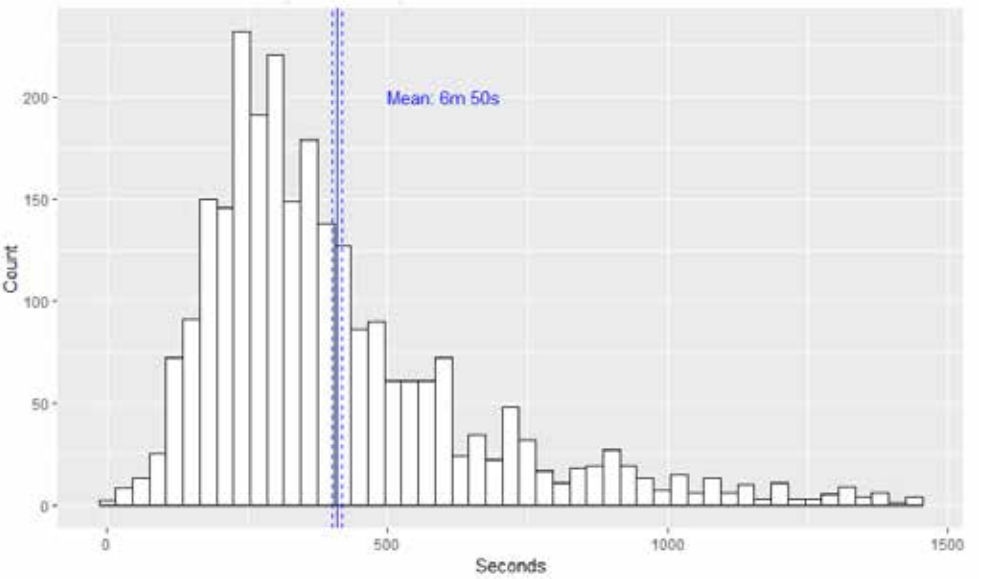


Figure 2: Distribution of Fire Mission Times (13 NTC Rotations, FY19-20)

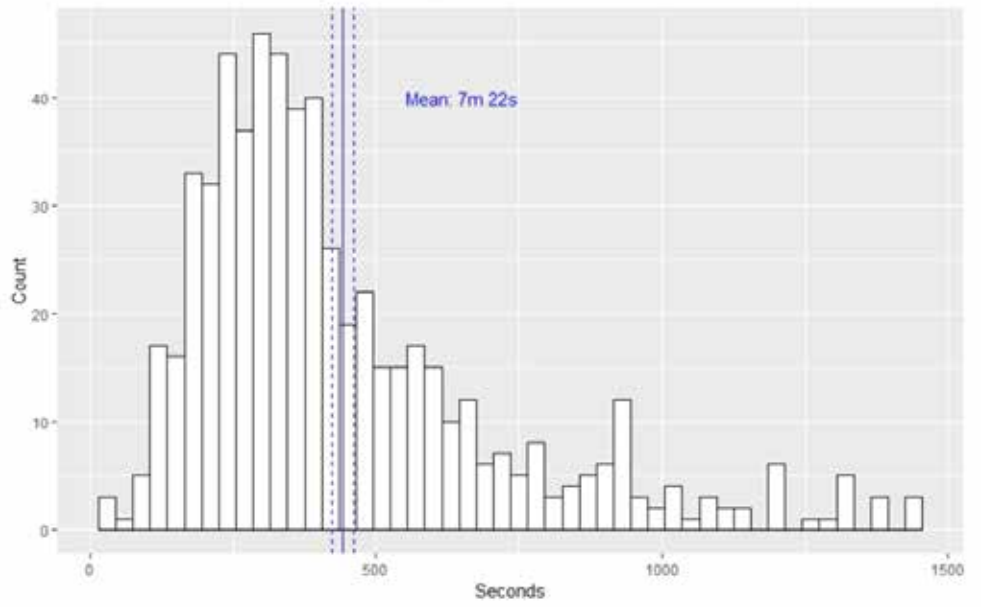


Figure 3: Distribution of High Explosive (HE) Fire Mission Times (13 NTC Rotations, FY19-20)

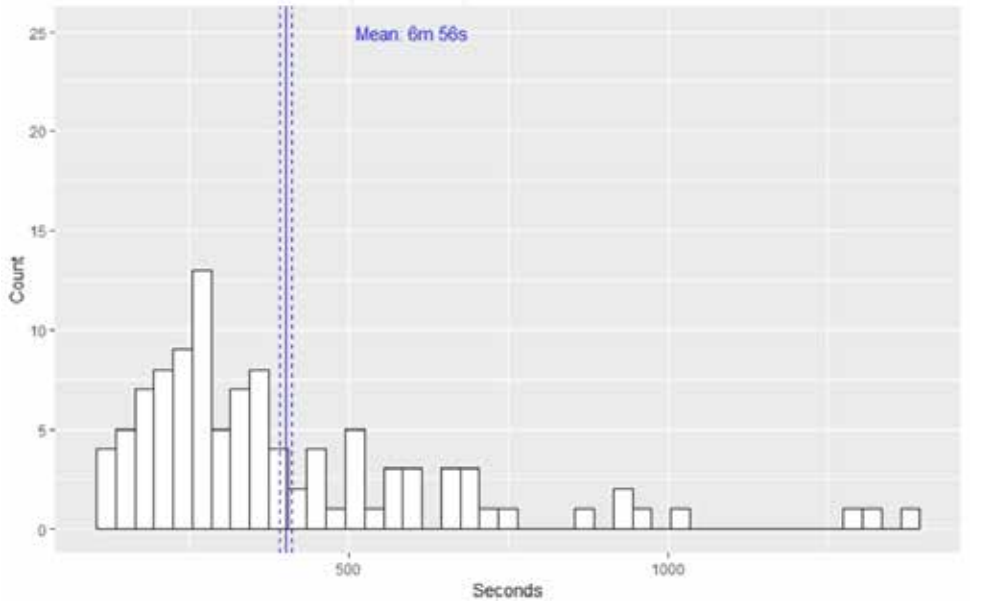


Figure 4: Distribution of Counterfire Fire Mission Times (13 NTC Rotations, FY19-20)

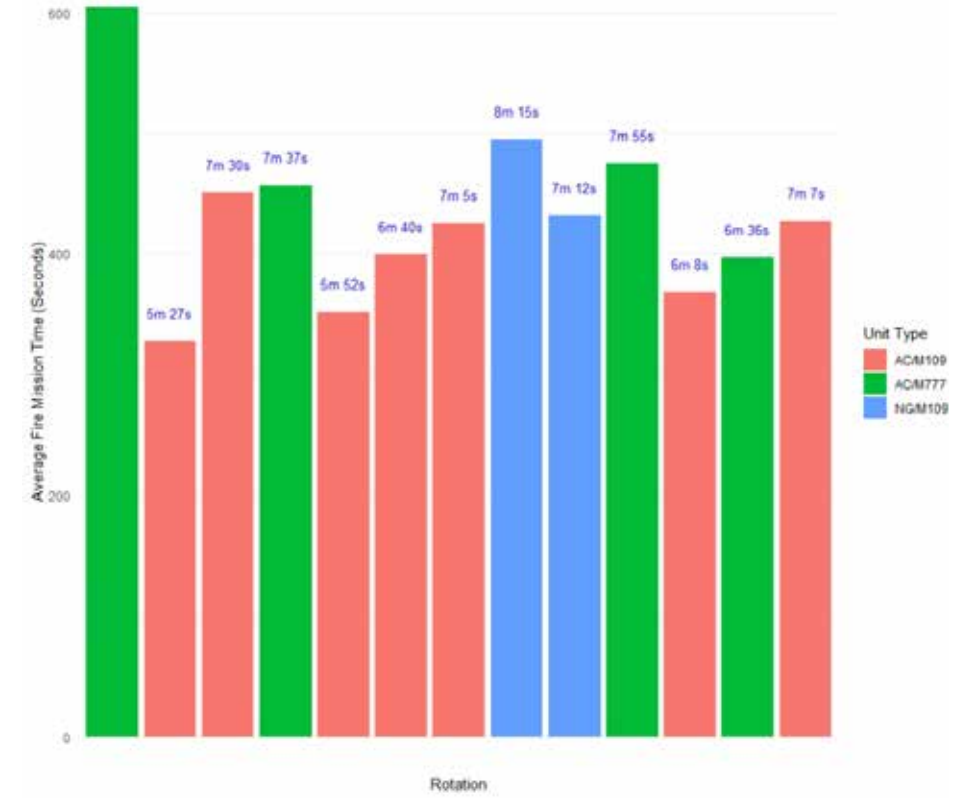


Figure 5: Average Fire Mission Times by Rotation (13 NTC Rotations, FY19-20)

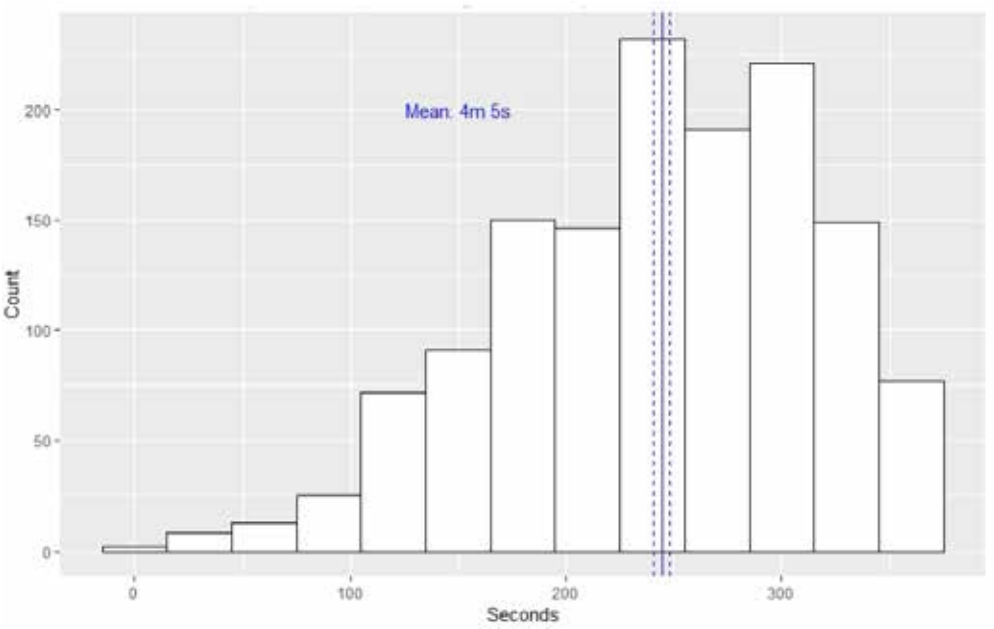


Figure 6: Fire Mission Times Assuming a 6 Minute Cutoff (13 NTC Rotations, FY19-20)

ing thresholds for target displacement established during planning and "baked" into the HPTL/TSS/AGM, should require an active decision by a pre-designated authority (a BCT Commander's delegation to the FSCOORD or the BCT FSO) to continue mission.

Use of the "shot clock," and exercising decisions to continue "lagging" missions, should be rehearsed in both fire support and field artillery technical rehearsals. Unless the target is still being observed, latent targets should not be fired to minimize our units' firing signatures, to prevent us from missing displaced targets, and to prevent us from expending ammunition transported over contested ground. The FSCOORD, FSOs at echelon, and the Master Gunner Team at the FA TOC should have ready access to metrics: which guns, platoons, or batteries are shooting quickly or not? The "shot clock" would reflect how well we get on base. While some readers will be concerned that introducing a human decision-maker into the kill-chain could slow mission processing, that concern runs counter to the empirics: we already have tools available to tell us that missions are lagging, but units are not taking action to correct the problem. Instead of watching lagged missions build up in the BCT FSE's fire mission buffer (as is often the case with NTC rotational units face a simultaneous close and deep fight), we should use the "shot clock" and the HPTL focus fires and to attack targets quickly – otherwise we risk spending ammunition to no effect.

Second, we recognize that the fire mission times recorded at the NTC are for Platoons: FDCs and howitzers. This means the time estimates under-estimate how long it is taking us to attack targets, let alone the time it is taking us to mass fires or accomplish more complex fire support tasks. So, let's dig into the process more to understand where we might gain efficiency. According to observations by "Wolf" trainers, most units training at the NTC executed centralized control over observers. For a variety of reasons (tactical, risk-related, etc…), calls for fire originate with individual observers, are routed through Battalion and Brigade FSEs to the FA Battalion FDC, and then down to the guns. However, the time standards presented in the TC 3-09.8 only reflect the observer time, the FA Battalion FDC, and at the Platoon (FDC and Howitzers). This implicitly reflects a time standard as if units are executing what is known as option 1 "decentralized" or option 2 "designated" for observer control in our doctrine.[16] More importantly, the decentralized or designated options are exactly how many units train during home station - combined arms live fire exercises (CALFEXs) or fire support coordination exercises (FSCXs) - with supported maneuver. These home station exercises often give maneuver leaders high confidence in the responsiveness of field artillery fires; a confidence later shattered by slow mis-

sion times during NTC rotations. Why should we expect centralized execution of fire support to be fast when we train and evaluate ourselves against decentralized standards during collective gunnery tables?

We recommend using priority of fire as a unifying principle for planning and execution. In our doctrine, priority of fire simply means one unit gets fires first when two are competing for the same asset. However, maneuver commanders frequently understand priority of fire to mean that they will get responsive fire support. We advocate for using the designated observer control method. Priority of fire should mean that observers designated to be a primary observer have the authority to call pre-planned targets, that command posts at echelon have cleared airspace pro-actively in anticipation of a designated observer calling a target (e.g. aerial platforms deconflicted, gun-target-lines cleared, and risk accepted at the appropriate echelon for at-risk aerial platforms), that the firing units have been positioned sufficiently forward to keep artillery maximum ordinates (MAXORDs) below the coordinating altitude, and we have planned and placed communications assets so that designated observers can call pre-planned targets directly to the FA Battalion FDC. Priority of fire, as a unifying principle, requires anticipating the maneuver commander's need and should encompass the "4 A's:" observer authority, cleared airspace, a stationary firing asset laid on the target, and the communications (antennas) to connect the kill chain.

This is simple in concept, but requires common understanding among maneuver leaders, fire supporters, and airspace users in a BCT area of operations. As the "Wolf" fire support trainers like to remind us, fire support is a BCT problem. The problem statement is common to all BCTs at the NTC: how do BCTs establish and maintain a permissive environment for fire support, at echelon and across battle transitions, within a Decisive Action Training Environment (DATE), to shape the BCT deep fight and mass effects in the close fight? Priority of fire, as a unifying principle encompassing authority, airspace, assets, and antennas (communications) is one highly effective tool to ensure that the BCT's area of operations is permissive for fires.

Most importantly, this is a cognitive adjustment to how we fight: in this instance, we need to fight like we train! This recommendation comes with an important warning: the recommendation does not come with empirical support that decentralized fire support is always faster. We only have data on platoon fire mission times and rely on the assumption that most missions at the NTC are executed with centralized control. While the data presented here cannot speak to whether centralized execution of fire is too slow, the data does show that we are already too slow; we as a fire support community should aggressively pursue doctrinal means to attack the right targets quickly. Using priority of fire as a unifying principle and decentralized execution is one possible solution that units can explore.

Conclusion

This article reveals trends in fire support performance at the NTC: readers who thought they were alone in building up thick scar tissue in "the box" have good company – including the authors. We argued here that the solution to our challenges come from adjusting how we fight by using data about ourselves to get better. Think of this way: how many readers methodically time and record every mile run, every deadlift weight achieved, and every repetition of the hand-release push-up as we train for the Army Physical Fitness Test (APFT) or the Army Combat Fitness Test (ACFT)… as a matter of routine? But do you track your unit's most important function – attacking the right targets quickly – with the same discipline?

We have solutions in our doctrine and a simple set of tools: using the HPTL/TSS/AGM with discipline, fighting with a "shot clock," and using priority of fire as a unifying principle that connects multiple warfighting functions and bridges how we train at home with how we fight at the NTC. For us, winning with fires in the BCT fight at the NTC requires making adaptations within ourselves: by using data about ourselves to generate advantage, by taking a "Moneyball" approach to fire support. Get on base by attacking HPTs quickly!

Epilogue

Soldiers do what leaders check and, in the view of these authors, units perform what leaders measure. That is the spirit of "Moneyball" fire support: instead of waiting for external evaluators to give feedback, we can monitor our own performance metrics and leaders can apply ingenuity to solve their own tactical challenges. You can be your own Billy Beane or, better yet, be your own Theo Epstein (who borrowed Beane's strategy and actually won World Series titles with both the Red Sox and the Cubs)! As a fire support community, we have a broader set of data needs that commonly tracked in current operations (CUOPS) sections of Battalion and Brigade command posts (CPs). Maneuver can often rely on simple metrics: what is the combat slant and where is the front-line of own troops (FLOT)? Fire supporters, however, may benefit from routinely tracking - and informing leaders at echelon – another set of metrics. Tracking and measuring ourselves is already built into our doctrine: measurement is central to the "A" or Assess of the Targeting Process (D3A or Decide, Detect, Deliver, and Assess). Knowing ourselves is essential to Assessment, which should be the hallmark of the fires kill chain: the threat environment requires us to win the first fight, and we do that by making sure we're attacking the right targets quickly for our BCTs.

We have already discussed two data-driven approaches to fire support: tracking target descriptions (what percentage meets the HPTL/TSS/AGM) and the "shot clock."

But what else can and should we actively track about ourselves? We often rely on unit Master Gunners to track section occupation times during Table VI, or Platoon O/C's to track platoon occupation times during table XII. But we can extend the concept of "Moneyball fire support" to other aspects of fire support that get far less attention than the Artillery Tables and maneuver Gunnery. Should we track how quickly units are occupying, displacing, or re-establishing firing capability during force-on-force training or combat operations? Don't Battery and Battalion Command teams need to know how quickly their Sections and Platoons are executing? Can we increase the rigor, speed, and precision of our retrains operations and our Radar section operations? And what about the staff, should commanders know how long it takes a staff to execute their key battle drills like producing a Field Artillery Support Plan (MDMP) through the "Artillerized" Military Decision-Making Process (MDMP), executing the FA Technical Rehearsal, or the FA Tactical Rehearsal? What about F Company's rearm and refuel operations?

You measure your runs and your standing power throws along with your performance on the other ACFT events, the sum of which is your readiness for combat. Are we accurately measuring the right individual components of how we fight at echelon to assess collective proficiency, as envisioned in the latest version of our training and readiness doctrine? How do you fight to find areas for improvement within your team or formation? In closing, we implore fire supporters at echelon to figure out what their critical collective tasks are and to establish standard operation procedures so that they measure themselves routinely on how quickly they are performing those tasks. Win with "Moneyball" fires!

Photo courtesy of Sony Pictures

1. The co-authors express a special thanks to Captain Carlos Trujillo, Fire Support Analyst for the "Wolf" Fire Support Team at the National Training Center (NTC) for providing fire support data from recent NTC rotations.
2. For broader context, we encourage readers to review the US Army Combined Arms Center Large Scale Combat Operations Book set (https://www.armyupress.army.mil/Books/Large-Scale-Combat-Operations-Book-Set/) and U.S. Army Training and Doctrine Command (TRADOC) Pamphlet 525-3-1, The U.S. Army in Multi-Domain Operations 2028 (https://www.tradoc.army.mil/Portals/14/Documents/MDO/TP525-3-1_30Nov2018.pdf).
3. Comprehensive data was only available for a limited number of NTC rotations. Specific rotation numbers and unit names are omitted to preserve unit anonymity. While the authors would have preferred to have analyzed fire support trends from all rotations at the NTC since Decisive Action Rotations were instituted, data availability limited options for analysis. Specific questions on data, analysis techniques, or related questions should be directed to the corresponding author.
4. The analysis presented focuses primarily on assessments of unit performance at the NTC. While the data focuses on performance, the argument (implicitly) is that continued poor performance will also affect unit effectiveness.
5. Moneyball: The Art of Winning an Unfair Game, was included on "Bookshelf" of the former Fires Center of Excellence (FCOE) Commander, Major General Wilson Shoffner (https://sill-www.army.mil/assets/doc/25%20July%202018_CG%20Reading%20List.pdf).
6. The analysis presented here focuses on unit performance and not on the quality of fire support planning: we are focused here on fire support execution, though we recognize and emphasize to readers that quality fire support planning is necessary for success. It is not enough to be disciplined with the HPTL/TSS/AGM if we have not gotten the fire support plan "right" in the first place. (implicitly) is that continued poor performance will also affect unit effectiveness.
7. TRADOC Pamphlet 525-3-1, pp. vii – viii.
8. On General McConville's guidance to the force: https://www.army.mil/article/225377/new_chief_of_staff_taking_care_of_people_key_to_winning_the_fight.
9. Data was collected from the "Wolf" Fire Support Team on 24 February, 2020, and analyzed between 25 and 26 February, 2020.
10. Targets were grouped by categories based on a matching algorithm developed by the authors and details are available upon request to the corresponding author.
11. Readers may counter by arguing that it is better that units are fighting with fires than not (i.e., the reader would rather see the units attacking targets than not, even if those targets are poorly described or not per the established HPTL/TSS/AGM). In our view, regardless of whether the units are "fighting the plan" or adapting to the threat, the lack of target descriptions reflects poor fire support discipline in execution: we are not being conscientious about what we are engaging and when.
12. Ultimately, if the entirety of the data gathered at the NTC was gathered in error (e.g., with "unknown" target descriptions simply reflecting a systematic failure to record target descriptions by the Wolf analysis team, a possibility that we as an author team dismiss), the interpretation here would be the same: units would be training without relevant, systematic feedback on whether they were attacking the "right" targets or not.
13. Some readers might recall, anecdotally, from their experiences at the NTC that volume of fires did not exceed the demand from maneuver leaders and that demand did not exceed supply (i.e., the ability of units to sustain the expenditure of ammunition). There is certainly an arithmetic relationship between demand for fires and the burden on the ammunition supply chain, a constraint that we can respect by focusing fires. We are not arguing for units to shoot less, but rather to shoot more on the most relevant targets. Units can undoubtedly create logistical problems by expending ammunition on targets that are not a priority. We bring balance to the system by shooting what is important. To be clear, this is not a call to place artillery "in reserve," but rather to use what we have wisely.
14. This trend towards a slow and "long" kill chain is not isolated the NTC. Fire support trainers at the Joint Readiness Training Center (JRTC) have observed the same trend and recently recommended best practices for "quick fire channel" operations. JRTC, "Fixing Fires: Tactics, Techniques, and Procedures Compilation," 10 April, 2020, p.43.
15. Consider that the TC 3-09.8 standard for "When Ready, Fire for Effect" HE missions (inclusive of only the FDC and Howitzer time) is 1:30 (90 seconds) for M109A6 platoons and 1:45 (105 seconds) for M777A2 platoons, Per TC 3-09.8, Appendix D, Table D-8 (page D-11), as downloaded from MilSuite on 5 February, 2020.
16. ATP 3-09.30, Observed Fire, 2017, page 2-8.

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M825A1 improved white phosphorous smoke munition utilized to deny ISIS's ability to see ISF maneuver elements in the battle for Mosul.

SMOKE EMPLOYMENT IN THE BATTLE FOR MOSUL

COL Daniel C. Gibson, LTC (P) Scott Pence and CPT (P) Stoney Grimes

A three-day engagement during the battle for western Mosul in 2017 demonstrated considerations for the use of artillery-delivered smoke in a dense urban environment. These best-practices in support of Iraqi Security Forces (ISF) could inform operations in future conflicts as the U.S. Army prepares for large-scale combat operations against a determined enemy in dense urban terrain. This article will describe the environment in which the operation took place, explain the risks that leadership considered during the operation, and highlight three observations from the use of artillery-delivered smoke in the urban terrain of northwest Mosul.

In 2017, Task Force (TF) Falcon, the 2nd Brigade Combat Team, 82nd Airborne Division provided support to the Iraqi Security Forces' efforts to liberate the city of Mosul from the Islamic State. The employment of fires by U.S. forces in support of the ISF provided the tactical overmatch necessary for success.

The battle for western Mosul lasted from January to July 2017. From June 2 through 4, 2017, the ISF executed an operation on the outskirts of the Jumhuri hospital complex in the Zanjili district of northwestern Mosul to rescue dozens of Iraqi civilians held hostage by ISIS fighters. In support of the operation, TF Falcon's direct support artillery battalion, 2nd Battalion, 319th Airborne Field Artillery Regiment, provided integrated fires to assist the ISF. This article focuses specifically on two obscuration fire missions employing M825A1 improved white phosphorus smoke munitions to deny ISIS's ability to see the ISFs maneuver and gain a relative tactical advantage.

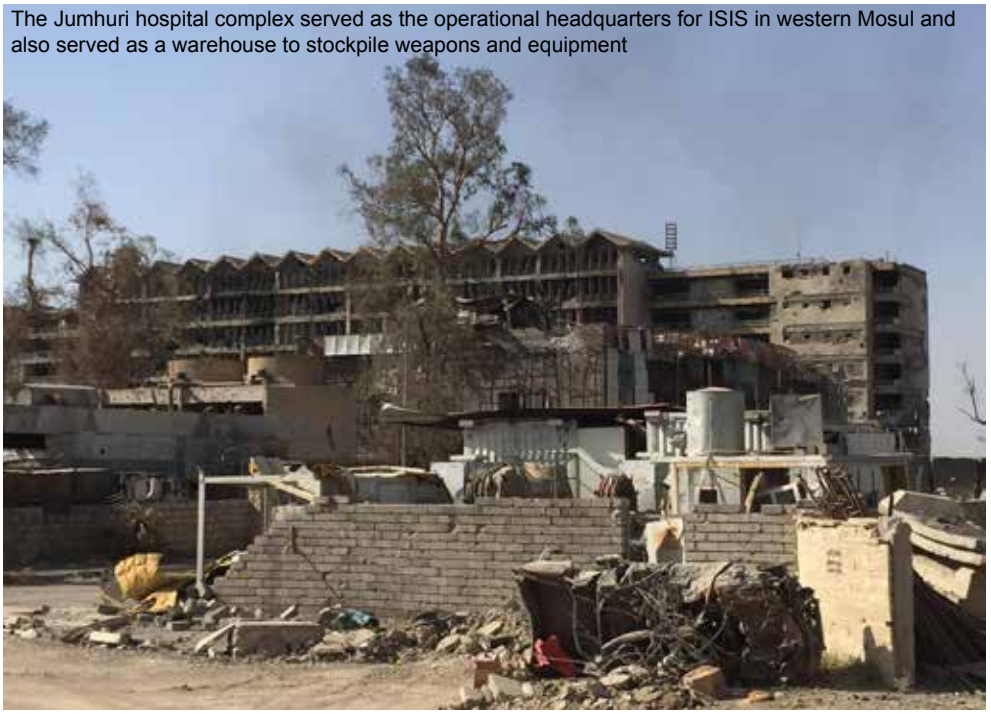
In 2017, the Zanjili district was a densely packed urban environment organized in generally geometric patterns with buildings arranged in neat blocks bounded by generally wide, straight roads. Structures varied from two to three-story residential and small business buildings to high-rise buildings more than five stories tall. The Jumhuri hospital complex east of the Zanjili district consisted of several high-rise buildings with five or more stories including the main hospital building. This main building, the Jumhuri hospital, stood more than seven stories high and dominated the surrounding terrain. It served both as the operational headquarters of ISIS in western Mosul and was used to stockpile weapons and equipment. Directly west of and adjacent to the hospital complex, ISIS occupied the Zanjili district using buildings that were formerly homes and businesses as bunkers, fighting positions and engagement areas. A four-lane thoroughfare, running from the northwest to southeast, separated the hospital complex from Zanjili. ISIS fighters positioned in the Jumhuri high-rises could easily observe ISF moving into the area and the four-lane thoroughfare made an ideal engagement area. Iraqi forces conducting the mission

expected to receive indirect and heavy weapons fire from the hospital buildings before encountering ISIS fighters employing small arms, machine guns and hand grenades from positions dug into the smaller, lower buildings of Zanjili. Both Iraqi and U.S. leadership identified the need for a smokescreen to deny enemy observation and facilitate ISF maneuver into the objective area.

The ISF depended upon U.S. forces for integrated fires to support their operation. Despite their possession of indirect fire systems, ISF could not employ them with the adequate precision and mass required to enable the operation. The 2-319th AFAR employed its organic M777A2 battery and a reinforcing M109A6 Paladin platoon from the 2nd Battalion, 82nd Field Artillery to provide the neessary close supporting fires.

At the time, the M825-series improved white phosphorous projectiles were the only U.S. smoke munitions available for 2-319th AFAR to employ in support of the operation. The 155 mm M825-series smoke projectile is superior to the U.S. Army's M116-series Hexachloroethane (HC) smoke projectiles in both the time required to build the smoke screen and the amount of time the smoke lingers, affording longer duration smoke screens with fewer rounds. Because of this, the U.S. Army has gradually phased the M116 HC smoke munition out of its inventory. However, the white phosphorous wedges used in the M825 munition burn at nearly 5,000 degrees Fahrenheit causing a risk of collateral damage to structures and non-combatants. In June 2017, there were no U.S. 155 mm HC smoke projectiles in the U.S. Central Command area of responsibility.

Despite the inherent risk of white phosphorous, the command deemed the likelihood of civilian casualties exceptionally low because nearly all civilians had fled the Zanjili district as a result of the intense fighting around the Jumhuri hospital the week prior. This conclusion was supported by full-motion video feeds from intelligence, surveillance and reconnaissance aircraft



The Jumhuri hospital complex served as the operational headquarters for ISIS in western Mosul and also served as a warehouse to stockpile weapons and equipment

that failed to detect any civilian patterns of life in the area. Additionally, many of the structures in the objective area were constructed from concrete reducing the likelihood that the structures themselves would catch fire. Thus, the com mand's decision to employ M825 munitions demonstrated a deliberate, necessary risk acceptance to enable the success of the Iraqi forces in their mission to rescue hostages.

The 2-319th AFAR captured three important observations that apply to the employment of artillery smoke in a dense urban environment. First, the conditions in the dense urban terrain caused variances in the meteorological conditions at surface level that changed the effectiveness of the smokescreen. This "micro-MET" at the surface could be dramatically different from what was captured in the meteorological data—the MET message—used to account for weather variations in the calculation of accurate firing data. This compounded as things caught on fire in the engagement area, causing micro high- and low-pressure systems in the urban canyons between the buildings that resulted in localized high winds that dramatically disrupted the smokescreen.

To mitigate this, the battalion executed the smokescreen as multiple, one-gun adjust-fire missions. As the conditions on the ground changed, the battalion fire direction center (FDC) adjusted the aim points and height of burst to sust-

Soldiers from C Battery, 2nd Battalion, 319th Field Artillery fire an M777 during a live-fire exercise. (Courtesy photo)

ain the necessary duration and thickness of the smokescreen. This enabled the battalion to continue firing with one or more guns while adjusting others to prevent a lapse in obscuration. The FDC quickly realized that if it managed the smokescreen as a single linear mission with multiple aim points, any adjustment would require the battalion to cease-firing on the entire mission. This would waste time, obscuration and ammunition as more ammunition would have to be fired to rebuild the screen inputting the adjustments.

Secondly, when the battalion fired M825 at the standard height of burst of 100 m, the smoke billowed ineffectively on the tops of and behind buildings. The FDC reduced the height of burst, sometimes as low as 20 meters above the ground, to place obscuration with some modicum of precision.

Finally, the FDC realized that the propellant charge affected how the screen materialized. The buildings in the immediate objective area became intervening crests that had to be accounted for in the technical firing solution. Firing a higher charge, at a lower quadrant elevation, and with a reduced height of burst, rounds cleared the intervening crests, but often impacted long from the aim point. The FDC reduced the charge to the lowest possible to achieve the range with the highest possible angle of fall to mitigate the intervening crest and contain the M825's felt wedges to a more confined area. This increased the probability that the desired effects were achieved in the target area.

By the end of the three-day operation, 2-319th AFAR fired more than 135 M825 smoke rounds, providing nearly 90 minutes of smoke. These effects enabled Iraqi forces to rescue dozens of Iraqi civilians held hostage by ISIS fighters and escape from the ISIS-held area in western Mosul with no subsequent reports of civilian casualties caused by the smokescreen. The timeliness of the rescue and the superior positions of ISIS justified the need to accept the risks inherent to the use of M825. This engagement demonstrated that the use of white phosphorous in cities is not only possible but effective. These considerations can shape how the Army trains the Fires force for the use of artillery-delivered smoke in a dense urban environment for future combat on an uncertain battlefield.

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Soldiers from C Battery, 2nd Battalion, 319th Field Artillery fire an M777 during a live-fire exercise. (Courtesy photo)

DON'T WAIT UNTIL FIGHT NIGHT

IT TAKES A BCT TO SYNCHRONIZE FIRE SUPPORT

LTC RICK JOHNSON

There are few things you can experience as an observer, coach or trainer that compares to the anticipation of a 'fight night' at JRTC. There is a palpable eagerness of the upcoming force-on-force battle with a trained infantry brigade combat team (IBCT) and the opposing force (OPFOR) in the demanding terrain of central Louisiana. Although the JRTC Operations Group carefully orchestrates the battle to optimize the IBCT's pursuit of their tailored training objectives for the rotation, no outcome is predetermined. The IBCT can win every attack or defense, and at times they do just that. But predominantly the OPFOR wins, regardless of force ratios. The OPFOR leaders over the past three years have offered the same insight into their ability to consistently defeat the latent power of a U.S. Army IBCT: the OPFOR fights as a combined arms team, whereas the IBCTs they face struggle to achieve that same synchronization in any meaningful mass. After action reviews (AARs) illustrate the salient learning points from each engagement, but they don't do much to reduce the sting of a proud, professional unit realizing the sobering fact that they endeavored greatly but lost.

Most IBCTs' Field Artillery (FA) battalions complete their tabled training at home station and arrive at JRTC with adequate technical gunnery skills. However, IBCTs struggle to mass responsive fires due to a relative lack of collective tactical training during that same progression. Rotational observations at JRTC yield three important trends regarding the underlying challenges to synchronize fire support with maneuver in the IBCT's fight. Primarily, IBCTs do not approach fire support as a holistic, organization-wide challenge; most rotational units will approach any inefficiency in the responsiveness or mass of fire missions as something for the FA battalion or the dual-hatted battalion commander/fire support coordinator (FSCOORD) to fix in relative isolation. Additionally, IBCTs rarely plan and prepare to mass fires since they have few chances to practice this during collective training events at home station. Lastly, FA battalions are generally not prepared to meet the challenges of sustainment and protection in the crucible of long-duration training at JRTC. These three challenges combine to cause unresponsive fires, with relatively low levels of battle damage inflicted upon the OPFOR.

If Artillery Tables XV (battery qualification) and XVIII (battalion qualification) are not adequately preparing our IBCTs for these challenges they encounter at JRTC, can we realistically create a different approach to training in an IBCT? Our discussion will review the existing professional discourse, and then present the current rotational observations for challenges in synchronizing fires within the IBCT. This provides relevant context to then examine each of the three aforementioned challenges in detail, identify best practices to address those challenges and finally recommend improvements to collective training progressions to reverse those trends.

A rich toolkit for the fire supporter

Collective tactical training which develops the synchronization of fire support within an IBCT is not a new challenge, nor does this challenge require the mindset of crisis management. The fire support community has a rich legacy of approaching challenges with a mixture of creative and critical thinking, as reflected both in published doctrine and professional discourse. The current effort to update FM 3-09, Field Artillery Operations and Fire Support, will result in a doctrine which will describe fire support and Field Artillery operations from the theater army to the BCT, but with enough specificity to be of value

at each echelon. And while no fire supporter would claim that neither the current FM 3-09 nor FM 3-96, The Brigade Combat Team, are perfect, those two references do provide the requisite structure and common lexicon to fight as a combined arms team. The most influential publication on the effort to align artillery gunnery within a larger BCT training progression is the 2019 revision of Training Circular 3-09.8, Fire Support and Field Artillery Certification and Qualification, which critically establishes the guidelines to conduct and assess gunnery. Furthermore, TC 3-09.8 aligns the effort to train, certify and qualify the BCT's fire supporters and FA units as a Field Artillery gated training strategy within the larger framework of the Integrated Weapons Training Strategy (IWTS). However, the IWTS focuses on synchronizing fire support during successive maneuver collective live-fire training events, which results in a relative gap in regards to further training imperatives with the supported BCT, especially in the critical areas of planning, sustainment and protection. The IWTS has done well to sharpen IBCTs' collective training in the pursuit of lethality, as illustrated by steady improvements of platoons, companies and battalions in JRTC's live-fire exercises over the years. However, lethality alone is not sufficient to synchronize all combined arms into a fight of any meaningful duration.

Similarly, fire supporters' professional writing over the past de-cade expands the aperture beyond straightforward gunnery. For the unique context of fires support within the BCT, the Center for Army Lessons Learned (CALL) disseminated "Hunting with Fires," in 2018 which provides a great in sight into one unit's approach to transitioning from an inherently restrictive environment for indirect fires to an inherently permissive and responsive environment. Within that discussion are several key concepts such as an effective BCT commander's guidance for massing fires, optimizing preemptive and unobserved fires, and integrating the FA battalion's staff with the BCT targeting cycle. From the combat training centers, COL Jon Shine's widely-circulated "If I could do it over again," provides great passages regarding the rigor of Field Artillery Tables XII, XV, and XVIII from the unique perspective of the National Training Center (NTC) senior fire support trainer reviewing his challenges as a battalion commander. Recent and relevant contributions from NTC include the BCT counterfire operations section, "Setting conditions for effective counterfire," as distributed by CALL, focusing on the staff processes and command post considerations for counter-fire operations within the BCT. JMRC's MAJ Kurt Knoedler recently published, "Building the confidence of maneuver commanders," which provides a detailed review of the rigor and detail required to maintain responsive fires with digital communications within a BCT. His 2020 FA Journal article contains the critical insight that "This is not solely a Field Artillery battalion problem, but a larger problem for the BCT." And as a confirmation that approaching the synchronization of fires from a BCT-wide perspective is not a new challenge to the force, then- LTC Janosko's "JRTC fire support observations," provides an example of similar challenges for brigades over two decades ago. While partially focused on the challenge of sustaining artillery operations within a brigade, he concluded in 1996 that, "there's still much to do – the impact of FA and other fires on the outcome of the battle and protection of the force is just too important."

The evidence

A study of JRTC's rotational counterfire trends highlight that there are some definite improvements across the force. The most positive trend deals with the IBCT's ability to clear air and ground during a counterfire drill. In August 2016, the rotational average for this task was 7:49, and today it averages 1:47. Further more, fire supporters and fire direction centers (FDCs) routinely demonstrate the ability to use the proper method of control to allow the FA battalion to process the fire mission concurrently so that nobody is waiting for this clearance before they proceed. However, overall rotational averages for fire missions have remained relatively stable in the 12:30 to 14:30 range since 2016.

It is also important to note that times at FDCs and on the gun line continue to improve. While rotational averages do not meet the exacting standards of TC 3-09.8, this should not come as a surprise since fire missions at JRTC oftentimes include environmental factors such as "too hot," "too wet," "too hungry," "too dark," "under fire," and at times, all five. This stands in stark contrast to the usual conditions for an Artillery Table V and VI (section certification and qualification) with well-rested and specifically prepared crews conducting a known variety of fire missions to isolate the technical aspects of the crew drill for assessment.

These rotational averages for fire mission processing are not perfect summations of the processing times at all stations. There are several reasons for this, with the two primary factors being communications and tactical fire direction. When all sensors and shooters are linked digitally, this 'slack time' between stations approaches zero. But that is rarely the case during force-on-force training at JRTC, where units revert to voice communications or a combination of both. The second factor which drives even more 'slack time' in the rotational average is poor tactical fire direction, as expressed in bad decisions regarding which firing unit should deliver fires. Out-of-traverse fire missions add considerable time, with some rotational units firing a third of their missions at JRTC after shifting the trails of their towed howitzers. Additional challenges include sending emergency fire missions ('hip shoots') to displacing units without selecting an alternate firing unit. As we will discuss later, often the challenges with tactical fire direction has its roots in the cascading effects of poor security, protection

and sustainment – or the FA battalion's inability to enforce the reporting and command post practices required to overcome those issues.

In summary, the best opportunity to improve the responsiveness and synchronization of fires is to address this 'slack time.' The FA Gated Training Strategy, healthy digital sustainment training, and repetitions in crew drills provide a clear way for FA battalions to reduce approximately 4:30 worth of fire mission processing time by improving the technical aspects of fire support and howitzer operations. Rotational observations at JRTC indicate that there is about 5:30 of the aforementioned 'slack time' in fire missions due to insufficient collective tactical training. As such, we will focus on the tactical aspects of delivering responsive massed fires within the IBCT.

Fires as a BCT-wide challenger

Responsive fires are a primary measure of an IBCT's ability to plan and rehearse an operation in exacting detail. It represents the summation of an IBCT's ability to coordinate and synchronize across warfighting functions. Without harmony across multiple elements and echelons, fire support might be accurate due to technical mastery, but they will lack the requisite mass, responsiveness and relevancy due to shortcomings in the IBCT's tactical proficiency. One example to illustrate the difference in technical and tactical proficiency is to consider the trigger for a priority target in the defense. The forward observer might be able to meet all requirements for acceptable target location error, understand the specific spot on the terrain in front of them when they initiate the fire command and understand the exact fire mission processing time after an indepth technical rehearsal earlier in the day. But the tactical employment of that fire mission is equally important; the fire mission must be synchronized within the maneuver force's engagement area development, and the enemy formation must meet the commander's engagement criteria.

One useful model to understand the relationships among tactical and technical aspects of synchronizing fires within the IBCT are 10 imperatives for responsive fires (see figure).

The 10 imperatives for responsive fires

The most capable and savvy FSCOORDs can ensure that the IBCT addresses all 10 of these imperatives, but they only directly influence the last four. Furthermore, the FA battalion is the exclusive action arm of only the last three. As such, it takes the collective training of an IBCT to truly develop and maintain a capability for responsive fires.

Given the limited resources and competing demands across the IBCT as it prepares for a JRTC rotation, approaching fires as a holistic IBCT training priority is perhaps the most challenging aspect. For some units, prioritizing the synchronization of fire support may require an inequitable distribution of time, physical resources, professional development sessions and collective training opportunities. Generally, rotational unit leaders report that they have one iteration in an IBCT command post-exercise, and one iteration in an IBCT field training exercise to prepare for JRTC. Conducting one of those collective training events concurrently with an Artillery Table XVIII provides a great opportunity to gain efficiency.

However, by the very nature of that arrangement, it requires a considerable amount of external support to provide the synchronized exercise control to protect the equities of both training audiences. Furthermore, it is a challenge at most installations to conduct artillery live fires required in Artillery Table XVIII while simultaneously replicating constructive fires for an IBCT's field training in adjacent areas. Absent of an opportunity to link an Artillery Table XVIII and the IBCT's culminating training event, the IBCT staff must be able to replicate a full response cell for Artillery Table XVIII and any BCT-level fire support coordination exercises. The effort for this multi-echelon training goes beyond making the FA battalion feel like there is an actual IBCT to support; the IBCT commander and their staff must understand what it takes for the IBCT (not just the FA battalion) to meet the 10 imperatives listed above.

A prudent review of any IBCT's training progression for JRTC should result in multiple opportunities to:

- Enable the IBCT and FA battalion staffs to refine their wargaming techniques as a means to synchronize intelligence collection and fires.
- Plan and adjust PAAs that are reflected on common graphics throughout the IBCT.
- Validate a PACE plan (an order of precedence list based on primary, alternate, contingency and emergency communications) for the IBCT Fires nets (voice and digital) at distance.
- Collaborate between the IBCT and FA battalion staffs to develop the complementary fire support coordination measures and airspace coordination measures required to mass joint fires.

Planning to mass fires as a BCT

Massing fires enables the IBCT to maximize effects with an economy of resources and improves the FA battalion's survivability by limiting the number of volleys required to achieve the desired effects. From the IBCT's perspective, massing fires may include the synchronization of close air support and Army attack aviation with the FA battalion's organic firepower. In large-scale combat operations, the division may require the FA battalion to periodically support other efforts in a reinforcing role, but massing the fires of the FA battalion is still a fixture in the IBCT's most effective means to concentrate all forms of combat power across the combined arms team. At JRTC, less than 10 percent of all fire missions are massed with multiple firing units during force-on-force training.

IBCT FIGHT

BCT COMMANDER'S GUIDANCE FOR FIRES
- Does prudent risk balance risk-to-force with risk-to-mission, enabling responsive fires?
- Does the guidance enable detail wargaming to synchronize intelligene and fires?

TERRAIN MANAGEMENT & BATTLEFIELD GEOMETRIES
- Are PAAs distributed on common graphics across the BCT to prevent 'squatters?'
- Does the Target Working Group review and adjust the CFL, IHOL, and radar zones?

AIRSPACE MANGEMENT
- Does the Target Working Group review and adjust the CFL, IHOL, and radar zones?
- Can the BCT leverage AFATDS/AMDWS/TAIS connectivity to visualize the airspace?

INTELLIGENCE COLLECTION PLAN
- Does the IC Matrix include the BCT's target acquisition radars and synchronize them?

COMMUNICATIONS
- Do units plan a robust PACE for AFATDS and fight to get back on the primary means?
- Who synchronizes and validates AFATDS databases across the BCT regularly?

ARTILLERY CL V SUSTAINMENT
- Does the Target Working Group result in updated RSRs and resupply triggers?
- When demand exceeds BCT haul assets, does it coordinate for throughput distribution?

FIRES CELLS (FIRE SUPPORT ELEMENTS, FIRE DIRECTION CENTERS, AND COUNTERFIRE CELLS)
- Has the BCT analyzed the CF Cell's location; should it be at the BCT or the FA BN?
- Are the fires cells central aspects of CPs, or are they relegated to a separate tent or vehicle?

FA BN FIGHT

FIRING UNIT MANAGEMENT
- Do FATs balance counterfire & close supporting fires, w/ assigned BTRYs and allocations?
- Does the FA BN purposefully manage 'Hot' and 'Cold' firing units to mass fires?

TACTICAL FIRE DIRECTION
- Do the AGM & TSS enable rapid decision-making to send the fire mission to the right unit?

TECHNICAL GUNNERY
- Can FDCs and howitzer sections operate in FOC, degraded, and manual modes?
- Are fire supporters and radars qualified and capable of processing acquisitions digitally?

RESPONSIVE MASSED FIRES ARE THE SUMMATION OF THE IBCT'S ABILITY TO COORDINATE AND SYNCHRONIZE ACROSS WARFIGHTING FUNCTIONS. WITHOUT THIS HARMONY ACROSS MULTIPLE ELEMENTS AND ECHELONS, FIRES MIGHT BE ACCURATE BUT THEY WILL LACK THE REQUISITE MASS AND RESPONSIVENESS.

Ten imperatives for responsive fires in the IBCT. (Rick Paape/Courtesy information)

Massed fires across the IBCT have both proactive and reactive aspects. Successful IBCTs proactively plan to mass fires via the targeting process to relentlessly hunt and kill high payoff targets (HPTs), and balance that with requirements to mass close supporting fires for the maneuver force. The aforementioned "Hunting with Fires," is a good example of the detailed planning and coordination required to achieve that balance between HPTs and close supporting fires. Our observed trends and best practices during decisive action training environment rotations at JRTC indicate that successful IBCTs exhibit four common traits:

1. Utilize target pattern analysis to synchronize the limited assets in an IBCT.
2. Exhibit discipline in maintaining sensor-to-shooter pairings, most often through the use of a detailed Target Synchronization Matrix.
3. Relentlessly hunt and kill the top HPT formation until the IBCT meets destruction criteria; do not split sensors nor shooters (specifically FA batteries) across several different HPT formations simultaneously.
4. Plan close supporting fires by purposefully allocating targets which mass the FA battalion, then disseminating bottom-up refinement to those targets.

Reactive fires provide the IBCT with an ability to mass joint fires in response to enemy HPTs as they are acquired. Our observed trends and best practices indicate a further four common traits for successful IBCTs to mass fires reactively, and

thereby mass fires responsively. Although these four common traits enable reactive massed fires, they require detailed planning by the IBCT staff to:

1. Develop positioning guidance for firing units as an output of the Target Working Group.
2. Establish dedicated 'counter-fire shooters' with one of their firing units.
3. Utilize quickfire nets to reduce the 'to' in sensor-to-shooter during specified phases of the operation.
4. Centrally locate fire support elements, FDCs and counter-fire cells within applicable command posts.

Similar to the previous discussion regarding the ten imperatives for responsive fires, effective multiechelon training requires representatives from across the IBCT to adequately train the proactive and reactive aspects of massing fires. In addition to validating the technical mastery required to mass the FA battalion during an Artillery Table XVIII, IBCT training progressions must also incorporate two aspects to ensure that the FA battalion can mass in support of the IBCT:

- Provide repetitions of the IBCT's targeting cycle, including the inputs from the FA battalion and dissemination of the outputs to the IBCT's current operations staff and subordinate battalion and squadron fires cells.
- Fully plan and rehearse a fire support plan for both an attack and a defense for the IBCT and each maneuver battalion or squadron.

Sustaining and protecting the FA battalion

FA battalions' challenges in security, protection and sustainment also create unfavorable conditions for responsive massed fires. Much like a cage fighter, even the most lethal combatant will not prevail if they can't protect themselves from a thinking opponent or sustain themselves for the duration of the fight. To extend this metaphor, our current tabled training methodology is resulting in fighters who can strike with more predictable accuracy and power owing to their technical skill, but it is not sufficient in and of itself to win the fight. Rotational units which train in accordance with TC 3-09.8's mandate to qualify in full operation capability, digitally degraded, and fully degraded can manage transitions between digital and degraded fires, and fight to get back to their primary means for determining and processing firing data. However, often the rotational unit finds themselves in a final AAR, realizing that their training progression through these tables did not prepare them for the additional challenges of sustainment and protection.

The first insight is that firing units will often displace and occupy multiple times in rapid succession during an Artillery Table XII, XV and XVIII. Multiple occupations are a great method to train and assess the unit's ability to survive by means of "shoot and move," but this frenetic pace provides an unintended challenge which is most pronounced in an IBCT owing to the longer occupation and displacement times inherent in towed artillery. If a battery has never occupied a position area for longer than eight hours during their training progression the command team will be challenged by position improvement and expanding security after eight hours. Over time at JRTC, the OPFOR chips away at combat power via multiple forms of contact, since IBCTs struggle with the synchronization of terrain management and additional fuel required to support a constantly moving FA battalion. Furthermore, a rotational unit untrained in battery defense will be less efficient in managing their ready platoons or howitzer sections, contributing to the aforementioned challenges for tactical fire direction. Few IBCT staffs understand that critical assets such as the M777A2 and target acquisition radars will usually be the IBCT's priority defended assets, and they fail to develop some routine procedures to protect and secure them. While maintaining mobility and adhering to survivability move criteria are often the best means of surviving against OPFOR indirect fires, protecting these assets with prepared positions and dedicated security elements is an imperative to survive the other forms of contact. It is a supreme challenge if battery security operations are only a single page of checklists in a tactical standing operating procedure and not a practiced event. Engineer companies that have never dug in a firing battery are about as capable in rapidly planning, building and refining a firebase as firing batteries that have barely met their adjacent engineer company. The only thing more ineffective than a firing battery which has never occupied a fully developed set of howitzer parapets is the engineer company which has never received the constructive feedback to build suitable howitzer parapets. However, few IBCT training progressions make combined training with engineer assets a fixture, nor does a Field Artillery Table XV require it.

SUCCESSFUL ROTATIONAL UNITS UNDERSTAND THE OPPORTUNITY TO TAKE ADVANTAGE OF BOTH THE FIRING BATTERY'S HIGH DENSITY OF CREW-SERVED WEAPONS AND THE INFANTRY'S ABILITY TO EXTEND SECURITY BEYOND THE FIRST VISIBLE WOODLINE.

The time and combat power that firing batteries dedicate to self-securing their gun lines comes at an opportunity cost of keeping all howitzers in position and ready to fire, let alone addressing other priorities of work such as routine maintenance. Just as the FA battalion must train with engineer assets, they must also train with the infantry squads or platoons that may be tasked to secure them periodically. The nuances of securing an artillery asset with inherent danger areas and specific hazards require close coordination, and coordinating with an adjacent unit at the battalion level is insufficient. Successful rotational units have practiced this coordination on the ground; they understand the opportunity to take advantage of both the firing battery's high density of crew-served weapons and the infantry's ability to extend security beyond the first visible woodline.

The second insight is that Field Artillery Tables XII, XV, and XVIII rarely last long enough or require enough commodities to truly stress platoon, battery and battalion sustainment. Unfortunately, if units expect to train for 72 hours in one of these qualification tables, they can deploy to the field at home station with three days of supplies on board and not require much in the way of external support. At JRTC, we see this sustainment challenge manifest itself most acutely in terms of Class V artillery munitions. The relatively low amount of high explosives, smoke and illumination rounds required to complete a table will not inherently stress the unit's ability to proactively manage combat loads. For context, most FA battalions will fire approximately 288 rounds during Artillery Table XVIII, which is only five percent of that battalion's combat load. In turn, rotational units at all echelons find themselves unfamiliar with the requirements to forecast, track and distribute the scope of replicated Class V at JRTC, where there is no such thing as a paper equiv-alent to facilitate training. During force-on-force training at JRTC, either you have a concrete filled replicated round with the proper Department of Defense identification code, fuze and propellant, or you don't. An ineffective distribution of munitions serves to limit the number of available options for a fire direction officer, especially during planned operations when the FA battalion must balance the equities of multiple Field Artillery tasks.

As such, building capacity in protection and sustainment within the FA battalion requires an artful balance of field training opportunities and participation across the IBCT. As with the preceding discussion, shrewd FSCOORDs will seek opportunities to align sustainment training with existing field training for Artillery Tables XI, XV, and XVIII. "If I could do it over again" details several complementary activities to show that, "a livefire FA Table has not been completed unless the unit has …," similarly, there is an opportunity to focus on protection and sustainment once the appropriate command team qualifies that echelon, and the training audience is still in the field.

Few rotational units arrive at JRTC understanding the critical aspects of sustaining FA battalions. Rotational units are not validating two key parts of their sustainment enterprise if they only train through short-duration gunnery tables and iteratively combined arms live fires. First, they do not understand their capacity to organize, haul and distribute combat loads. Although it leaves but a few cubic inches to spare, the first combat load to sustain a FA battalion will fit on the organic ammunition haulers and sections within the firing batteries, and the second combat load will fit on the forward support company's (FSC's) combined trains. The third combat load becomes a prudential decision for the sustainment leaders to carry with the brigade support battalion's (BSB's) limited assets or hold it in reserve to be called forward. However, this arrangement of combat loads as-sumes that there is full manning since firing batteries will generally fill howitzer sections first, then FDCs. In general, FA battalions and their FSCs will begin a rotation with the ability to move and distribute 25 percent to 50 percent of a single combat load, but continue to plan and shoot as if they have two combat loads available.

The second critical aspect of sustaining the FA battalion regards the effort to command and control that effort. Few FA battalions establish - let alone validate - command posts for both combat trains and field trains during their training progression for JRTC. The lack of practiced command posts to track and distribute artillery munitions is particularly evident when neither the FA battalion commander nor the BSB commander can articulate the artillery field trains' command support relationship, task organization and coordinated reporting requirements.

In some cases, training an IBCT to adequately protect and sustain their FA battalion may require additional venues to train the force. With a bit of rigor and detail, table-top exercises, tactical exercises without troops, and command post exercises all provide options for a complementary effect. When combined with a culminating training event in the field, these additional events within the IBCT's training progression should provide the IBCT opportunities to protect and sustain the FA battalion by:

- Identifying routinely prioritized defended assets within the FA battalion and allowing those tactical units to train with their protection and security elements.
- Developing a fires-protection team (firing batteries and engineer companies) through iterative digging exercises in a similar fashion to the way a maneuver fires team develops through iterative live-fire exercises.
- Understanding the unit's carrying capacity for artillery Class V and identifying the best tactical opportunities for throughput distribution when demand exceeds the IBCT's limited haul capacity.
- Enabling the FA battalion to evaluate and standardize their prepackaged artillery Class V loads.
- Validating the FA battalion's combat trains command post and field trains command post in conjunction with BSB training.

Train as you fight: as a team

The Army's principles of training begin with the familiar expression to train as you fight as a realization that, "[i]n this way, units conduct training employing more than one echelon, multiple warfighting functions, and functional units in a manner that closely replicates how they will fight." Rotational unit leaders consistently cite time as the most fleeting resource during homestation training, but they do not appear to rush, circumvent, or sacrifice standards within the Field Artillery Gated Training Strategy. Fire supporters are wellversed in the commander's responsibilities and specific technical requirements within TC 3-09.8. However, the avenue of technical gunnery in TC 3-09.8 generally appears to be

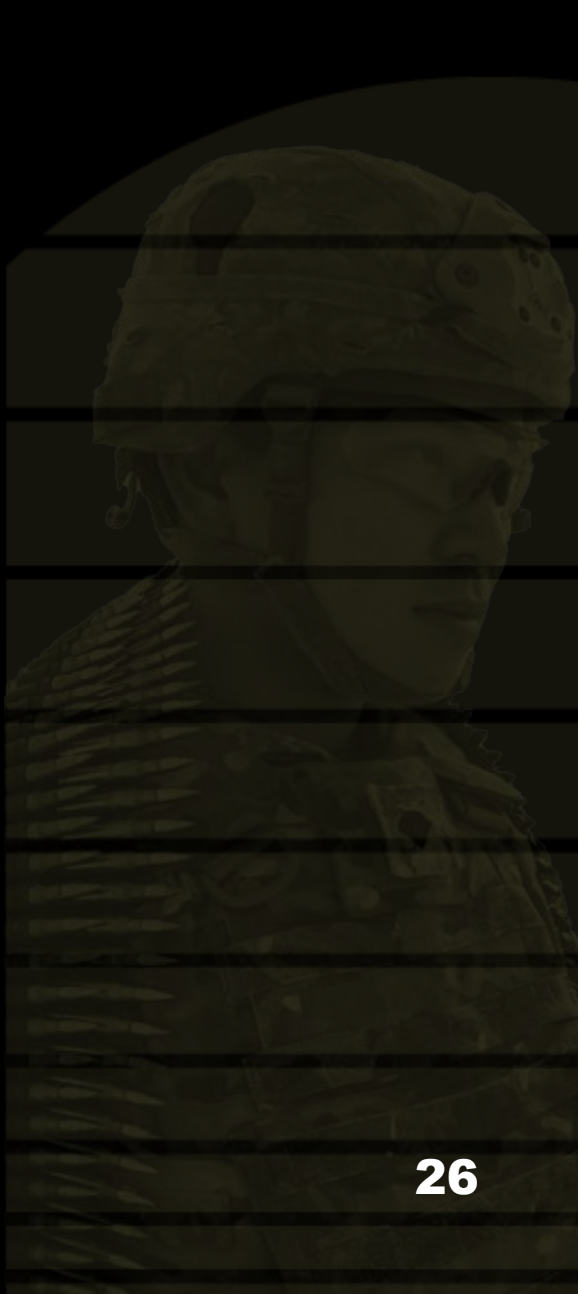
the only pathway that rotational units use in their quest to prepare for JRTC, with brief stops along the way to train in limited duration scenarios with the supported IBCT and other warfighting functions.

If you're an FA battalion command team, arguably you have the first and most critical responsibility to continue the positive trends in artillery gunnery. Only you can command the effort to build and maintain a collective technical proficiency within the IBCT. Fire mission processing times must continue to improve. Units that remain disciplined to published attack guidance, standard fire orders and doctrinal radio transmissions are better equipped to overcome the challenges in fire mission processing inherent in large-scale combat operations. These are aspects that FA battalions can train to a high degree of collective competency, by the means of digital sustainment training and periodic training minimums for each echelon. These are most effective when command teams (FA battalion, DIVARTY and the supported IBCT) clearly define their expectations, with an approach that the additional training complements the tabled certification and qualification requirements. But as outlined above, technical skill does not represent the largest opportunity for improvement when it comes to responsive massed fires.

The IBCT and DIVARTY commanders must ensure that those leaders in the FA battalion are not trying to solve the complex, resource-constrained challenge to synchronize fire support across the IBCT in isolation. Synchronizing fires with the other warfighting functions and among organic combat formations is demonstrably a challenge for an IBCT commander to address, with the support of the associated DIVARTY commander and their staff. Both staffs must approach this challenge together, in an acknowledgment that we are preparing FA battalions together for large-scale combat operations against a peer competitor, not tailored packages for the force-generation conveyor belt to Iraq and Afghanistan. And if you're a division commander and somehow this article makes its way into your hands (whether by some cosmic happenstance or an act of subterfuge), make your colonels and their staffs demonstrate how they will provide the IBCT with the opportunity to train as a combined arms team before JRTC, not just a team of talented subunits which meets periodically for collective live-fire events.

Improving our tactical collective training is the first of many steps we will need to take if we want our IBCTs arriving at JRTC both willing and able to prevail against the OPFOR by synchronizing responsive massed fires. Ostensibly, it is the same approach to ensure that we are ready to answer the call for actual combat operations in the Sustainable Readiness Model. Commanders at all echelons must know how many training days it requires to get their units to an objectively trained status; we must approach this aspirational training status in terms of fighting as a combined arms team, not parallel tracks to build lethality across disparate warfighting functions. The IBCT commanders must ask themselves why (and at which echelon) they are directing the FA battalion to support live-fire exercises, owing to the inherent opportunity cost associated with each event. Fire supporters must ask themselves if the Field Artillery Gated Training Strategy precludes any realistic chance of matching the maneuver force's tempo through the training progression, less critical aspects such as sustainment and protection are relegated to theory, and not practice across the IBCT.
The FA battalion's progression through Field Artillery Table XVIII provides a rigorous, demanding pathway to achieve lethality through technical gunnery. Properly augmented by digital sustainment training and other complementary activities, it can provide the IBCT with a dependable, accurate fire support capability. However, that is not enough in and of itself. We can no longer afford to wait until the IBCT finds itself in the unforgiving environment of a JRTC 'fight night' to learn these lessons regarding the collective tactical training required to synchronize and mass fires.

LTC Rick Johnson currently serves as the fire support senior trainer at the Joint Readiness Training Center. He previously commanded 2nd Battalion, 377th Parachute Field Artillery Regiment. His published works include "The Biggest Stick: The Employment of Artillery Units in Counterinsurgency" (Combat Studies Institute Press, 2012) and "Hybrid Warfare" (Joint Special Operations University Press, 2013). He enjoys continuing the discourse on fire support with the #Firestwitter community at @Fox06burneracct.



THE ARMY CONCEPT OF FIRES:
Laying the Foundation for the Future

Fires Center of Excellence Capabilities Developments & Integration Directorate

Why concepts? To put it simply, concepts are the start point. In recent years, the Army has made modernization a top priority and it uses concepts as the entry point to drive capability development and define how the Army will fight in the future. Fires is among the top modernization priorities for the Army, making the U.S. Army Concept for Fires a critical document for shaping the future of the Army. It is the starting point for modernization.

The Army Concept for Fires (AC-Fires) is part of the Army Conceptual Framework. The purpose of that framework is to provide "a foundation for developing future capabilities and helps Army leaders think clearly about future armed conflict, learn about the future through the Army's campaign of learning, analyze future capability gaps and identify opportunities, and implement interim solutions to improve current and future force combat effectiveness," according to the former Director of the Army Capabilities Integration Center (now the Future Capabilities Center), LTG(ret) H. R. McMaster. Thinking, learning, analyzing, and implementing, indeed; the process by which the Army glimpses, if imperfectly, into a vague and uncertain future.

The Army Conceptual framework of which the AC-Fires is part starts with a strategic vision from the *National Defense Strategy* and *National Military Strategy of the United States of America*, publications produced by the National Security Council. From the guidance provided in these pulblications, a joint operating concept is produced, which in turn informs the Army's operating concept. At present, a joint operating concept is under revision. The Army has recently published two seminal concepts: TRADOC Pam 525-3-1, The U.S. Army in Multi-Domain Operations 2028, and TRADOC Pam 525-3-8, U.S. Army Concept for Multi-Domain Combined Arms Operations at Echelons Above Brigade (EABC) 2025-2045. These concepts inform the AC-Fires. So as expected, the AC-Fires describes how fires formations and capabilities support and enable joint, interagency, intergovernmental, and multinational (JIIM) efforts, in support of Multi-Domain Operations (MDO) in the 2028 and beyond timeframe. Future warfare requires the Army to integrate and execute fires to conduct MDO against future peer threats. This integration and execution falls to the Army's Fires Warfighting Function.

Fires Defined

Before a functional concept can be imagined, the object of the function needs definition. While concepts are not bound by doctrine, current and emerging doctrine may inform a concept to create shared understanding for terms and techniques as a start point upon which to expand innovative ideas, or conversely to scope new ideas. Accordingly, the AC-Fires refers to the term "fires" within the context of existing and emerging doctrinal definitions to clarify future fires actions and identify required fires capabilities. JointPublication 3-0 defines fires as "the use of weapon systems to create specific lethal and nonlethal effects on a target." Additionally, joint fires is defined as "fires delivered during the employment of forces from two or more components in coordinated action to produce desired effects in support of a common objective." Army Doctrinal Publication (ADP) 3-19 Fires, dated 31 July 2019, defines the Fires Warfighting Function as "the related tasks and systems that create and converge effects in all domains against the threat to enable actions across the range of military operations." Under this broad definition, Army fires are understood to integrate and execute fires across the five domains of land, air, sea, space, and cyberspace as well as the electromagnetic spectrum and information environments to support JIIM operations.

To accomplish the tasks required to create and converge effects, Army fires employ or coordinate surface-to-surface fires, air-to-surface fires, surface-to-air fires, surface-to-space fires; integrates and synchronizes cyberspace operations and electronic warfare with ground-based fires; and integrates

space operations, multinational fires, and special operations with joint fires to support MDO. Army Fires are integrated with JIIM operations through the targeting and operations processes; fire support planning; airspace planning and management; electromagnetic spectrum management; multinational integration, rehearsals; and air and missile defense planning and integration. To this end, the AC-Fires focuses on concepts for integrating fires at all echelons to penetrate and disintegrate threat anti-access and area denial (A2/AD) capabilities and strategies, defend critical assets, and defeat threat fires to enable joint force freedom of action. The AC-Fires presents concepts for how the Army will conduct fire support, targeting, and air and missile defense in the future.

A Central Idea

Any multifaceted concept such as the employment of Army fires must spring from a central, overarching idea. The AC-Fires asserts that Army fires contributes to the joint force by enabling deterrence in competition, and in armed conflict integrates and employs fires at all echelons, throughout the depth of the MDO battlefield framework, to penetrate and disintegrate A2/AD capabilities, defend critical assets, and defeat threat capabilities to enable joint force maneuver. During return to competition, Army fires contributes by posturing capabilities and reconstituting forces to preserve the favorable condition established during conflict.

This central idea for future Army fires leads, logically, to four components of the solution that are critical to success in MDO: echeloned fires capabilities; enhanced sensor-to-shooter linkages; multi-domain targeting; and leverage JIIM capabilities. These components form the essential role of fires in the future operational environment and support the key tenets and solutions described in the Army Operating Concept (AOC), TRADOC PAM 525-3-1 The U.S. Army in Multi-Domain Operations 2028. These components have been validated in recent experimentation and are rooted in Army success in large scale combat operations against peer threats in the 20th Century. Understanding the past provides a window into the future, because the nature of war is unchanging and immutable. Rooted in each solution are requirements to leverage emerging technologies that advance the role of fires, including artificial intelligence, robotics and autonomous solutions, advanced target recognition, and technologies that expand range, enhance lethality, and improve survivability.

Solution Components

Echeloned Capabilities. The Army fights in echelons, spanning across each level of war from tactical to strategic, each dependent upon the other for success. Fires formations at all echelons provide responsive fires to support strategic, operational and tactical operations to win through MDO. Army fires require structure and capabilities at all echelons in order to shape in depth and provide a layered defense. Echeloned capabilities gives the Army the ability to fight extended campaigns, cover vast distances of physical terrain, and provides an array of fires capabilities coupled with requisite authorities to employ them. Echeloned capabilities are critical to the employment of effective fires in all domains in large scale combat operations and helps the Army set desired conditions at decisive points.

Enhanced sensor-to-shooter linkages. The Army must move toward any sensor, best shooter as a state-of-being. The temporary and ad hoc arrangements between sensors and shooters that have been the norm for decades will not effective in future warfare where the scale, scope, and rapid decision cycle required to employ responsive, effective, fires will determine success and failure. In the future, automated battle management tools must overcome human constraints to responsiveness and minimize human cognitive overload through a 'human on the loop' interface where sensors and shooters are rapidly converged from multiple networks across domains, monitored through common data terminals and managed by exception, creating an "any sensor, best shooter" paradigm. Sourcing of data from sensors across domains and pairing that data with the best available shooter enables rapid target engagement regardless of domain. These enhanced linkages move the Army beyond simple kill-chains and help establish the creation of "joint kill-webs" that push and pull targeting data from a wide array of available sensors to the desired capability that can create the desired effect on the target. Building trust in this kind of system of systems requires rigorous joint and combined training to achieve confidence in the advanced automated tools, which will have the potential to employ fires without a human decision-maker directly in the loop.

Multi-Domain Targeting. MDO requires Army fires to support the commander's targeting priorities by leveraging existing and emerging technologies to stimulate, see, understand, and strike targets across domains with input from JIIM partners to create lethal and nonlethal effects. However, MDO does not drive a departure from the Army Targeting Process (Decide, Detect, Deliver, Assess) or the Joint Targeting Process, but it does require a unified approach to targeting at echelon including the integration and synchronization of lethal and nonlethal effects in all domains to enable convergence. In order to effectively penetrate and disintegrate A2/AD capabilities, the Army cannot afford to wait until armed conflict to build accurate intelligence and determine effective targeting solutions against threat A2/AD capabilities. Therefore, the Army (along with joint and multi-national partners) must conduct thorough and continuous target development against threat high payoff targets before reaching the threshold of war. Greater flexibility in both deliberate and dynamic targeting procedures must be implemented to meet the time-sensitive demands of targeting in MDO.

Leverage JIIM capabilities. In all

future operations, Army-only solutions will not be enough to address the problem. Current policy restrictions as well as limited network and platform interoperability hinder the Army's ability to share data, system capabilities, and even network connectivity, which constrains the ability to access and provide capabilities. To be successful in MDO, Army fires must be enabled by JIIM sensors and shooters to seamlessly integrate and converge fires into operations. This requires improved information sharing with JIIM partners to integrate the full range of capabilities available and enable seamless integration. Interoperable systems and the impleme the Army to increase the magazine depth of multi-domain capabilities available to address the threat.

Embracing the Future

Regardless of how imperfectly the Army divines the future, an analytical approach proves most viable for shaping the future force and how it will employ emerging technologies, making the future battlefield more lethal within an operations tempo, which will strain human endurance and ability to synthesize. The AC-Fires attempts to provide a foundation for understanding these challenges. The AC-Fires introduces new and innovative capabilities for testing and experimentation in the coming years, described in detail in its Science and Technology appedix.

The AC-Fires describes fires capabilities necessary to execute MDO within the context of a central idea, which provides the framework for the components of the solution presented – echeloned capabilities, enhance sensor-to-shooter linkages, multi-domain targeting and leveraging JIIM capabilities. Derived with data captured from experimentation, ntation of cross-domain solutions are required to optimize operations and facilitate real-time coordination of fires. Leveraging JIIM capability allows these components of the solution drive discussion and frame future assessments for leadership, industry, and capability developers. Army fires will continue to play a critical role in joint force operations. These operations in the future OE will occur in all domains, requiring the Army as part of the joint force to counter complex, advanced peer threats. For the Army to execute MDO throughout the expanded battlefield, fires must be delivered responsively, integrated at all echelons and across the joint force.

The Army Concept for Fires provides broad conceptual underpinnings topursue future technologies, capabilities, and doctrine, organizations, training, materiel, leadership and education, personnel, facilities, and policy solutions to modernize and equip Army fires to support MDO. On track to be officially released this summer, the Army Concept for Fires is a must read for all leaders, especially those who play a role in the integration and employment of fires. Thinking about future warfare is a professional responsibility and an essential part of preparing for victory against emerging threats.

Author Biographies

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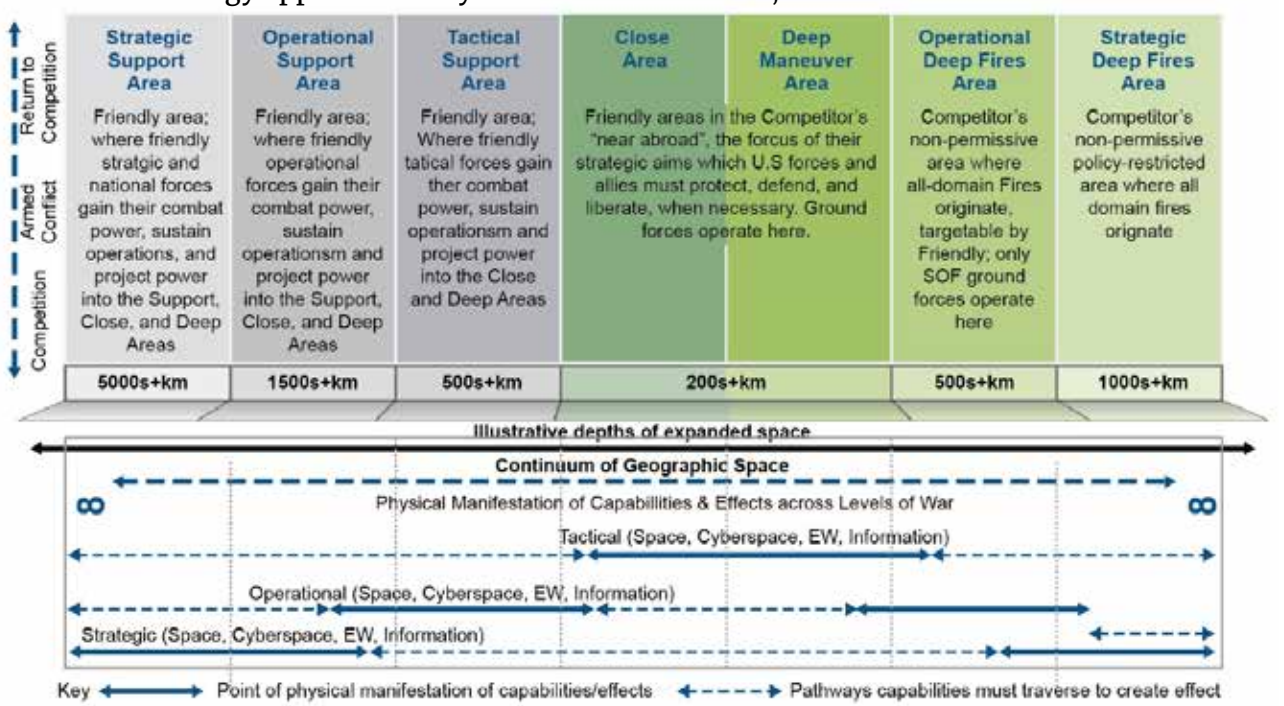

The U.S. Army Concept for Fires 2028-2040

The *fires warfighting function* is the related tasks and systems that create and converge effects in all domains against the threat to enable actions across the range of military operations.

Operational Environment

- Russian and Chinese long, mid, and short-range missile capabilities overmatch U.S. Army fires capabilities with advantages in capacity, range, and lethality
- Air/Land/Maritime superiority is not assumed. Russian and Chinese A2/AD capabilities limit USAF/USN/USMC/USA access in the operational and strategic fires areas
- Russia and China employ an integrated long-range fires complex, protected by integrated air defense systems (IADS), designed to mass fires on friendly maneuver from stand-off ranges
- Russia and China can contest in all domains with cyber, information warfare, and space-based ISR capabilities integrated with long range surface to surface and surface to air systems

Russian and Chinese Threat Capabilities

- Ballistic, Cruise, & Hypersonic Missiles
- Cyber & Information Warfare
- Unconventional Warfare
- Fixed & Rotary Wing Aircraft
- Integrated Air Defenses
- Recon-Fires-Strike Complex
- Long/Mid-Range Massed Artillery
- Unmanned Aircraft Systems
- Electronic Attack
- Counter Space & PNT
- Directed Energy
- CBRNE & WMD

Military Problem: *How does Army fires enable the joint force to compete below the threshold of conflict and, if necessary, during conflict employ and converge multi-domain effects throughout the depth of the battlefield to target and counter A2/AD capabilities, defeat threats, enable joint maneuver in MDO, and return to competition on favorable terms?*

Central Idea: *Army fires contributes to the joint force by enabling deterrence in competition, and in armed conflict integrates and employs fires at all echelons, throughout the depth of the MDO battlefield framework, to penetrate and dis-integrate A2/AD capabilities, defend critical assets, and defeat threat capabilities to enable joint force maneuver. During return to competition, Army fires contributes by posturing capabilities and reconstituting forces to preserve the favorable condition established during conflict.*

Components of the Solution

Echeloned Capabilities

- Army fires structure and capabilities at all echelons
- Shaping in depth/layered defenses
- Improved range, lethality, mobility, and survivability
- Convergence of effects

Enhanced Sensor-to-Shooter

- Any sensors, best shooter
- JIIM network integration
- Redundant and assured communications
- AI enabled targeting, airspace and information management

Multi-Domain Targeting

- All-domain target development in competition
- Improved deliberate and dynamic target execution
- Lethal and nonlethal fires convergence

Leverage JIIM Capabilities

- Access to JIIM sensors and shooters
- Shared understanding
- System and network interoperability
- Seamless integration

Key Fires Actions in Multi-Domain Operations by Echelon

XXXX Theater Army / XXXX Field Army

- Support targeting in all domains
- Set the theater for fires (calibrated force posture)
- Establish theater fires architecture and linkage to supported CJTF / GCC
- Conduct strategic attack, J-SEAD, Air Interdiction
- Penetrate and dis-integrate A2/AD capabilities
- Assist development/prioritization of critical asset lists
- Assist development and dissemination of AADP, ACO, ACP, SPINS
- Provide AIAMD SA/SU to all echelons and JIIM partners
- Provide AMD forces for theater asset defense
- Provide theater AMD early warning

XXX Corps

- Defeat threat long-range fires
- Penetrate and dis-integrate A2/AD capabilities
- Integrate cross-domain fires (CEMA/IO)
- Employ J-SEAD
- Develop Corps CAL/ADP in coordination with Theater/JIIM
- Recommend ACMs for ACO inclusion
- Integrate sensors into common operational picture
- Develop Corps EMCON plan

XX Division

- Employ proactive and reactive counterfire, SEAD
- Reinforce BCT fires
- Integrate cross-domain fires (CEMA/IO)
- Set conditions for BDE cross domain maneuver
- Develop Division CAL/ADP in coordination with Corps/JIIM
- Assist in airspace deconfliction
- Provide AMD forces to support Division Area Defense Plan
- Integrate sensors into common tactical picture

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2019 Henry A. Knox Award

Congratulations to Headquarters and Headquarters Battery of the First Infantry Division Artillery, Fort Riley, Kan.

The 1ID DIVARTY Fort Riley, Kan., took full advantage of every training opportunity in fiscal year 2019 and executed its missions with distinction. The train-up and execution of the Multi-National Warfighter Exercise 19-04 and support to Operation Atlantic Resolve through the 1ID Forward Deployed Mission Command Element in Europe, propelled the battery towards realizing its full potential as the senior element responsible for every aspect of the fires warfighting function within the 1ID.

The Henry A. Knox Award is named after the first Chief of the Field Artillery, and first Secretary of War, Major General Henry A. Knox. The award recognizes the most outstanding active component battery. Originally called the Knox Trophy and Medal, the awards were established in 1924 by the Chief of the Field Artillery and presented annually. The trophy recognized the best Field Artillery battery and the medal recognized the best enlisted Field Artillery Soldier. Before World War II, the awards were not presented. In 2002, the Knox Trophy was reinstated and the medal was replaced with the Gruber Award to recognize individual Soldiers.

2019 Edmund L. Gruber Award

Congratulations to CW3 Christopher Ludwick with Headquarters and Headquarters Battery, 3rd Battalion, 320th Field Artillery Regiment, 101st Airborne Division Artillery, 101st Airborne Division (Air Assault), Fort Campbell, Ky.

Throughout his career, CW3 Ludwick has demonstrated incomparable leadership and dedication to the Field Artillery as both an enlisted NCO and warrant officer. While serving in the 3rd Brigade Combat Team, 101st Airborne Division (Air Assault) as the brigade targeting officer, CW3 Ludwick significantly enhanced the lethality and capability of the brigade. He created, and masterfully implemented, a revised targeting process, providing more lethal and non-lethal options to the brigade commander. This targeting process acutely serves air assault and airborne forces, in support of large-scale combat operations, and is primed to be aopted throughout the division and beyond.

An output of the targeting process resulted in the creation of nondoctrinal targeting products and facilitated more effective synchronization within the brigade operations process. His creativity led to recognition by the Joint Readiness Training Center leadership in March 2019 as a best practice as well as a feature in the quarterly Center for Army Lessons Learned Insider newsletter.

The Edmund L. Gruber Award is named after Brigadier General Edmund L. Gruber, a noted Field Artillery officer, who as a first lieutenant in 1908 composed the "Caisson Song," which the Army adapted a "The Army Song" (The Army Goes Rolling Along) in 1952. The Gruber Award was established in 2002 to recognize individual Field Artillery Soldiers for innovations that resulted in significant contributions to enhance the Field Artillery's war fighting capabilities, morale, readiness and maintenance.

2019 Alexander Hamilton Award

Congratulations to Charlie Battery, 1st Battalion, 161st Field Artillery, Kansas Army National Guard.

Charlie Battery's mission is to destroy, neutralize or suppress the enemy by cannon fire, to help integrate all fire support assets to dominate large-scale combat operations and on order to conduct Civil Support Operations in support of Defense Support to Civil Authorities (DSCA). The battery executed their assigned mission in an exemplary manner by participating in multi-national partnerships in support of Operation Spartan Shield, and security force missions in support of Operation Inherent Resolve as assigned. Charlie Battery participated in Table XVIII gunnery qualification while in country.

Additionally, the unit achieved numerous significant readiness milestones including: a 100 percent duty MOS qualification, meeting 119 percent of their reenlistment mission, 100 percent Army Physical Fitness Test (APFT) take rate, 88 percent APFT pass rate, and 100 percent qualification on personal weapons. The unit led the battalion in the Noncommissioned Officer Education System with an overall 100 percent completion and also ranked among the highest within the state with a 100 percent assigned strength, and an exceptional 100 percent duty MOS qualification, all contributing to the unit's overall success. Charlie Battery rear detachment Soldiers also excelled at mission execution by supporting DSCA activities during multiple periods of state active duty. Charlie Battery participated in ceremonial salutes, wildland firefighting efforts as well as supported stranded motorist assistance and recovery teams during winter inclement weather.

The Alexander Hamilton Award recognizes the best Army National Guard Battery. It was created in 2002 and is named after American Statesman and Continental Army Artilleryman Alexander Hamilton. Alexander Hamilton was an outstanding artillery battery commander and a skilled cohort of General George Washington during the Revolutionary War. Hamilton helped frame the U.S. Constitution and served as the nation's first Secretary of the Treasury.

ASYMMETRIC ARTILLERY:

Achieving Economical Operational Effects in an Era of Austerity

Colonel Brian P. Duplessis

Introduction

Throughout its illustrious history, field artillery has enjoyed the well-deserved reputation as the arm of decision for destroying, neutralizing, and suppressing enemy units and capabilities which threatened our maneuver forces. Fittingly, General George Patton once remarked, "I do not have to tell you who won the war. You know, the artillery did."[1]

Despite such glowing endorsements we cannot remain content to sit on our laurels; we must aggressively strive to influence the action beyond traditional close support to maneuver forces. We can and should endeavor to provide low-cost operational effects in support of Joint Force Commanders. Programed advances in munitions, firing platforms, command and control (C2) systems, and target acquisition can yield heretofore unimaginable ranges with enhanced effects against non-traditional targets such as enemy maritime capabilities. Alluring as this is however, we cannot wait for next year's promises to come to fruition; we must act boldly today. Furthermore, given ongoing economic decline, we must assume reduced future defense spending further delaying attainment of these enhanced capabilities. These delays do not, however, equal irrelevancy.

Artfully employed, with prudent risk acceptance, conventional field artillery firing today's munitions can achieve operational effects to include sea control,[2] sea denial,[3] and air superiority at relatively low-cost. Three historical vignettes from the middle ages, world war two, and the cold war era provide salient examples.

The Ottoman "Throat Cutter," Sea Control Facilitating a Land-Centric Campaign (1453)

"Hey Constantinople! Either I take you, or you take me!"[4]

By 1451, the Ottoman Empire was in ascendancy having occupied or-subjugated most of Anatolia and the Southern Balkans (see Figure 1). The Byzantine Empire, chief Ottoman competitor, was conversely in decline. The once-powerful Byzantines were reduced to a sclerotic rump state centered on their capital city Constantinople.[5] Strategically located, Constantinople links Europe and Asia as well as connecting the Black and Mediterranean Seas via the Bosporus Strait, the sole Byzantine link to their Black Sea and Anatolian exclaves. Nevertheless, the Byzantines believed they could indefinitely hold Constantinople protected by the city's seemingly impenetrable walls and confident of uninterrupted resupply from the sea. These assumptions were reasonable as seven previous Sultans had floundered on Constantinople's walls while largely ceding the maritime domain.[6]

This was soon to change as a young aggressive Sultan assumed the throne. Undeterred by his predecessors' failures, Mehmet II resolved to seize Constantinople without delay.

He meticulously analyzed the operational environment and astutely assessed the key Byzantine lifeline - the Bosporus Strait - was also a major liability, a critical vulnerability by modern terms. Mehmet sought control of the Bosporus as a key shaping action prior to besieging and ultimately seizing Constantinople.[7] Deprived of this lifeline, Constantinople would lack the grain, revenues, and reinforcements desperately needed and unobtainable elsewhere. Weakened as such, Byzantine resolve would not last as it had during previous sieges.

To achieve this goal, Mehmet ambitiously decided to build a fortress at the Bosporus' narrowest point using his newly acquired artillery to interdict vessels failing to halt. The plan was audacious as the fortress was sited on nominally Byzantine territory but lay directly across from an Ottoman fortress on the Bosporus' Asian shore (See Figure 2).

Despite his Viziers' warnings,[8] Mehmet was willing to risk this provocative action correctly assuming the Byzantines were too weak to react. Secretly, he amassed the required building materials, laborers, and artisans. Once all pieces were set, the fortress was erected in four months, a herculean effort for the era.[9] This middle ages expeditionary advanced base sealed Constantinople's fate.

Rumeli Hisari, literally "Fortress in the Land of the Romans," was outfitted with heavy cannon and garrisoned by 400 first-line Janissary troops.[10] I In November 1452, the garrison was first tested when two Venetian ships successfully ran the blockade. The next challenger was not so lucky and summarily sunk by artillery fire with the survivors executed as an example to others. No further vessels tested the

blockade effectively solidifying Ottoman control of the Bosporus.[11] The resulting lack of Black Sea-sourced provisions, revenues, and reinforcements gravely impacted Constantinople. Given Mehmet's eventual thin margin of victory, Rumeli Hisari was the key shaping action that set conditions for future operational success; the fortress fully earned its colloquial nickname, "The Throat Cutter."

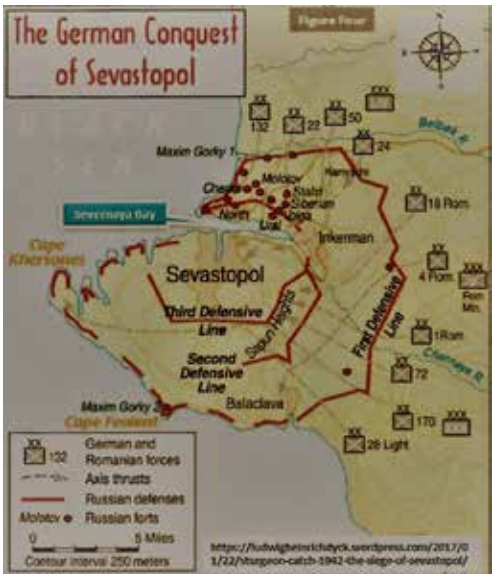
Land-Based Sea Denial: Sevastopol (1942)

"...in the hands of an enemy with command of the sea the Crimea was liable to become a serious menace deep in the flank of the Eastern Front, quite apart from the fact that the air bases would continue to threaten the Rumanian oilfields."[12]

The Crimean peninsula also constitutes strategic terrain (See Figure 3). Site of the fabled Charge of the Light Brigade, English, French, Sardinian, Greek, Turkish, and German invaders have all sought this prime real estate; World War Two was no different. Three weeks after Hitler's invasion of the Soviet Union, Crimea-based bombers successfully raided Rumanian oil facilities, Germany's sole petroleum source.[13] Consequently, Hitler directed this "unsinkable aircraft carrier" be seized without delay. Additionally, the Crimean port of Sevastopol hosted the powerful Black Sea Fleet.[14] Directed to capture the Crimea, Field Marshall Erich von Manstein correctly saw the Black Sea Fleet as the Soviet center of gravity.[15] Specifically, the fleet provided theater-wide reinforcement and evacuation, naval gunfire, and amphibious assault capability. Conversely, due to Montreux Convention restrictions, Germany was barred from sending ships into the Back Sea and was forced to rely on the Luftwaffe to counter the fleet.[16] Finally, the Germans sought to deter Turkey from joining the Allies and protect the flank of a planned advance into the oil rich Russian Caucasus.[17]

Manstein's initial attack into the Crimea was overwhelmingly successful as his 11th Army rapidly seized the peninsula, less

Sevastopol.[18] For the final attack, he elected to make his main effort in the north (See Figure 4), despite its daunting defenses, as possession of Severnaya Bay's north shore would place the harbor under effective observed artillery fire denying the Black Sea Fleet's anchorage, a critical requirement.[19] [20]



On the verge of seizing the north shore, Manstein was placed in a dilemma when the Black Sea Fleet conducted amphibious assaults in his rear. Despite crushing both lodgments, Manstein settled in for a siege as his army recovered and refit.[21]

Once ready to resume the offensive, Manstein again cast his main bid in the north. Attainment of the north shore was even more urgent as the attacking Germans faced eminent loss of critical air support to higher priority operations. Additionally, the Luftwaffe was running critically low of aerial ordnance forcing riskier and more numerous attacks for maximum accuracy.[22] After brutal fighting, Manstein's forces seized key observation posts facilitating observed fire against the harbor. Faced with this new threat, the fleet withdrew to lesser Caucasian anchorages and largely ceased to be a threat. Without naval support, Soviet positions became untenable and Sevastopol soon succumbed.[23]

While the Luftwaffe terrorized the Black Sea Fleet, dropping more ordnance on Sevastopol than was dropped on the entire United Kingdom throughout the war,[24] they were unable to nullify this enemy center of gravity. For example, during the siege's final month, the fleet brought in 24,000 reinforcements, 15,000 tons of cargo, and

evacuated 25,000 wounded.[25] Only when the main harbor became subject to artillery fire was Admiral Oktyabrsky forced to cease operations. Artillery fire further interdicted makeshift harbors, such as Cape Khersones.[26]

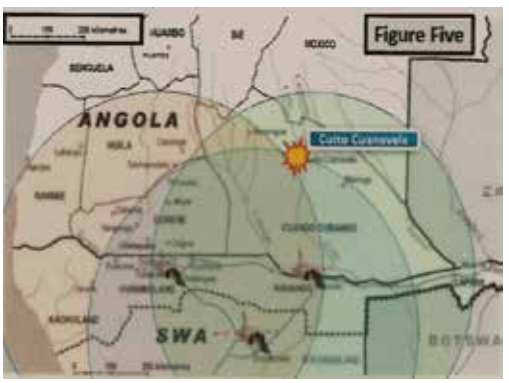
Once again, field artillery proved to be the arm of decision achieving operational effects with tactical weaponry.[27] With the capture of Sevastopol, the Soviet threat to the Romanian oil fields was removed, Turkey was deterred, and the German flank was secured.[28]

Air Superiority through Artillery: Cuito Cuanavale (1987)

"The G5 artillery groups … commenced bombarding Cuito. The South African Air Force sent in 4 Mirages as a decoy and while the MiGs were being rolled out …the G-5s pounded the runway with shells. Within a short space of time the airfield was destroyed and the remaining MiGs were forced to move back to Menongue."[29]

Throughout the 1980s, the South African Defense Force (SADF) fought an undeclared war against Angola's Soviet and Cuban backed People's Movement for the Liberation of Angola (MPLA) regime. In 1987, this imbroglio exploded as SADF 20 Brigade counterattacked deep into Angola. The campaign's climactic battle of Cuito Cuanavale demonstrated the potential of field artillery fires to disrupt, in some cases deny, air operations.

After this deep pursuit, SADF formations operated at the extreme range margins of friendly air support which could provide only three



SADF forces found themselves increasingly under air attack and often limited to night operations. In response, SADF Commanders creatively employed their tactical center of gravity against the MPLA air arm: a grouping of G5 and G6[31] 155mm howitzers. Boasting 40 km range and high accuracy, the G5/G6s were the gold-standard of 155mm howitzers in 1987-88. Accordingly, a 1989 Defense Intelligence Agency assessment rated these weapons as the most effective employed by either side.[32] Accepting risk, SADF Commanders positioned their G5/G6 group within range of Cuito and Cuanavale airfields placing devastating fires on aircraft, runways, and support infrastructure denying air operations and, on at least one occasion, destroying taxiing aircraft.[33]

In response, MLPA aircraft shifted from defensive counter-air and close air support to armed reconnaissance against the G5/G6 group without success. Furthermore, these low altitude flights rendered the MiGs vulnerable to stinger missiles with multiple aircraft lost and prohibitively raising the cost to the MPLA. On the horns of a dilemma, MPLA relocated their aircraft abdicating air superiority and thus limiting their close air support edge.[34] Field artillery fires once again proved an asymmetric avenue to defeating the enemy center of gravity delivering low-cost operational effects.

Conclusion

The preceding case studies clearly demonstrate the operation potential of field artillery against enemy units/capabilities outside our tactical core competency of close support. Possibilities for future application are limited only by imagination and reasonable risk acceptance. A hypothetical confrontation with Russia provides an illustrative example of how field artillery today can create low-cost operational effects.

Russia is not the Soviet Union, but faces the same naval dilemma of four geographically separated fleets incapable of mutual support[35] and susceptible to interdiction. Specifically, the Black Sea, Baltic Sea, and Pacific Fleets are vulnerable to confinement in the Black and Baltic Seas and the Sea of Okhotsk. Field artillery, positioned on key maritime terrain and working with other joint capabilities, could threaten these close and confined waters allowing the Maritime Component Commander to concentrate against the North Sea Fleet, the most dangerous formation. Such an economy of force concept of employment matches the Commandant of the Marine Corps' direction for, "exploiting positional advantage and defending key maritime terrain that enables persistent sea control and denial operations forward."[36]

While we are not optimized for engaging maritime targets today, the mere threat of field artillery can cause an adversary to modify his operational calculus. For example, the threat emanating from North Vietnam's meager artillery park caused U.S. naval gunfire ships to increase offshore distance and conduct evasive maneuvering to avoid this unsophisticated threat degrading the quality of gunfire support to forces ashore.[37]

While pursuit of Multi-domain Task Forces and Theater Fires Commands combined with pending acquisition of anti-ship missiles are positive steps for the future, we other need to be ready to fight tonight. We cannot drop our proverbial pack during this widening window of vulnerability idly awaiting arrival of "wunderwaffen" while simultaneously facing inevitable defense budget austerity. The U.S. Field Artillery has been world class for 75+ years not due to equipment prowess, but due to superior doctrine, C2, training, and leadership. Upon these pillars rests the outcome of tomorrow's fights. While the character of war has dramatically evolved, the nature of war has not. Mehmet, Manstein, and the SADF defeated their enemies' center of gravity via a natural bias for action, creativity, and assumption of risks their opponents discounted. I sincerely hope we demonstrate the same mettle as tomorrow's victory will demand it.

About the Author:

Colonel Brian P. Duplessis is a USMC Field Artillery officer that is currently serving as the Deputy Commander of Expeditionary Strike Group 2.

Notes:

1. https://www.azquotes.com/quotes/topics/artillery.html
2. Sea control operations are seek to secure use of the maritime domain by one's own forces and to prevent its use by the enemy. JP 3-32: Joint Maritime Operations.
3. Sea denial operations seek to prevent enemy use of the maritime domain without controlling it for one's own use. Sea denial is inherent to sea control. JP 3-32: Joint Maritime Operations.
4. Source: https://quotepark.com/authors/mehmed-ii/
5. Constantinople is modern Istanbul Turkey
6. Crowley, Roger; 1453: The Holy War for Constantinople and the Clash of Islam and the West.
7. Rise of Empires: Ottoman, Episode One
8. Ottoman Viziers were the Sultan's primary ministers and advisors
9. Crowley.
10. Janissaries were formerly Christian young men (principally from modern Albania, Serbia, and Bosnia) taken as youths, converted to Islam, taught Turkish, and trained as full-time professional soldiers maintaining a Spartan-like existence. They constituted the Sultan's elite.
11. Crowley.
12. Manstein, Erich von. Lost Victories. Pg 129.
13. Soviet Storm, War in the East, Episode Three: The Defense of Sevastopol.
14. In 1941, the Black Sea Fleet consisted of: 1 Battle ship, 6 Cruisers, 16 Modern Destroyers, 6 Old Destroyers, 44 Submarines, and numerous freighters and transports.
15. https://ludwigheinrichdyck.wordpress.com/2017/01/22/sturgeon-catch-1942-the-siege-of-sevastopol
16. The 1936 Montreux Convention governs passage through the Bosporus and Dardanelle Straits. Per the convention, only Black Sea states are permitted to have capital ships in the Back Sea. Turkey, as owner of the straits, is also permitted to close the straits in time of war. Ultimately, the only axis vessels in the Black Sea were motor torpedo boats which navigated the Danube River to its Black Sea estuary.
17. Manstein. Pg 127.
18. Manstein. Pg 134.
19. Manstein. Pgs 136 & 148.
20. When the Soviets recaptured the Crimea in 1944, they undertook a similar scheme of maneuver to deny German evacuation by sea. In our own history, Henry Knox's artillery surreptitiously occupied Boston's Dorchester Heights threatening Boston Harbor and forcing the British fleet and occupying army to evacuate, the first expulsion of British forces from a major city during the War of Independence.
21. Manstein. Pgs 136 & 137.
22. Manstein. Pgs 148 & 153.
23. https://ludwigheinrichdyck.wordpress.com/2017/01/22/sturgeon-catch-1942-the-siege-of-sevastopol
24. Hayward, Joel. Stopped at Stalingrad: The Luftwaffe and Hitler's Defeat in the East, 1942–1943. PG 96
25. https://ludwigheinrichdyck.wordpress.com/2017/01/22/sturgeon-catch-1942-the-siege-of-sevastopol
26. https://ludwigheinrichdyck.wordpress.com/2017/01/22/sturgeon-catch-1942-the-siege-of-sevastopol
27. During the siege of Sevastopol, the Germans employed artillery behemoths such as the 800mm "Dora" rail gun and a pair of 660mm Mortars "Thor" and "Odin." These leviathans had little practical effect and did not impact the Black Sea Fleet's operations.
28. https://ludwigheinrichdyck.wordpress.com/2017/01/22/sturgeon-catch-1942-the-siege-of-sevastopol
29. Morris, Michael. Fighting Columns in Small Wars: On OMFTS Model. Pg 53
30. http://samilitaryhistory.org/vol091ig.html
31. The G5 is towed while the G6 is wheeled self-propelled. Both feature a 52 caliber cannon tube and fire a wide suite of ammunition to include Extended Range Full Bore (ERFB) base bleed HE.
32. 1989 Defense Intelligence Agency: The 1987-88 Combat in Southern Angola: Lessons Learned.
33. http://samilitaryhistory.org/vol091ig.html
34. Morris. Pg 53.
35. https://nationalinterest.org/blog/buzz/russia-not-soviet-union-it-has-same-navy-nightmares-91851
36. 38th Commandant of the Marine Corps' Planning Guidance
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Airspace Prioritization

A methodology for airspace planning in large-scale combat operations

MAJ Ryan Johnson

"Weapons and units work more effectively when they operate together. No single action, weapon, branch or warfighting function generates sufficient power by itself to achieve the effects required to prevail."[1] This statement comes to us from ADP 3-90, Offense and Defense and it captures the essence of how we fight. Our joint and U.S. Army doctrine is built around fighting as a team. Our effectiveness, efficiency and lethality increase when all of our branches and all of our capabilities work in concert with one another. To fight and win against a near-peer adversary we truly must be the 'Musicians of Mars' that GEN George S. Patton described in his famous quote. A major component of this combined arms mindset is air-ground integration. Unfortunately, as evidenced in every "key observations" report that the Mission Command Training Program (MCTP) produced from present back to FY15, we tend to struggle with effectively integrating air and ground assets to mass effects on the enemy. This article will delve into why we tend to struggle in this area and offer a potential solution in the form of an airspace planning methodology.

The greatest symptom that manifests itself from our challenges in air-ground integration is ineffective surface-to-surface fires as a result of slow and cumbersome airspace clearance procedures. I witnessed this as an observer, coach or trainer with MCTP, I lived it as a division fire support officer and Joint Air-Ground Integration Cell chief, and the MCTP annual "key observations" reports validate it. The root problem, however, is several layers deeper.

Airspace clearance is overly cumbersome and slow because, more often than not, our unit airspace plans (UAPs) are poorly thought out and not maintained to stay relevant in a dynamic fight. Our UAPs are essentially our framework for how we are going to integrate all airspace users, and they are comprised of individual airspace coordination measures (ACMs). The doctrinal basis for this is in FM 3-52 Airspace Control which states that "Army commanders use airspace coordinating measures to facilitate the efficient use of airspace and simultaneously provide safeguards for friendly forces."[2] Now, to look more deeply at the problem, we must ask ourselves, why do we tend to struggle so much with developing useful UAPs?

There are ample reasons our UAPs tend to be inadequate: lack of detail, infeasible, do not account for all airspace users and not complete. The biggest cause, however, is that we fail to appropriately prioritize airspace usage based on the nature of the current fight we are in. Prioritizing airspace usage is the foundation of our UAPs, and like any structure, it cannot stand if we don't build it correctly from the ground up.

Airspace usage prioritization is crucial because, like all prioritization we do in the military, it guides our planning efforts, resources and focus. Unfortunately, we seem to consistently skip over this critical step. We are all victims of our own recent experiences and we tend to automatically prioritize fixed-wing assets as the primary airspace users. This mindset is derived from two places. First, our experience over the past 15 years fighting counterinsurgency where fixed and rotary wing assets were clearly, and rightfully so, the primary airspace users. And, second, we also tend to drag priorities from one phase of the fight into another even though the nature of the fight has changed. In the joint phasing model Phase III and Phase IV ("seize the initiative" and "dominate" respectively) are the arenas where warfighter exercises take place and largely consist of large-scale ground combat operations. There is a portion of the fight where the "… joint force commander seeks to degrade enemy capabilities …"[3] that is typically characterized by significant deep shaping operations, most of which are conducted by fixed-wing assets with very few long-range surface fires in support. During this portion, the initial shaping effort, it

1. Build the team
2. Prioritize airspace usage
3. Plan for the surface fires fight
    a. Template the enemy
    b. Build CFFZs
    c. Template pre-planned deliberate fires
    d. Position friendly artillery
    e. Build surface fires AMCs
4. Integrate rotary wing assets
5. Integrate joint assets
6. Plan for UAS

Figure 1. Steps in the unit airspace planning process. (Courtesy information)

Division Staff		DIVARTY Staff	CAB Staff
DFSCOORD/FSO	G3 (rep)	S3	S3
Targeting Officer	G5 (rep)	S2	S2
FAIO	G2 (rep)	FCO	TACOPs
ALO	Collection Manager	Targeting Officer	Senior Pilot
CM+D Officer	G3 Air	Counterfire Officer	ISR
AMD	Airspace Manger		

Figure 2. The minimum required personnel and positions to establish a UAP team. (Courtesy information)

is logical that we would build our airspace plans around our fixed-wing assets. As we transition to ground combat, however, the fight changes and we see a significant increase in surface fires utilization. Even though the nature of the fight has changed, and therefore airspace usage has changed, we oftentimes do not readdress our airspace usage prioritization accordingly. In large-scale ground combat operations, from what we have learned from simulating a peer/near-peer fight in warfighter exercises over the past decade, it is a fires fight and surface fires occupy the airspace for a preponderance of the battle.

The price of not accurately prioritizing airspace usage in support of large-scale ground combat operations is slow and ineffective surface-to-surface fires. So, how can we correct this? The following methodology describes how to build a UAP that will enable rapid surface fires and full integration of all air users. Of note, this example is written through the lens of a division planning effort, but it is applicable at any echelon.

Step 1 Build the Team

Building a UAP is a team effort, to be successful you have to have the right people involved. The team should include at a minimum all of the personnel listed in the Figure 2. It is also critical to know when to bring this team together. If we want true integration of our air-ground assets we need to build our airspace plan simultaneously with our maneuver and fires plans. This means that we need to be discussing airspace as soon as we start the military decision-making process (MDMP). The "air-space team" should come together frequently throughout MDMP with the bulk of the conceptual work being done during the course of action development (COA DEV) process and the detailed work being done somewhere around COA approval. Like all of our planning efforts, we must plan for airspace continuously.

Step 2 Prioritize airspace usage

The basis for this planning methodology is that we will first prioritize airspace usage based on the nature of the fight, and subsequently build our UAP around that usage. Our repeated simulations during warfighter exercises of a peer/near-peer fight show that surface fires are the primary airspace user. Therefore, in this methodology, we will begin sculpting our airspace plan for surface fires first, specifically our counterfires.

Step 3 Plan airspace for the surface fires fight

This includes both preplanned deliberate fires as well as counterfires. The following substeps break this process down.

Step 3A Template the enemy

This does not have to show the entire event template, simply focus on high payoff targets. Of critical importance here is the marriage of the Division Artillery (DIVARTY) S2 and division G2 sections (ie. fusion, collection, targeting). It cannot be overstated how important it is for the two organizations to collaborate to develop the best possible and most detailed assessment for how the enemy is going to employ his artillery assets and where they will be located on the battlefield.

Step 3B Build call-for-fire zones (CFFZs) over enemy long-range artillery (LRA)

Once we have templated the enemy LRA it is time for our DIVARTY counterfire officer to build CFFZs. Since templating the enemy is not an exact science, these CFFZs should be large enough to encompass error in our enemy template, dispersed enemy artillery formations and the survivability moves that the enemy will inevitably conduct. It is a balance however, as we do not want to unnecessarily consume space that other airspace users could utilize.

Step 3C Template preplanned deliberate fires

These are commonly fires that support the preparation of objectives or other relatively known or fixed locations. Plot them on the map to visually show them just like we did with the CFFZs in step 3B.

Step 3D Position friendly artillery

Now that we know where we are shooting, we can appropriately place our friendly artillery. Presumably, the DIVARTY has already created a position area for artillery (PAA) overlay based on terrain analysis that will help narrow down our options. This is a collaborative effort between the DIVARTY staff and the G3 and G5 to ensure that we place our artillery in positions where we can maximize the effectiveness of our munitions ranges while balancing terrain management and risk to the force.

Step 3E Build surface fires ACMs

Once we know where we are shooting to and from, we can build ACMs to "pre-clear" the airspace for the surface fires fight. The goal is to account for all of the airspace needed to shoot anywhere inside the CFFZ or target areas without being overly restrictive to other airspace users. The best technique to accomplish this is to utilize "SSMS" geometries. A Surface-to-Surface Missile System (SSMS) is a combined geometry that consists of the position airspace hazard (PAH), target airspace hazard (TAH), and missile flight path (MFP). Leveraging advanced Field Artillery tactical data system and target areas of interest (TAIS) you can gain the technical firing solutions by running digital dry fire missions from the center of your PAAs to the lower-left corner of the CFFZ and the upper-

right corner of the CFFZ (or target area for planned fires). The resulting geometries provide you the data (PAH, TAH, MFP, and maximum ordinate) to submit into your UAP to create a pre-cleared zone of airspace for surface fires that you can turn on and off as needed. This is similar in concept to how artillerymen build their safety T's. This technique is preferred because it is the least restrictive and allows the Air Force master air attack plan planners the most flexibility.

Step 4 Build a network to integrate rotary wing assets

Rotary wing assets are relatively simple to integrate. The coordination level ensures vertical deconfliction from other airspace users, our only concern then is lateral deconfliction from our artillery assets. Our goal here is to create some sort of a simple network or framework that will keep our assets from flying directly over our PAAs and target areas and will serve as a common graphic to quickly move assets across the battlefield as necessary. You can accomplish this with a series of checkpoints, establishing zones, or overlaying a grid system. This effort is spearheaded by the combat aviation brigade staff, in coordination with the DIVARTY staff.

Step 5 Integrate joint assets

The next step is to integrate our joint assets. Again, vertical deconfliction is relatively simple. The primary focus of this effort is lateral deconfliction and building the specific ACMs necessary to move fixed-wing assets into and across division airspace without moving through any preplanned artillery missile flight paths. The division air liaison officer is the proponent for this piece of the plan. This includes building kill boxes, air corridors, close air support holding areas, minimum risk routes, etc. Our measure of success is generating a plan that will allow all airspace users the ability to operate simultaneously, in concert with one another, to bring the maximum amount of destruction to the enemy.

Step 6 Plan for unmanned aerial systems

Although they are unmanned we still have to account for their presence in the airspace. Key areas to focus on are their launch and recovery zones and the space they need to climb to their assigned operating altitude. Once they are at altitude and we have achieved vertical deconfliction, we can plan routes to get these assets to and from the named areas of interest and TAIs they are collecting in. The collection manager and ISR reps at echelon lead this part of the discussion with input from all other airspace users.

Step 7 Brief UAP at the combined arms and fires/intelligence rehearsals

This ensures all airspace users understand the initial plan and that the plan is complete. It also generates an appropriate level of pressure and commander involvement.

This simple planning methodology will serve as a handrail to help personnel develop thoughtful and complete UAPs that address the challenging problem set of airspace planning. There are, however, a few additional points to address. First, our discussion during the airspace planning working group mirrors the typical targeting process agenda and provides the division targeting officers a golden opportunity to build or validate all of their initial targeting products. Second, just like the targeting officers, the collection manager can use this planning effort to build or validate their initial collection plan. Third, this is only the initial plan. We first address it during MDMP and it is realistic to build it out to 96 or 120 hours. We then need to maintain and update our plan as the fight unfolds. Since white space in a division battle rhythm is hard to come by, a possible solution is to include the airspace discussion in the targeting working group or conduct a separate airspace working group immediately after. Simply asking "what ACMs do we need to build to ensure our shaping fires are permissive?" is a great segue from the targeting to airspace management discussions. Whenever we choose to do it, we must ensure we have enough time to submit our new ACMs or refinements before the Air Force conducts their master air attack planning On the eve of D-Day, General Dwight D. Eisenhower described the enemy the allies were about to face. His characterization of the enemy rings true to the near-peer opponent we are training to fight today. To succeed we must find harmony in battle with all weapons, branches and warfighting functions complementing one another. Achiev-ing complementary effects in the deep fight requires successful air-ground integration. Appropriately prioritizing airspace usage based on the nature of the fight we are currently in is the foundation for building a solid division UAP that will stand the test of battle. Any infantryman would relish the opportunity to build the terrain they are going to fight on; we need to take the opportunity we have to build the terrain our airspace users will fight on so that it works for us, rather than against us.

1 ADP 3-90 Offense and Defense, July 2019, para 2-47
2 FM 3-52 Airspace Control, October 2016, para B-1.
3 JP 3-0, Joint Operations, 17 January 2017, page V-10 para 3.

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Artillery-Delivered PGMs in LSCO: Insights from the Battle for Mosul

COL Daniel C. Gibson, LTC (P) Scott Pence and CPT (P) Stoney Grimes

The Iraqi Security Forces' (ISF) offensive into western Mosul in the spring of 2017 demonstrated the utility of artillery-delivered precision guided munitions (PGMs) in large-scale combat operations (LSCO). Originally developed during the height of the counter-insurgency campaigns in Iraq and Afghanistan, PGMs provided ground commanders with low-collateral-damage options for defeating insurgents and terrorists on the battlefield. Later 2nd Battalion, 319th Airborne Field Artillery Regiment (2-319th AFAR) would employ PGMs in the 2017 battle for western Mosul. 2-319th AFAR's employment of artillery-delivered PGMs offers insight into the efficacy of these munitions in LSCO against a determined enemy in dense urban terrain. This is relevant to future conflict for many reasons. Knowing that the United States follows jus in bello principles and always seeks to minimize collateral damage and civilian casualties, future adversaries will place their highest value assets in dense urban terrain. This article will describe the environment in which the operation took place, explain the battalion's best practices for PGM employment, and identify the challenges inherent to employing artillery-delivered PGMs in dense urban terrain.

The battle for western Mosul lasted from January to July 2017. During this time, Task Force (TF) Falcon, the 2nd Brigade Combat Team (BCT), 82nd Airborne Division provided support to the Iraqi Security Forces' efforts to liberate the city of Mosul from the Islamic State of Iraq and Syria (ISIS). The ISF depended upon US forces for integrated fires to provide the tactical overmatch essential for success. Despite their possession of indirect fire systems, the ISF could not employ them with the precision necessary to enable their operations. TF Falcon's direct support artillery battalion, 2-319th AFAR, provided many of these fires. To do so, the battalion employed its organic M777A2 battery, a reinforcing M109A6 Paladin platoon, a French general support-reinforcing 155mm Caesar battery, and general support joint fires assets including an M142 High Mobility Artillery Rocket System (HIMARS) platoon.

In 2017, the densely packed urban environment within the city of Mosul consisted of structures varying from two to three-story residential and small business buildings to high-rise buildings over ten stories tall. The city was organized in geometric patterns with buildings arranged in neat blocks bounded by generally wide straight roads. This changed dramatically as one approached the ancient Old Mosul district tucked against the west bank of the Tigris River. The medieval old city featured structures arranged seeming indiscriminately with archaic buildings packed on top of each other. Narrow alleyways, few roads, and a labyrinth of pedestrian thoroughfares weaved between walled courtyards. ISIS added complexity to this already complicated environment.

In preparation for the impending attack, ISIS integrated obstacles in support of a deliberate defense in depth. Using earth-moving equipment captured from the ISF or seized from civilian businesses, ISIS constructed berms and moved rubble to place deliberate obstacles along key avenues of approach into and within the city. The obstacles canalized ISF into deliberately constructed engagement areas overwatched by ISIS fighting positions in structures that were once homes, schools, hospitals, and mosques. Fighters barricaded themselves inside buildings, cutting holes into exterior walls to cover obstacles with fire and observation without being directly observed themselves from outside. Moreover, they cut holes into interior walls so that they could move between adjacent buildings within a block without being visible from either the air or the ground and protected from the effects of small arms fire. If ISF maneuvered without the support of TF Falcon, the defensive positions gave ISIS a clear relative advantage and the Iraqi's would sustain unacceptable combat losses.

TF Falcon sought to degrade the ISIS defensive positions to enable ISF freedom of maneuver. To do so and avoid unnecessary collateral damage, precision munitions, especially M982A1 Excalibur and the M1156 Precision Guidance Kit (PGK), were often the weapons of choice. The M982 Excalibur is a cannon launched GPS guided precision munition with a circular error probable (CEP) of less than 3 meters.[1] The PGK is a GPS-enabled electronic fuze placed on a conventional M795 high explosive or M549A1 Rocket Assisted Projectile that turns it into a near-precision munition with an advertised CEP of less than 50 meters. The PGK can be set to point detonate (PD) or an airburst function known as variable time (VT).[2] 2-319th AFAR would use these capabilities with decisive effects throughout the fight for western Mosul.

On the morning of May 4, the 9th Iraqi Army Division—at the time, the Iraqi Army's only armored division—began its much-anticipated attack into northwest Mosul. 2-319th AFAR supported the assault with precision munitions—predominantly PGK and Guided Multiple Launch Rockets (GMLRS)—allowing precisely placed fires to suppress ISIS fighting positions while minimizing damage to structures. In the dense urban terrain of western Mosul, a miss by as few as 20 meters meant having effects on the wrong side of a block of buildings or behind another piece of urban micro-terrain that resulted in no effects on the intended target. What's worse, tactically, such a miss would cause damage to structures that then became obstacles or fortifications that the ISF would later have to breach. Further, a 20-meter miss might damage in-

1. "Excalibur Projectile," Raytheon Missiles & Defense, accessed May 18, 2020, https://www.raytheon.com/capabilities/products/excalibur.
2. "Northrop Grumman Details Precision Guidance Kit," Monch Publishing Group, accessed May 18, 2020, https://www.monch.com/mpg/news/land/5238-ng-precision-guidance-kit.html.

frastructure or cause civilian casualties that ISIS could exploit for strategic effect targeting the cohesion and will of the coalition. PGK was an ideal option for these fires because of its near-precision capability and its ability to be set to VT. Employing PGK in VT-mode reduced the probability of damaging structures while suppressing enemy fighters on rooftops or dug-in positions. It often forced ISIS fighters to go to ground or displace altogether, allowing the ISF's advance.

2-319th AFAR used precision munitions both for preplanned and on-call targets. On-call targets were often in direct support of ISF at danger close distances where the precise nature of the munitions mitigated the risk to friendly forces. Almost daily, a typical vignette occurred in which Iraqi forces advanced through the city until they made contact with ISIS fighters. As ISIS fighters engaged from prepared positions inside buildings, Iraqi forces took cover, often directly across the street and as close as 12-15 meters from ISIS positions. This produced an urban World War I-like stalemate scenario where adversaries were statically entrenched and engaging each other across an open "no-man's-land." Iraqi forces would then request fires, through their advisor network, to the 2-319th AFAR battalion fire direction center. The battalion's standard response was M795 high explosive fuzed with the M1156 Precision Guidance Kit. Despite the 50-meter advertised CEP of the PGK, the battalion routinely employed these munitions on rooftops or within courtyards with near pinpoint accuracy. As long as the five requirements for accurate fire were met, the technique achieved decisive effects. For small, thin walled structures the battalion employed PGK in PD mode to suppress ISIS fighters in their prepared positions within buildings. These techniques provided the suppression necessary for Iraqi forces to cross one linear danger area after another, assault building after building, block after block.

This suppression was effective unless ISIS fighters were too deeply entrenched within their positions. In such cases, 2-319th AFAR employed Excalibur munitions in multiple precision aim point missions (MPAM) firing multiple Excalibur rounds against different aimpoints on the same target to achieve a destructive effect. While the PGK could only be set to PD or VT, the Excalibur has a delay function that enables the munition to penetrate structures before detonating. An Excalibur MPAM became the mission of choice for engagements where ISIS was fighting from larger, heavier structures because of the munition's ability to penetrate and kill with blast, fragmentation, and overpressure while still leaving the structure standing.

When employing Excalibur, the battalion had to coordinate across multiple layers of command due to the extremely high trajectory, or maximum ordinate, of the Excalibur munition. The munition, fired high angle, followed a trajectory that typically crested over thirty thousand feet above the ground. Without prior planning and coordination, this necessitated a lengthy process to clear the airspace of manned and unmanned aircraft routinely working over the city of Mosul. The battalion mitigated this challenge by designating a target area of interest (TAI) and kept the airspace between the firing unit and the TAI clear of friendly aircraft to minimize the time required to engage targets in the vicinity of the TAI. As an alternative, 2-319th AFAR often employed the PGK fuze in lieu of the Excalibur. The PGK was designed to be fired low angle and thus produced a significantly lower maximum ordinate that reduced the airspace clearance requirements.

Despite these best practices, the environment and ISIS's tactics challenged the battalion's organic capabilities and tactics. When ISIS fighters employed mortars and heavy weapons from firing position in the middle and lower stories of multi-story buildings PGK and Excalibur were often ineffective because neither munition could penetrate deep enough to have effects on the target. Additionally, structures in the target area formed intervening crests that prevented low angle attacks from reaching the target. To overcome this challenge, the battalion coordinated for aerial platforms to employ forward-firing munitions such as the AGM-114 Hellfire missile to achieve the desired effects.

The battle for western Mosul demonstrated that precision artillery fires are not only useful in counter-insurgency operations where civilian casualties and collateral damage are an overriding concern, but also in LSCO scenarios in dense urban terrain. In the battle for western Mosul and the subsequent battle for Tal Afar later that summer, 2-319th AFAR fired more than three hundred M982A1 Excalibur rounds and more than a thousand M1156 Precision Guidance Kits. Artillery-delivered PGMs can be employed rapidly and effectively in close support of maneuver elements to increase the probability of effects with the first round, thus minimizing the number of rounds necessary. This enables maneuver commanders to employ artillery fires at extreme danger close distances with confidence and minimal risk. Further, the reduction in the number of rounds required to achieve effects will reduce the firing time and subsequent vulnerability time of firing units, increasing their survivability. Additionally, firing units can apply MPAM procedures to PGK missions to get a precisely placed area fire effect and mitigate the need for saturation fires or the massing of guns.

The tactics, techniques, and procedures for PGMs in dense urban terrain that 2-319th AFAR used in Mosul could be used in the future to support US military efforts in LSCO. Near-peer competitor countries rely on large-scale volume of massed artillery fire to achieve their effects. However, lethal effects placed precisely can achieve the same outcome as a massive barrage if every round fired counts. The US military can apply these lessons from operations in Mosul to achieve effects on future battlefields.

Fire Support Conditions

CPT Samuel H. DeJarnett, Sr.

Fire supporters are failing to set the conditions for lethal fires. In Syria during ISIS clearance operations, thousands of artillery rounds were fired with less than lethal effects. A recent unit at the Joint Readiness Training Center (JRTC) fired 342 mortar rounds and 120 artillery rounds, in a deliberate defense, without inflicting a casualty on the opposing force. In both environments, most indirect fires (IDF) were not observed. At JRTC, communications with the observers were unreliable and target descriptions unclear. In both situations, ground force commanders struggled to understand the risk associated with each mission. Fire supporters failed in training and combat to set the conditions for IDF to be lethal. Whether at a combat training center (CTC) or in combat, achieving lethal effects with IDF requires three conditions: observation, communication and clearance.

One of the biggest lessons a fire support officer (FSO) can learn at a CTC is to stop focusing solely on planning targets and focus on planning observation. If the senior fire supporter in the Fires cell does not plan observation points (OPs) chances are the junior fire supporters will not either. Most rota tional training units come through focused on producing "fighting products" which exclude the detail of a doctrinal Annex D. These products are most often a target list worksheet, attack guidance matrix, high-payoff target list, fire support execution matrix, and a fire support overlay. Only two of these products, if made correctly, include any instructions for observers. However, the overlay and fire support execution matrix are often ignored by the subordinate commanders, not provided to the company FSOs, or lost when combined with the operations order and graphics. The battalion FSOs must place greater effort in communicating the importance of each OP to the subordinate fire supporters and commanders by including OPs in the task to subordinate units of the operations order. This turns the observation of targets from a recommendation of the staff to a specified task in the operations order. Company commanders rarely ignore a "Task to Subordinate Units" paragraph. After the OP is initially planned and tasked the onus is on the observers to be in the right place at the right time. Observers must use the OACOK (observation and fields of fire, avenues of approach, key and decisive terrain, obstacles, and cover and concealment terrain assessment as a tool and not an excuse. One of the skills the JRTC teaches a unit is how to utilize terrain. The vegetation at JRTC often limits observation to less than 100 meters. This means observers must learn to create observation at key points while at the same time utilizing the vegetation to conceal their OPs. Just as hunters create shooting lanes in the woods, observers must create observation lanes to see their targets and triggers. The National Training Center is effective at teaching the importance of dominating key terrain. The large dominant terrain features force observers to master their optics and conducting line-of-sight analysis. The best observers not only utilize their joint battle command platform (JBCP) or S6's systems planning engineering and evaluation device tool, but a map utilizing contour lines, string and a protractor to do line-of-sight analysis. At JRTC and NTC, observers rarely employ all the optics available on the modification table of equipment. The Lightweight Laser Designator Rangefinders, thermal weapon sights, binoculars and other tools are underutilized resulting in poor observation when light and weather conditions deteriorate and or targets and triggers are at a great distance.

Lack of observation means that the artillery and mortars are firing blind. The risks associated with such actions range from wasted rounds to fratricide. Without ensuring observation of the target, the odds of hitting the enemy targeted are extremely low. Reliable observation also creates the opportunity to adjust fires onto a target and forgo starting a new fire mission. Many consider sending their forward observers forward to observe targets as an unacceptable risk. Is the risk to force and risk to mission higher when firing targets observed or unobserved?

A trusted colleague said that if the observers can't communicate with the higher headquarters, they are just out there camping. The communication condition has two aspects. The first is radio telephone operators (RTOs) at all levels must be able to speak clearly and concisely. This means training to use simple descriptive reports, such as the SALUTE (size, activity, location, uniform, time and equipment), calls for fire formats and identification of threat systems. When RTOs and observers are experts at these skills they can communicate clearly and concisely so triggers and targets can be easily understood. The clear and concise target description alleviates friction in both voice and digital communications.

Establishing a clear understanding of the target enables rapid tactical fire direction and contributes to processing times of one to two minutes per echelon. Without this, processing times from company through the brigade fires cells can range from five-to-ten minutes per echelon and results in confusion and target decay.

The second aspect of communication is using a validated PACE (primary, alternate, contin-

gency, emergency) signal plan. A commonly briefed PACE plan in the Field Artillery world is: primary is FM Digital, alternate is FM Voice, contingency JBCP/joint capabilities release (JCR), emergency is a runner. This plan has serious flaws. It ignores the fact that fire support teams (FISTs) have high frequency and tactical satellite capable radios. The 1694 series, Harris 152 and 117 series radios give the FIST beyond line-of-sight capability that is rarely understood or used. The ability to use these radios to their full potential must be trained before deployment or rotation through a CTC. The PACE above also assumes that each company level FIST has access to a JBCP/JCR. This is most often not the case as it is a primarily mounted system in vehicles that the infantry brigade combat team's FIST does not have and is improbable for dismounts to employ. It also ignores the fact that utilizing a runner is less feasible than a preplanned visual signal. Proficient use of all systems available ensures that leaders at echelon can receive the key calls from observers on time to achieve the desired effect.

Clearance is the last condition and also the one which demands the most from the maneuver units' command posts. Graphic control measures (not just fire support control measures) can enable the proper trigger of target engagement, shifting, echelon and cut-off. Maneuver graphic control measures also enable accurate battle tracking. The awareness of where friendly units are on the battlefield is essential in assessing the risk of each mission. When combined with the clear reports, graphics make visualizing the distance between a target and a friendly unit simple and quick. Commanders must first account for friendly forces distance from the target and then assess the to-tal risk to force and risk to mission. Risk estimate distances give commanders a guide on the risk of munitions within range, but do not take into account the current conditions of each engagement. Fire supporters must have a conversation with the ground force commander concerning other risk-mitigating factors such as weaponeering and degree of cover. Commanders must consider issues like: Are the improved con ventional munitions fired close to the friendly battle position less or more dangerous than the BMP-1s attacking it? Does the risk calculation change with overhead cover, delay fuzes, or ratio of friendly to enemy forces? These are all things the maneuver commander must consider and fire supporters must have the information to inform decision.

Analyzing 116 IDF missions across three JRTC rotations only 45 missions produced lethal effects. Each of these missions had observers in place, clear communications and efficient clearance. Unfortunately, 15 of these missions were friendly forces calling IDF on their positions as they are overrun; final protective fires called after all defensive obstacles are breached; friendly forces within risk estimate distances or sheafs of their missions without understanding the risk. Eleven of these missions also produced civilian or friendly casualties. The trends at JRTC point to the fact that fire supporters are not setting conditions that will enable lethal effects in a conventional fight. Battalion fire supporters must address observation, communication and clearance in training and planning before entering their first fights.

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FA SUSTAINMENT

Wagging the Dog

CPT John Oliver and CPT Russell Vickers

The Fires warfighting function is an ineffective tool for the brigade combat team (BCT) without the rounds to support a brigade commander's priorities and intent for fires. Integration and ample time between planning and execution are critical to the successful sustainment of the Field Artillery battalion. Observer - Coach or Trainers of Field Artillery (FA) cannon battalions at the Joint Readiness Training Center (JRTC) are firsthand witnesses to the success and failure of operationalizing logistics into a maneuver and fires plan, promptly to support the maneuver operation. Directed Field Artillery tasks and enemy formations should drive the unit's fire order (the quantity of ammunition required to achieve a specific target effect), not the sustainment enterprise. This paper discusses the best practices observed at JRTC, to ensure that the sustainment tail does not wag the dog.

Successful planning in the FA battalion has to be collaborative and iterative with the BCT planning timeline. In a competitive environment with a constrained timeline the military decision-making process (MDMP) needs to evolve into a collaborative, rather than a sequen

tial process that focuses on product creation and dissemination. Warfighting products must be produced early to provide the brigade sustainment enterprise the time it needs to execute mission requirements. Due to a lack of ammunition platforms in both the forward support company (FSC) and the brigade distribution company, Class V typically is not stored in large quantities within the brigade. Therefore, it must be requested through division and delivered by the combat service support battalion. Through multiple rotations, we have observed that this process takes anywhere between 48 and 72 hours from request to delivery to the FSC. When an order gets published 72 to 96 hours before the execution, the battlefield calculus and Class V order require a quick turn-around to meet the commander's intent. The MDMP timeline must be closely managed by the FA battalion executive officer to enable successful sustainment operations. It must not only be timely, but also complete, and collaborative. Class V planning requires staff integration and indepth analysis to get the right munitions to the right place at the right time. The FA battalion S2 must provide an accurate intelligence preparation of the battlefield focused on the enemy artillery assets. Through pattern analysis, the S2 can estimate the quantity and types of targets of opportunity for a given battle period (attack, defense, counter-at-tack). In conjunction with the S2, the counterfire officer can estimate the quantity of counterfire missions the unit can anticipate. The fire direction officer (FDO) develops the fire order for given targets. The fire order is derived from estimates combined with planned targets from the target list worksheet and legitimizes the final required supply rate for fuzes, charges, primers and rounds. The FDO must work with the battalion S4 to identify any shortfalls from the known controlled supply rate or unit haul capacity that will require further prioritization.

During continuous combat opeations as observed at JRTC, the FA battalion S4 must find opportunities within the battle rhythm to anticipate requirements. One of those opportunities is the targeting working group. ATP 3-60, Targeting, lays out all of the lethal and non-lethal sections of people who are required to participate in the targeting working group and targeting board. However, the sustainment warfighting function is absent from the attendee roster. The targeting cycle provides an opportunity for logisticians to conceptualize bulk Class V consumption and drive updates to the logistics common operating picture (LOGCOP). The targeting working group also provides updated fire support tasks, attack guidance, and target selection standards that will significantly impact distribution operations. These planning figures provide the battalion S4 an opportunity to update their running estimates with ammunition requirements.

Two other critical battle rhythm events are the brigade and battalion logistics synchronization meetings (LOGSYNC). The FA battalion S4 must maintain an accurate LOGCOP that includes Class V from the firing platoon up through the BSB. The battalion XO must conduct daily LOGSYNC to ensure that the reports building the LOG-COP are accurate and that batteries have visibility of when to expect their next resupply. Utilization and validation of the LOGCOP during the battalion LOGSYNC empow ers the S4 to prepare and communicate needs at the daily brigade LOGSYNC with the support operations officer in the brigade support battalion. Brigade LOGSYNCs also provide the forum for the battalion S4 to communicate his stock shortfalls of Class V and also his distribution limitations and where the distribution company can assist in battery resupply.

In summary, Artillerymen always want to shoot the proper fire order, and sustainers want to provide the right logistics package, but these separate operations are intrinsically linked. Commanders must show the proper emphasis to the sustainment aspect of fire order derivation to achieve the desired endstate. Timely and collaborative MDMP supported by a battle rhythm thatconsistently synchronizes the warfighting functions is critical to a unit's ability to have the desired effect on the enemy. Each staff section must understand its impact on the other warfighting functions, and they must be active participants in one another's processes. If sustainment ever determines what you're shooting, it is time to relook the process.

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Timely Effective Fires

CW4 Jimmy Mannings

During fiscal year 2018 warfighter exercises, Division Artillery (DIVARTY) and Field Artillery brigades struggled to deliver timely and effective fires which led to an overall ineffectiveness in artillery fires. The ineffectiveness of general support rocket artillery increased the burden on direct support cannon artillery battalions and it was a significant factor in the heavy losses sustained in brigade combat teams. Many underlying factors can be related to the effectiveness, or lack thereof, of artillery fires – ranging from the accuracy of the sensor to the accuracy and efficiency of the crews. In a warfighter training event however, there is a direct correlation between timing and effectiveness. On average, fire missions with the shortest sensor-to-shooter time were most effective. In other words, to increase the effectiveness of rocket artillery fires, the unit must reduce the time it takes to put rounds on target.

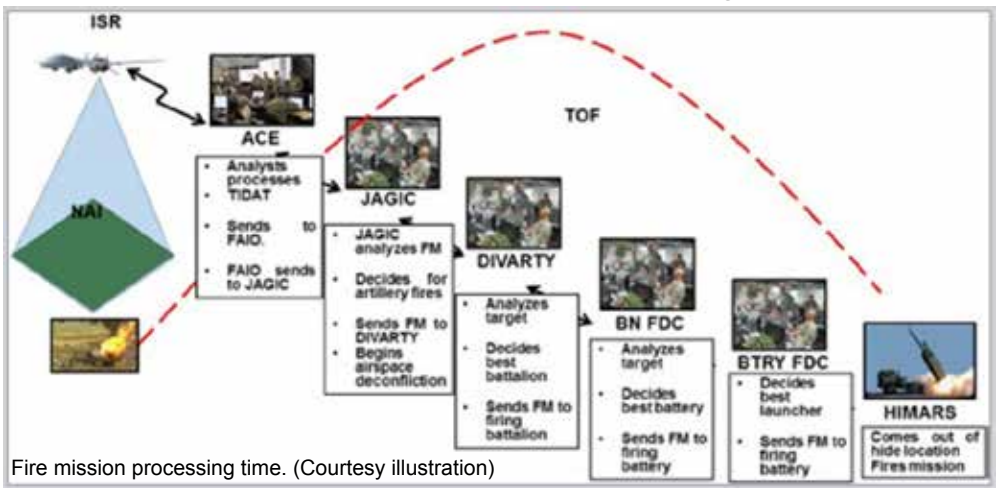
Establishing fast effective sensor-to-shooter links is not a new procedure. This was a very common procedure within the fires community in the 80's and 90's doctrine. Often, the fire direction communicated directly with the observers. However, in the last couple of decades, the leadership lost confidence in these links because the Army adopted a riskaverse attitude that revolved around counterinsurgency operations. Therefore, every fire mission had to be centrally planned and centrally executed with multiple echelons involved in the process. This process significantly increases the fire mission processing time. Relearning to establish quick and effective sensor-to-shooter links will require a fundamental change in the current processes in fire mission execution. It will also require detailed-level planning to set the conditions on the ground and air-space, and finally, it will require conducting thorough tactical and technical rehearsals.

Fire missions have to be processed in four minutes or less to increase the possibility of effects. The time starts when the target is identified to the time when rounds land on the target. In the last six warfighters, fire missions that took less than four minutes achieved the most significant effects. These were fire missions with "catastrophic kills." Unfortunately, those fire missions were exceptions and not the norm. On average, only three out of every 10 fire missions had catastrophic effects on target. Most of the fire missions achieved little to no ef-fects. Some of the delay is caused because most units use the fire mission process that requires a call-for-fire (CFF) to stop at every echelon so it can be checked, logged and sent to the next subordinate unit. Every time the fire mission stops at each echelon, it delays the delivery of fires, giving the enemy more than enough ample time to displace from the area and avoid any effects.

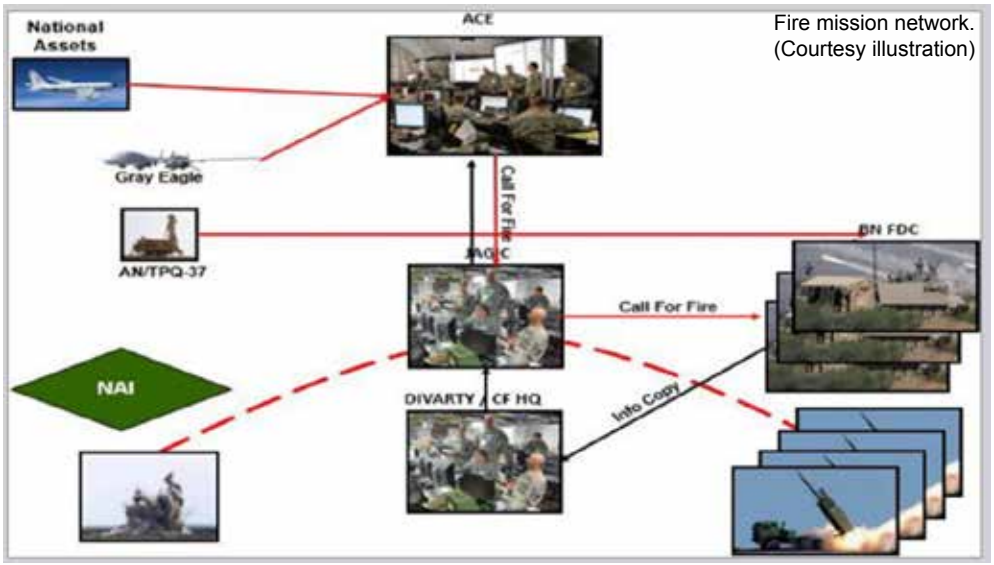
A typical fire mission involves the analysis and control element (ACE), Joint Air-Ground Integration Center (JAGIC), DIVARTY fire control element (FCE), the battalion fire direction center (FDC), and a battery or platoon FDC before it reaches the firing unit. When a sensor detects a target, the information is sent to the ACE at the division headquarters to be analyzed and processed. Once this process is complete, the Field Artillery Intelligence Officer sends a call for fire (CFF) to the division JAGIC.

The JAGIC receives the target, analyzes and validates it. The fire support NCO or Advanced Field Artillery Tactical Data System (AFATDS) operator logs the target and distributes the information to the rest of the JAGIC personnel via chatroom and via analog methods. Then the JAGIC decides to prosecute the target with air support or artillery fires. If the JAGIC decides to prosecute the target with artillery, the fire mission goes to the DIVARTY FCE. The FCE analyzes the target, logs and processes the mission in a similar manner as the JAGIC. The FCE decides which battalion is in range of the target and sends the mission to the battalion FDC. The battalion FDC conducts similar actions and then sends the mission to the battery. The battery FDC finally sends the mission to the firing unit, and two to three minutes later, the firing unit finally shoots.

It takes an average of 17 minutes for a fire mission to be processed from sensor-to-shooter. Counter-fire is faster, but not by much. The fires community needs to address the fire mission process to be competitive against a near-peer threat. To do so, the fire mission process must be planned and executed with a true sensor-to-shooter link mindset, reducing the number of stations slowing down the process. This does not mean echelons



Fire mission processing time. (Courtesy illustration)



Fire mission network. (Courtesy illustration)

will be completely bypassed; it just means the fire missions will take the quickest and most direct path to an available firing unit. It would be great if a radar acquisition is sent directly to the battery fire direction and straight to the launchers. That would be the simplest and quickest way to increase artillery effectiveness against today's indirect fires threats. But this would require graduate-level planning, training and rehearsing.

Effective fast sensor-to-shooter links require extensive training and multiple rehearsals. It may even require a culture change within the fires community. The AFATDS is capable of automated fires. The system can be configured to immediately process a CFF without intervention. This requires well-trained operators at every echelon to configure the system properly. All units must emphasize training with digital systems as a "fires enterprise" before the warfighter. With the right training and focus, units can truly reach graduate-level automated fires. This method does involve a lot of risks, but the risks can be mitigated by setting the proper conditions through detailed-level planning which can allow a decentralized execution of the fires plan.

Every sensor must be "tied" to a shooter and the sensor must be able to deliver fires on target immediately after detection. Most leaders are not used to doing business this way or feel uncomfortable with the process. But there are methods to help mitigate the risk. Thorough synchronization and integration of four plans will enable the delivery of rapid effective fires. These plans are called the four components of effectiveness; these are the maneuver plan, the field artillery support plan (FASP), the information collection plan (ICP), and the unit airspace plan (UAP). None of these plans can be developed in a vacuum. The FASP supports the maneuver plan and the ICP facilitates the FASP. The UAP enables all three plans. Units must give special emphasis to airspace planning because the lack of a thoroughly developed airspace plan can severely hinder the collection plan and delay artillery fires. Airspace clearance is the most significant factor in delaying artillery fires.

Rehearse, rehearse and rehearse! Most units conduct a combined arms rehearsal and a fires rehearsal before the start of the warfighter training event. Most of the time however, these rehearsals do not go into the necessary detail to deliver fires rapidly. Tactical and technical rehearsals are necessary because they involve all the echelons in the fire mission process. Successful units normally employ target synchronization matrices and fire support overlays to rehearse, which enables detailed sensor-to-shooter synchronization. In a decisive action fight, units will probably not have sufficient time to rehearse all assigned targets. However, they can use a target synchronization matrix to prioritize rehearsals on specific targets, especially high payoff targets. Rehearsing even just a few of the planned targets can set the conditions for the rapid execution of all planned and unplanned targets.

A good tactical rehearsal enables the unit to ensure they are at the right place and at the right time to execute the mission. This is important because it will ensure designated firing units are within range of the targets and they have proper munitions onhand to engage the targets. One of the most common delaying factors is assigning fire missions to a unit that is out of range or does not have the right munitions on hand. Additionally, units can avoid delays by conducting technical rehearsals and testing every digital and analog system in the fire mission chain.

The enemy artillery fires of today are fast and they are extremely lethal. Every enemy sensor is directly connected to a shooter that can deliver fires rapidly. That is the science that units need to master to have a chance at achieving effects on the enemy. What is old is new. The best chance units have to increase artillery effectiveness is by setting the conditions on the ground and in the air, establishing effective sensor-to-shooter links to allow decentralized execution of fires, and rehearsing diligently and frequently.

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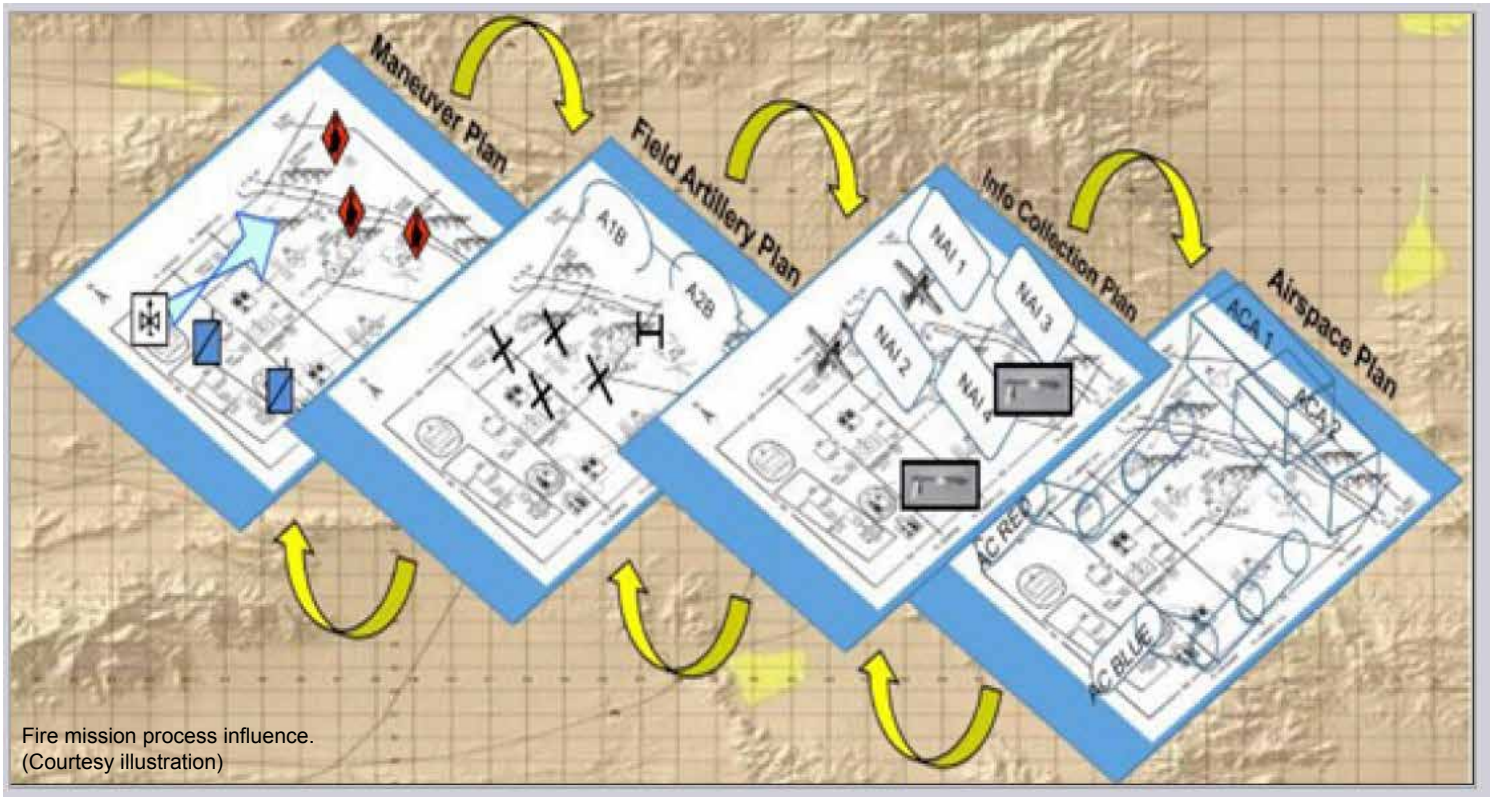
CW4 Jimmy Mannings is a former observer coach, trainer assigned to Operations Group Foxtrot which focused on training Division Artillery and Field Artillery brigades during warfighter exercises. CW4 Mannings currently serves in the Joint Fires El-ement, Combined Forces Command, U.S. Army Garrison, Yongsan, South Korea. He received a Bachelor's de-gree in Applied Management from Franklin University, a Master's degree in Military Arts and Science from the Command and General Staff College, and a Master's degree in Cybersecurity with focus on threat detection from Webster University.



Fire mission process influence.
(Courtesy illustration)

OBSERVER PLANNING

CPT Andrew Agee

Rotational units at the Joint Readiness Training Center (JRTC) routinely fail to mass the effects of fires assets in support of brigade combat team (BCT) operations. Contributing to this shortfall is the inability of BCTs to properly develop and implement an observer plan. Units regularly do not develop an observer plan beyond identifying primary and alternate observers in the target, trigger, location, observer, delivery system, attack guidance and communication portion of the fires plan. In a decisive action fight, a top-driven observation plan with bottom-up refinement increases the likelihood of effective fires. Placing observers in the right place with the right tools aids in massing effects and achieving the BCT commander's intent for fires. Utilizing the doctrinal tools for the devel-


Soldiers from 2nd Battalion, 15th Field Artillery, 10th Mountain Division fire an M777 during a live-fire exercise during a rotation at the Joint Readiness Training Center, Fort Polk, La. (10th Mountain Division)

opment and tactical employment of the observer plan exponentially increases the BCT's lethality with fires. The common trend observed at the JRTC is that the BCT leaves the site selection for observation posts (OP) to the subordinate units. As a result, integration and shared understanding of the BCT observation plan in not achieved across the warfighting functions. Commanders should understand why they are establishing an OP and the fire support tasks associated with the desired effects needed to meet the BCT commander's intent for fires. Units at the JRTC often see the observation plan as independent of the fires warfighting function and do not coordinate across the warfighting functions in the development of the plan. The ATP 3-09.42, Fire Support for the Brigade Combat Team, provides a six-step, top-driven technique for observation planning that includes:

1. Determine the desired effects of fires.
2. Determine target observation suitability.
3. Develop the observation course of action.
4. Task observers and observation points in a top-down observer plan.
5. Refine and rehearse the observation plan.
6. Monitor and adjust observer plan execution.

This method allows the BCT planners to develop an integrated observer plan with built-in flexibility to adapt the plan as the land-scape of the battlefield changes. The more robust BCT staff is better suited to develop the observation plan given the resources at their disposal.

Determine the desired effects of fires

The first step in the process requires a clear understanding of the BCT commander's intent for fires. The fire support coordinator (FSCOORD), BCT fire support officer (FSO), BCT targeting officer, and fires cell planners work in conjunction to translate the BCT commander's guidance into actionable fire support tasks. These fire support tasks will initially inform the number of BCT targets required to achieve desired effects as well as the number of observers required to support each target.

Determine target observation suitability

Through the targeting process, the fires planners will determine the location for each target. This will allow the BCT staff to analyze possible observer locations and suitability of observation. The BCT fires planners in conjunction with the BCT intelligence section have the means for in-depth terain and line-of-sight analysis to inform this process. The fires and maneuver planners determine observer location, method of attack and factor in risk-estimate distances (REDs). This enables the FSCOORD and BCT FSO to inform the BCT commander of risk decisions as it relates to the observation of targets.

Develop the observation course of action (COA)

The entry argument for this step is a diagram depicting target locations, possible OP locations, line-of-sight analysis and REDs in relation to OPs. During wargaming, the staff will identify primary and alternate observer locations, covered and concealed routes to and from the OPs, time analysis associated with the establishment of the OP and the time needed to deliver effects on the given target. The fires and maneuver planners allocate assets to each target and the overall COA developed must be feasible and suitable. Development of the observation COA in this fashion alleviates planning pressure from subordinate units and allows them to provide a bottom-up refinement to the plan.

Task observers and observation points in a top-down observer plan

The observer tasking includes a clear task and purpose and covers the five Ws. An example observation task found in ATP 3-09.42 is as follows, "Task Force 3-316 Infantry maneuvers to and establishes observation of AE0030 from OPs 301 and 302 not later than 0530 hours to neutralize a suspected antitank firing line to limit the enemy's ability to impede BCT movement along with AXIS ARROW. The OPs may disengage once task force trains are in position at Command Post 3." Observer tasks need to be descriptive in nature in regards to expectations and capa-bilities required of the observer. The base operation order within "tasks to subordinate units" is the best place for observation tasks and not solely within the Annex D. This technique enables the synchronization of the observation plan with maneuver. Additionally, it allows maneuver commanders to understand and visualize how the observation plan, and in turn, the fires plan supports the scheme of maneuver.

At the JRTC, units fail to task units with the establishment of OPs. BCTs also fail in developing defined triggers associated with the targets. Frequently the trigger identified by the BCT staff is positive identification (PID) of the enemy and in no way is the trigger tied to friendly or enemy movement, events, or time. Using PID as a trigger does not allow for bottom-up refinement and places the development of the trigger on the subordinate unit. A top-driven plan ensures units understand their role within the BCT observation plan and affords them the necessary buy-in to provide refinements to the plan.

Refine and rehearse the observation plan

During this step in the process, the BCT fires cell will determine a cutoff time for all targets and trigger refinement from subordinate units. At the JRTC, BCTs commonly fail to set a cutoff time or allow for so much time that the BCT fires cell cannot refine products and reissue a complete plan before execution. The BCT fires rehearsal, BCT combined arms rehearsal and FA technical rehearsal further provide the opportunity to validate the BCT target list worksheet, observation plan and triggers as well as generate a shared understanding of the plan across the warfighting functions. The top-driven technique results in rehearsals of a synchronized plan as

opposed to a back brief or quasi wargaming session.

Monitor and adjust observer plan execution
With a top-driven observation plan and maintained fires running estimates, the BCT can adjust the observation plan as needed to adapt to the ever-changing battlefield.

Once the BCT has developed a cohesive observation plan and issued the operation order, subordinate units through their own planning process provide refinements to the plan and tactically employ their OPs as part of the larger BCT observation plan. The ATP 3-09.30, Observed Fires, pro-vides the memory aid SLOCTOP for the tactical occupation of an OP that stands for security, location, communication, targeting, observation and position improvement. The observer party executes the phases of the SLOCTOP method concurrently and not necessarily as a step-by-step process.

At the JRTC, units establishing OPs rarely do so utilizing the SLOCTOP method, which makes for an incomplete BCT observation plan. The result is a piecemealed observation plan that does not promote massing effects to meet the BCT commander's intent for fires.

Security
The unit executes reconnaissance of the proposed OP covering 6,400 mils and a radius of 500 meters around the OP. The most suitable location for the OP is determined through the reconnaissance.

Location
The position should not be skylined or easily identified as an OP. The observer party occupies the position, and determines the location of the OP post with the most accurate means possible and reports the location to their higher headquarters and adjacent units. The observer party will maintain an accurate common operating picture and develop a terrain sketch from their OP. When the location allows or if digital means are possible, the observer party forwards a terrain sketch to the higher headquarters to provide them with situational awareness. This will enable the BCT to maintain an accurate observation plan picture and update their fires running estimates. At the JRTC, terrain sketches are rarely developed and forwarded to the higher headquarters. A successful observation plan generates a graphical display of the holistic view of the unit's observation plan at echelon within the command posts.

Communication
The number one priority during the establishment of an OP is communication. The observer party will establish communications with their higher headquarters and adjacent units during the security and location phases. At the JRTC, OPs commonly lack sufficient communications equipment to coordinate with adjacent units and their higher headquarters. Exclusive use of FM communications platforms is common and rarely are redundant means utilized.

Targeting
Observers will utilize the most accurate means available to them to determine the target location. Regularly observed at the JRTC is underutilized targeting equipment, which forces observers to rely on map spot for target location. Units often do not integrate organic optics and targeting equipment into the tactical employment of OPs. It is common to see zero pieces of targeting equipment employed during the course of a JRTC rotation.

Observation
In this phase, the observer party ensures clear fields of view from their OP post and provides refinements of the fires plan to their higher headquarters. The best time to provide refinements to the fires plan may be from within the OPs, however, the BCT must account for the time needed to receive refinements and publish new products before execution. During this phase, a great opportunity exists for the establishing unit's commander and FSO to execute battlefield circulation to verify positions, terrain sketches and equipment operability.

Position Improvement
Position improvement is a continuous process. The areas of focus for the observer party should include cover and concealment, camouflage, security, noise and light discipline, weapons and equipment maintenance, and communication. The observer party will also determine alternate OP locations as well as routes to and from the alternate locations. At the JRTC, units do not execute continuous position improvement and rarely identify alternate OPs.

The development and execution of a successful observation plan requires input and refinements at echelon across the BCT's war-fighting functions. While many factors play a role in a BCT's ability to mass the effects of fires the units that excel at the JRTC have a well-developed and executed observation plan. BCTs that methodically establish an observation plan using a top-driven technique and refine their plan based on real-time feedback from subordinate units find far more opportunities to mass effects on enemy elements.

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CPT Andrew Agee serves as a fire support observer, coach or trainer at the Joint Readiness Training Center. His previous assignments include battery commander and squadron fire support officer with the 3rd Infantry Division, Fort Stewart, Ga. He has deployed to Afghanistan in support of Operation Enduring Freedom and to the Republic of Korea in support of Regionally Aligned Forces. He is a 2009 graduate of the University of Kentucky.


2ID Divarty(Courtesy photo)

Transformation Through Rigor
Field Artillery AIT

Captain Justin L. Allen

"Rigor," is a term that has become a trademark for the Center of Initial Military Training, and carries a complexity of implications for training, educating and inspiring future Field Artillerymen and women. The "increase rigor" initiative became the launching point for refocusing the development of Soldiers on basic warrior tasks and battle drills which has driven the Army's success in near-peer op erational environments (OE). As the world's conflicts change, it has become incumbent upon the U.S. Army to change with them. The Army has adapted over the last 18 years to a global strategic environment that is unpredictable, increasingly volatile[1] and extremist driven. However, our near-peer adversaries have trained and developed their military formations, and are increasingly capable of contention with the United States Armed Forces in large-scale combat operations (LSCO).

The Field Artillery (FA) recognized the need for development in Advanced Individual Training (AIT) to prepare Soldiers for the rigors of future combat. In an article, Meeting the Challenge of Large-Scale Combat Operations Today and Tomorrow[2] LTG Michael D. Lundy states, "Mastering the skills and experiences acquired during training, education and operations requires repetition. Sustaining and improving what we are doing now is our challenge." The 1st Battalion, 78th Field Artillery (1-78th FA), Teamwork Battalion accepted that challenge.

The 1-78th FA is the home to Field Artillery AIT. Its mission is to create future Field Artillerymen and women to enter the combat force, ready to provide effective and timely fires and fire support. Field Artillery initial military training is currently transforming to match the intensity, rigor, and complexity of Multi-Domain Operations.[3] TRADOC commander GEN Paul E. Funk II deemed the primary goal of training to be "tenacity," as the operational force recognizes its need for development. Tenacity builds the necessary resiliency in individual Soldiers to maximize readiness, and to equip Soldiers for an increasingly complex OE. Field Artillery Commandant, BG Stephen G. Smith, echoed that guidance in 2018 with a directive to increase rigor across the U.S. Army Field Artillery School by getting trainees back in the field. The Field Artillery must prepare to provide fires and fire support in degraded, denied and disrupted OEs. Technical competency is no longer the primary key to success for the Artillery, but tenacity, resiliency and readiness are the key to victory. In 2018, 1-78th FA received the directive to increase rigor in AIT and to reenforce the need for tenacity within the Field Artillery community.

The 1-78th FA pushed forward in FY19 to increase rigor in AIT by introducing a culminating training exercise into every 13 series MOS training schedule, adding academic rigor through a reconstruction of the program of instruction (POI), and refocusing on degraded operations.

To initiate transformation, 1-78th FA introduced a four-day, three-night field training exercise for all 13 series AITs, called the culminating training exercise (CTE). The CTEs placed increased attention on the rigors of near-peer combat through the implementation of foot marches, artillery skill proficiency tests (ASPT), an engagement skills trainer (EST), a combat obstacle course, terrain navigation, and live-fire operations. The new CTE added a significant amount of rigor in contrast to the limited field time in AIT before November 2018.

Cannon Crewmember (13B) AIT incorporated training on firing point occupation, survivability drills and defensive operations to develop 13Bs with combat functionality. Foot marches to and from firing points in conjunction with this training added rigor that simulated the intensity of combat. The 13Bs were no longer merely pulling the lanyard, but there was now a revitalized effort to create Cannoneers capable of conducting mission command at the lowest level. The 13Bs were able to shoot, move and communicate to support maneuver elements in combat aggressively.

Joint Fire Support Specialist (13F) AIT introduced a CTE that physically challenged students to meet the requirements of intense ground combat. This CTE required a more intensive focus on the fundamentals of combat: basic Soldier tasks and battle drills, foot marches, basic rifle marksmanship, observation post (OP) selection and occupation, and land navigation with an M2 compass. The 13F schoolhouse matched the increased rigor of the CTE with an intensified train-up before the field exercise that would prepare Soldiers for quality training. The 13F POI expanded to include High Physical Demands Tests (HPDT) consisting of a 12-mile foot march with OP occupation, a hand grenade course, land navigation testing, and a live graded call-for-fire exercise. These training objectives accurately tested 13F students' ability to endure rigorous physical, mental and emotional challenges. The future fight will likely demand "FiSTers" who can move tactically and efficiently, and provide fire support under rigorous conditions.

Fire Control Specialists (13Js) shifted from a classroom-based focus on the Advanced Field Artillery Tactical Data System (AFATDS) to training that placed students in a field environment conducting skill level 10 tasks, degraded operations, foot marches, and fire direction center (FDC) occupation drills. These radical shifts successfully added rigor and created 13Js who could effectively control and deliver

fires in contested domains.

M270 Multiple Launch Rocket System/High Mobility Artillery Rocket System [MLRS/HIMARS] Crewmember (13M) and Firefinder Radar Operator (13R) AITs introduced rigor within CTEs by introducing foot marches, marksmanship training, ASPTs, basic warrior tasks and battle drills, and dismounted land navigation. The launching of rockets during MLRS and HIMARS live-fire has also provided the opportunity for students to witness the technical proficiency required to safely deliver and observe live rockets.

The 1-78th FA challenged schoolhouses to integrate training across MOSs, to maximize training value in the field. The Field Artillery is comprised of multiple skillsets all geared toward one joint mission; to destroy, neutralize or suppress the enemy by cannon, rocket and missile fire and to help integrate all fire support assets into combined arms operations.[4] The battalion integrated training by allowing 13Js to conduct fire direction, while 13Rs and 13Fs observe during 13M MLRS and HIMARS live-fire operations. The 13J students have the opportunity to operate the AFATDS with close supervision and gain practical experience. During howitzer live-fire operations, 13F students conduct call-for-fire operations, establish communications with 13J students operating in the FDC, and observe live rounds from 13Bs on the gunline. Through the integration of CTEs, students witness the complex coordination required to accurately deliver fires in near-peer combat.

The second line of effort to increase rigor was to restructure POI across the battalion to maximize academic rigor. Limited contingency operations[5] over the last 17 years allowed the FA to focus on technological advancement, improvement of intelligence, reconnaissance and surveillance capabilities, and close-range counter-fire operations. This focus geared FA AIT toward creating technically proficient trainees, ready to provide fires and fire support for counterinsurgency operations while enjoying the luxuries of multi-domain superiority. Now our near-peer adversaries have worked to match our capabilities. Necessarily, the FA mindset is shifting to a focus on LSCO. Such combat requires FA Soldiers to be proficient in the basic skills that they are trusted to employ. The 1-78th FA has restructured POI to increase technical proficiency in AIT graduates and prepare them for near-peer combat.

To do this, POI became less focused on automated systems, and more focused on basic Soldier tasks. Schoolhouses adjusted POI to create technical competence within the classroom by training on all level 10 ASPTs in conjunction with technical MOS training. The skill level 10 ASPT tasks are specific to each MOS and are essential for building combat-ready Field Artillerymen and women. All 13 series MOSs partially covered these tasks before the reconstruction, but with a heightened demand for proficiency, FA AITs added all ASPT tasks to the POI.

The 13M schoolhouse added dismounted navigation with the Defense Advanced GPS Receiver (DAGR) and operation of the AN/VRC-104 HARRIS radio to the POI. The 13R schoolhouse added OE-254 set-up, M2A2 Aiming Circle training and map reading. Although the modifications to the 13M and 13R POIs seemed minimal; the reconstruction of lesson plans, resources and instructor certification proved to be both challenging and progressive.

The 13B AIT added POI that would serve to add both physical and academic rigor. The 13B HPDTs grew to include a hand grenade throw, sled drag, sandbag carry and an M107, 155 mm projectile ammunition carrier load test. The ammunition load test proved to be the most critical evaluation point for students by setting a new standard for 13B combat readiness. These changes in the 13B POI served to challenge the physical ability of the students and added practical combat-focused rigor.

The 13F AIT adjusted POI to match the need for proficiency in the fundamentals of joint fire support. Combat against a near-peer adversary requires an intensive understanding of basic fire support concepts such as special munitions employment, foreign enemy vehicle identification and OP selection and occupation. The 13F students are now required to complete all of these tasks in conjunction with the graded call-for-fire, as a graduation requirement. In addition to the new required tasks, 13F AIT expanded POI to include graded land navigation, Laser Designator Range Finder set-up and operation, and operation of the RT-1523 SINCGAR and AN/VRC-117G HARRIS radio. The 13F POI updates serve as the starting point to produce fire supporters capable of flexible fire support in a contested OE.

All of the 1-78th FA POI updates were challenging, but necessary for adding rigor and effecting change. POI updates have continued as training is implemented, evaluated and refined. Leaders in the battalion are constantly gathering data to determine where modifications to POI would best add rigor and maximize training value for AIT students.

In a final effort to add rigor, 1-78th FA placed an increased emphasis on the importance of degraded operations to prepare for the certainty of disrupted operations in contested domains. While the technological capabilities of the FA are vast, operational success has been overly reliant upon domain superiority across multiple domains; namely, air, space, cyberspace and the electromagnetic spectrum (ES).[6] The U.S. Army and the Field Artillery can no longer assume domain superiority against near-peer adversaries[7]; therefore, artillery systems must maintain the capability to operate degraded. All members of the "Kill Chain," from the 13F to the 13B, must be prepared to fight and win in degraded, disrupted and denied operations.

The 13J fire control specialist training was focused on gaining expertise and competence on automated gunnery systems before the rigor initiative; namely, the AFATDS. The 13J POI focused heavily on operating the AFATDS to minimize reaction time while enjoying domain sup-

eriority in cyberspace and the ES. In the future, technological degradation will demand 13Js who are highly proficient in the fundamentals of manual gunnery. The increase of manual gunnery was the largest attempt at academic reconstruction within the 13J schoolhouse. Delta Battery executed a mass purchase of graphical site tables (GST) and graphical firing tables (GFT) in 2019. GST and GFT are used for manual computation of firing data for howitzer systems. Additionally, the training emphasized firing chart proficiency, which is commonly referred to as "charts and darts."

The 13F AIT refocused on light infantry-style training by eliminating M7 Bradley Fire Support Vehicle utilization, and increasing focus on dismounted fire support. The 13F land navigation training was GPS aided with a DAGR, before the increase rigor modifications. Now unaided land navigation with an M2 compass is a graduation requirement for every 13F AIT student. Graded foot-marches, graded live call-for-fire, and degraded call-for-fire with special munitions have all aided the simulation of disrupted operations. In a future OE with disrupted air, ground and sea domains, these skills must be trained, refined and perfected.

The 13Bs added howitzer emplacement evaluations and degraded mission processing as graduation requirements for cannon crewmember students. While students continue to train howitzer operations with the Digital Fire Control System; there is an increased focus on ensuring proficiency while operating the M109A6, M119A3 and M777A2 howitzers in a degraded environment.

To conclude, the developments made in 13 series AIT have initiated the push for cultural change within the Field Artillery community. The 1-78th FA pushed to increase the rigors of AIT by introducing a CTE across all MOSs, increasing academic rigor through POI updates, and refocusing on degraded operations. All of these implementations serve the primary purpose of increasing rigor and preparing Soldiers for combat. These developments are the beginning stages for creating Field Artillery Soldiers ready and eager to join our formations. While the Field Artillery continues to adapt, and doctrinal updates emerge, the 1st Battalion, 78th Field Artillery Battalion will continue to educate, train and inspire Field Artillery trainees.

1. Meeting the Challenge of Large-Scale Combat Operations Today and Tomorrow
2. Ibid
3. TRADOC Pamphlet 525-3-1 (The U.S. Army in Multi-Domain Operations 2028)
4. FM 6-20 Chapter 2 FIELD ARTILLERY RESPONSIBILITIES
5. Meeting the Challenge of Large-Scale Combat Operations today and tomorrow
6. TRADOC Pamphlet 525-3-1 (The U.S. Army in Multi-Domain Operations 2028)
7. Ibid.

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CPT Justin L. Allen received his commission upon graduation from the United States Military Academy at West Point in May 2013. CPT Allen served as an AS3, battery fire direction officer and firing platoon leader. As an AS3, CPT Allen served as a battle captain during Operation Combined Resolve II in Grafenwoehr and Hohenfels, Germany. CPT Allen was then selected to serve as a fire support instructor for FA BOLC-B, with Bravo Battery, 1-30th Field Artillery. Upon completion of his time as a fire support instructor CPT Allen took command of Alpha Battery, 1st Battalion, 78th Field Artillery.
CPT Allen holds a Bachelor of Science degree in American Legal Studies from the U.S. Military Academy.

A rocket is fired during a live-fire training at Fort Sill, Okla. (Courtesy photo)

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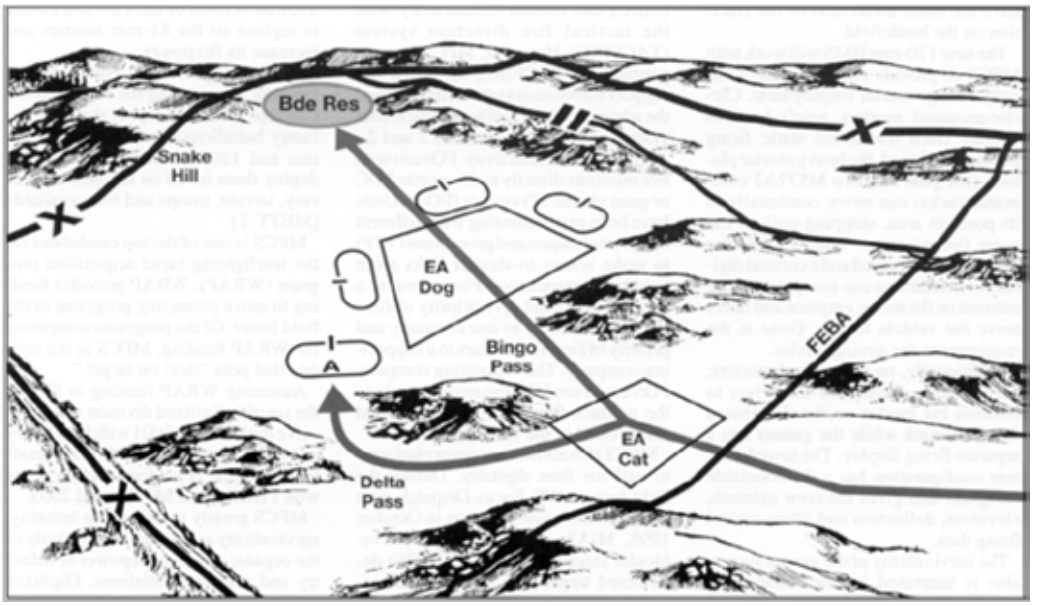
Battle Calculus and Fire Support Planning

Major Thomas L. Kelly



You are the new fire support officer (FSO) for Task Force 1-89 Armor and are part of a 3x6 155-mm Paladin direct support battalion. It's your first opportunity to plan combat operations as part of the task force battle staff. The mission is to defend the Bingo-Delta pass complex against a motorized rifle regiment (MRR) at 70 percent strength to prevent the MRR's penetration of the task force's defense. The regiment is leading the attack with a Forward Detachment, a motorized rifle battalion-plus-sized formation. The Detachment's mission is to control one of the two passes so the remainder of the regiment can follow on its way to seize the defensible high terrain just east of Snake Hill.

The task force commander outlines his concept of the operation: "I want Team A to limit the Forward Detachment's ability to control Delta Pass, forcing the remainder of the regiment to go through Bingo Pass. This will allow me to mass the effects of the other three company teams' direct and indirect fires into EA [Engagement Area] Dog on the reverse slope of Bingo Pass to destroy the rest of the MRR.

"Fires must disrupt the Detachment's ability to seize Delta Pass from Team A. allowing me to focus the other three teams into EA Dog. I believe Team A can retain Delta Pass if fires can destroy at least one of the Forward Detachment's MRCs [motorized rifle companies] in EA Cat."

The commander looks up at you from his notes and says, "Can you do it?"

How can you possibly answer the commander's question? One tool to help you is battle calculus. While the term "battle calculus" may not be familiar, the idea of applying planning factors, combat power values and other numeric and scientific parameters to military planning is not new.

The brigade trainers at the National Training Center (NTC), Fort Irwin, California, have defined battle calculus as "the process of using doctrinal rates, factors, speeds and other data to conduct detailed analyses that support military decision making. Through this process, commanders and staffs are able to analyze relative combat power, estimate and verify capabilities, translate [those capabilities] into missions, conduct predictive analyses and allocate resources to defeat the enemy."

For fire support planning, battle calculus can help answer questions such as "How long will it take?" "How much ammunition is required?" and "When do I need to trigger fires?" While battle calculus does not provide certainty, it does improve the likelihood of success. There is a danger in "over quantifying" your planning: the more you must assume as you calculate, the less realistic and accurate your work may become.

The real benefits of battle calculus occur with practice. As the task force battle staff consistently employs battle calculations, the process becomes routine and results in better developed and detailed plans and orders.

The fire support element (FSE) and the maneuver battle staff begin to "calculate" as a natural part of course of action (COA) development. The "science of war" is reflected in realistic plans that can achieve the commander's intent. The detailed, step-by-step logical process used in battle calculus (such as the example in this article) becomes second nature and quickly gives way to "rules of thumb." When the FSO can build feasible plans rapidly and train his commander to have realistic expectations of fire support, the fire support planning process is streamlined and more effective.

Can You Do It?

Using basic battle calculus, you can determine the feasibility of your fires achieving the commander's guidance. Note that this example is based on the assumptions outlined in the scenario and is not "the formula" for answering all commanders' Can-you-do-it questions. Rather, this example shows the process of trying to best-guess the integration of time, space and asset variables to achieve a specific goal.

Step 1: Translate the commander's guidance into a quantifiable effect. Once you've defined the task and purpose for fires (critical fire support task), you quantify that task to measure success or failure.

In this case the commander's guidance was..."destroy at least one MRC in EA Cat," and his purpose was to "disrupt the Detachment's ability to seize Delta Pass from Team A, allowing me to focus the other three teams [against the MRR's main body funnelled] into EA Dog."

You must at least destroy one MRC. You consult with the S2 to confirm how many combat vehicles are in an MRC: 3 T-80 tanks and 8 BMP infantry combat vehicles.

Step 2: Equate the required effects to the required ammunition. This calculation normally is based on the graphical munitions effects tables (GMETs) as captured manually or using an automated device. For this example, I use the NTC "GMET": to kill one tank, it takes 54 155-mm dual-purpose improved conventional munitions (DPICM) and to kill one BMP, it takes 18 155-mm DPICM.

Therefore, you can calculate how many rounds it takes to achieve the effects:

3 Tanks x 54 RDs = 162 DPICM

8 BPMs x 18 RDs = 144 DPICM

Total RDs Required = 306 DPICM

You've already checked to see how many rounds of DPICM your battalion has on hand: enough for 54 battalion-three volleys of DPICM—more than enough to achieve the effects.

Step 3: Determine the minutes available for the attack. For this step, you need some additional facts and must make some assumptions. You must attack the Forward Detachment with fires in EA Cat. Because time is a function of distance, rate of movement and formation size, you gather the information you need. From the S3 and operations overlays, you determine that EA Cat is nine kilometers long. In consultation with the S2, you assume consultation with the S2, you assume that a Forward Detachment in march formation in EA Cat is about one kilometer long by 250 meters wide. Also in conjunction with the S2, you assume the enemy rate of march in EA Cat is 30 kilometers per hour (KPH). From your FSO's "Smart Book," you determine that 30 kilometers per hour is one kilometer (KM) every two minutes. With this info, you calculate the time available to attack the enemy in EA Cat:

1-KM Det Pass Time = 2 MIN

Travel 9 KM in EA x 2 MIN per KM = 18 MIN

Total Time Available = 20 MIN

Step 4: Determine if the required ammunition can be delivered in the time available. Now you determine if we can deliver 306 DPICM (Step 2) in 20 minutes (Step 3). You look in your Smart Book to verify that your battalion's 18 155-mm tubes' rate-of-fire is one minute per round, based on the battalion's most recent Army training and evaluation program (ARTEP) times. Therefore:

20 MIN x 18 RD tubes per MIN = 360 RDs in time available

In this step, you've learned that the battalion can deliver 360 rounds in the time available—more than the 306 rounds required to achieve the desired effects. It would appear your mission is do-able. Unfortunately, the enemy formation you must engage is moving, so you also must calculate how many volleys your battalion can fire on the Forward Detachment at a single target location.

Step 5: Determine maximum volleys that can be fired on the moving formation at one target location. With your assumptions that the Detachment is 1,000 meters long by 250 meters wide while in march formation in EA Cat and that it will move at 30 kilometers per hour, you can calculate a pass time of two minutes—the time from the lead vehicle to the trail vehicle's crossing the same point on the ground.

Figure 1 shows how you calculate that your FA battalion can fire three volleys on the moving formation before the enemy can pass completely through the target location.

Step 6: Determine the number of attacks (battalion-three volleys) needed to deliver the required ammunition. You know that the battalion's 18 tubes firing a three-round volley is 54 rounds per attack. Therefore:

306 Required RDs + 54 RDs = 6 Attacks on Distinct Targets

Because the battalion must fire at a target and then shift six times, you now must determine if the enemy will be in EA Cat long enough—if EA Cat has enough space—to achieve the desired effects.

Step 7: Determine if time and space are available to execute the required attacks. From your Smart Book ARTEP data, you know it takes your battalion two minutes to deliver a battalion-three and three minutes to shift a volley from one target to another.

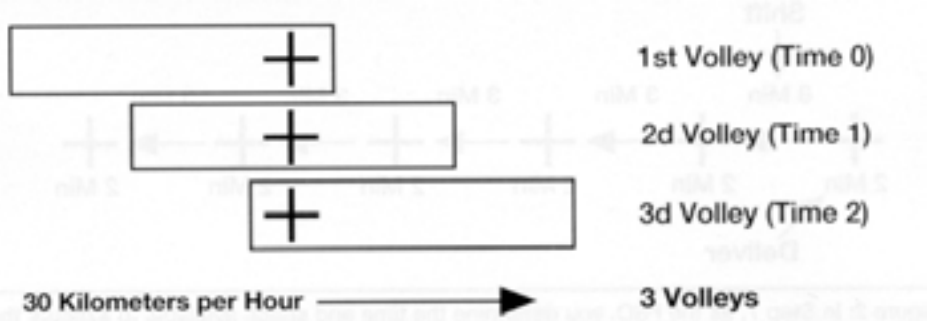


Figure 1: In Step 5, as the FSO, you determine the number of volleys your DS battalion can fire at one target location in EA Cat before the 1,000-by-250 meter enemy detachment moving 30 kilometers per hour can pass through that location.

Figure 2 shows how you add up the shift and fire times to determine how long it will take the battalion to achieve the required effects—in this case, it's 27 minutes.

You already know the moving enemy formation will have passed through EA Cat in 20 minutes. Therefore, the answer to the question, "Can you do it?" is "No, Sir" ....That is, unless you can increase—

- The space available. Can you put an observer in position to acquire the enemy farther out? Can the battalion range the enemy farther out?
- The time available. Can you slow the enemy down in the EA with family of scatterable mines (FASCAM), other obstacles, jamming, mechanical smoke, etc.?
- The volume or lethality of fire. Can you get reinforcing artillery, close air support (CAS) or attack aviation? Can you fire Copperhead rounds?

This example demonstrates that battle calculus is not a pure science and won't generate a flawless solution to every battlefield fire support problem. In fact, the battle calculus "answer" is rarely a definitive "Yes" or "No" but instead suggests how you can make success more likely by integrating obstacles, employing intelligence and electronic warfare (IEW), repositioning observers or adding killing assets and other combat multipliers. The answer should only be "It can't be done" after you've exhausted all means to meet the commander's guidance.

There are many ways to use battle calculus in fire support planning. Even the steps in the example in this article may change as mission, enemy, terrain, troops and time available (METT-T) change. To facilitate the process, the FSO should have at least the planning information listed in Figure 3 readily available in his Smart Book or through his FSE. The basic thought process of applying reasonable assumptions and tested planning factors to try to improve the feasibility of fire support plans and their synchronization with maneuver is sound.

To use battle calculus will not guarantee your fire support plans will succeed; but, when used routinely, battle calculus will result in fire support plans that can succeed. And that may be all an FSO can plan on.

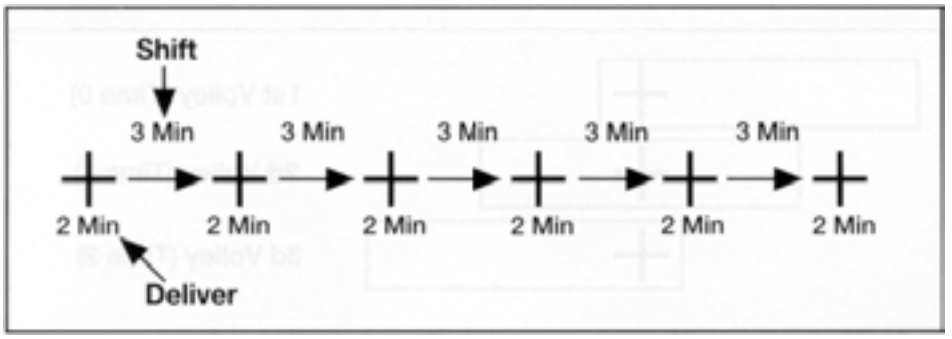


Figure 2: In Step 7, as the FSO, you determine the time and space available to execute the attacks. You know your battalion can deliver a battalion-three in three minutes and it takes three minutes to shift from a volley on one target to a volley on another. With that information, you can determine the battalion will take 27 minutes to deliver enough rounds to have the required effects.

- Number of Killer Missions by Munitions and Target Types
- Time Required to Fire Killer Mission by Munition (Ready to Rounds Complete)
- Artillery Shift Time by Weapon and Target Types (Planned or Target of Opportunity)
- Minimum and Maximum Ranges by Weapon and Munition Types and Primary Method of Delivery
- Copperhead Planning Factors (Copperhead Coverage Template)
- Observer Status (Location, Equipment, Observation Limits)
- Radar Status and Capabilities
  - Systems Available
  - Ranges
  - Cumulative Cue Time/Threat
  - Zone Planning Factors/Considerations
- Close Air Support (CAS)
  - Available Aircraft by Types and Sorties
  - Aircraft Capabilities
  - Available Munitions and Restrictions/Limits of Each
  - Response Time for Immediate CAS (Request to Command Post)
  - Station or Loiter Time (Command Post to Off-Station)
  - CAS Tactical Planning Data: Threat and Tactics, Required Airspace, Coordinating Alternative and Suppression of Enemy Air Defenses (SEAD) Timing/Separation
- Radio Ranges by Radio Type/Configuration
- Family of Scatterable Mines (FASCAM)
  - Number of 400 by 400 Medium Density Minefields
  - Time Required to Emplace by Battery/Two Batteries/Battalion for On-Order and Be-Prepared
- Number of Minutes of Illumination by Weapon Type
- Number of Modules of Smoke: 600 x 15 Minutes x Wind Direction x Conditions
- Target Spacing Minimums: Rate-of-March (Kilometers/Minutes) x [Shift Time + Deliver Time]
- Trigger Leads: Rate-of-March (Kilometers/Minutes) x [Time-on-Target Process Time + Time of Flight]
- Commander's Intent
- Commander's Planning Guidance

Figure 3: Fire Support Planning Factors for Battle Calculus. This kind of information and more should be readily available in the FSO's "Smart Book" or through his FSE.

About the Author:
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CHINESE ARTILLERY COMING OF AGE

The Chinese People's Liberation Army's (PLA) primary mission is to serve and preserve the power of the Chinese Communist Party (CCP).

This is drastically different from the US military forces that provide for the common defense without regard to the party of the serving administration. The PLA is the CCP's army. There is no other party and there will not be national elections to determine who will lead China.

In 1989 the PLA intervened with lethal force against peaceful political demonstrations against the CCP on Tiananmen Square in Beijing, demonstrating the PLA's loyalties for the world audience. Thousands of unarmed protesters were killed and injured.[A]

Since late 1979 China has undertaken a program of military modernization which has been influenced by the PLA's poor showing during its early 1979 conflict with Vietnam and by observance of US global military operations. The Tibet and Taiwan contingencies form the current basis of the modernization drive.

China believes its most likely conflicts will be local conflicts executed with a high degree of "informatization", the PLA's term for high-technology systems supporting operational elements.

The PLA is the largest military on Earth at nearly 2 million people, approximately 915,000 of which are in PLA Army Ground Forces combat units. The PLA consists of the PLA Army (Ground Forces), PLA Air Force, PLA Navy, PLA Rocket Forces, and the PLA Strategic Support Force. The Premier of the CCP, Xi Jinping, is the Commander in Chief of the PLA as well as the head of the CCP.[B]

The PLA suffers from a tightly controlled, top down leadership method that enforces strict political control. Every PLA element from company level up has political commissars assigned to ensure that leaders and subordinates are toeing the CCP line.

PLA is Artillery Heavy

Artillery is the key component of PLA Ground Forces. **Fires form the backbone of the newly reformed Combined Arms Brigades. More than one third of all PLA Ground Forces units are artillery units.** The PLA has 15 artillery brigades.[C] **China possesses approximately 3800 self-propelled artillery pieces and 3600 towed pieces.** According to Military Balance 2019, PLA artillery holds almost 8,954 pieces of artillery weapon systems with a focus on Self-Propelled systems and Multi-Barrel Rocket Launcher systems. PLA artillery emphasizes the ability to rapidly project forces long distances, to be highly mobile on the battlefield and to provide precision, long range fires on enemy targets.[D] In pursuit of this goal, China has invested heavily in its artillery forces over the past twenty-plus years.

Figure 1. Chinese PLA PCL181 155mm self-propelled howitzer at its debut at China's National Day parade in Beijing, October 1st, 2019. PLA photo

Systems Confrontation Doctrine

PLA artillery fully integrates electronic warfare assets under its Systems Confrontation Doctrine, utilizing satellite, airborne, including unmanned aerial systems (UAS), and ground based GPS jammers/spoofers, communications jammers[E] and counterbattery radar to detect, delay and confuse enemy forces long enough to deliver effects to defeat them.

Counter Battery Smart Drones

Simultaneously, PLA artillery is employing the Chinese BeiDou satellite navigation system[1], UAS for detection and targeting of enemy artillery, some with electro-optical payloads that can detect the muzzle flash of concealed systems, artillery tube-launched targeting UAS that identify and laze targets for precision munitions, as well as "loitering munitions" UAS that are both detector and projectile used to target enemy units.

Michelle Van Cleave, national counterintelligence executive under President George W. Bush, said China's military has targeted U.S. military communications technology for collection. "China would like nothing better than to be able to disrupt or corrupt sensitive U.S. military communications it is at the heart of their military strategies of information dominance and anti-access/area-denial."[F]

New Artillery, Smart Artillery

An example of the PLA's execution of its plan to develop and utilize deployable, highly mobile artillery systems capable of long-range precision fires is the PCL181 155mm truck-mounted self-propelled howitzer manufactured by China's North Industries Corporation (NORINCO).

The PCL181 was designed to be deployable by rail, its size being a proper fit for Chinese rail cars, having no overhanging parts.

It is also a mere 25 tons[2] making it air transportable by smaller Chinese aircraft. The Y-9 medium transport plane[3] can carry one PCL181 while the Y-20 heavy transport can carry two.

Its comparatively light weight gives the PCL181 an advantage when traveling on roads and bridges. Its 6 X 6-wheel drive chassis also makes it highly maneuverable off-road. It has a max speed of 90km/h[4] (about 56 MPH) on roads.[G]

The China-based website chinamil.cn suggests that the PCL181 can transition from road-march to ready to fire, fire six projectiles, go back to road-march and displace – in three minutes. While that sounds ambitious, it demonstrates what the PLA would like to achieve. The PCL181 has an armored six-man cabin with digital controls. The howitzer has an automatic gun-laying system and on-board fire direction that, according to chinamil.cn, requires only the azimuth of fire to be input.

The gun also has a semi-automatic ammunition loading system. According to DefenseWorld.net, each vehicle can carry 27 projectiles and 15 containers of propellant. The L52 is also capable of firing all US and NATO 155mm projectiles.[H]

The PCL181 mounts the NORINCO 155mm L52 howitzer capable of firing multiple types of standard and specialized projectiles including laser-guided and satellite guided projectiles out to 50 kms and has a firing rate of four to six rounds per minute.

Figure 2. PCL181s rail loaded for transport.

Figure 3. PLAAF Y-20 heavy transport aircraft.

Figure 4. PCL181s traveling over roads in China. View from the rear. Photo MilitaryReport.cn

There is no current data on the system's accuracy, but we might assume it meets PLA standards since it has already been fielded to four artillery brigades; 74th Artillery Brigade, 74th Group Army, Southern Theater Command, 75th Artillery Brigade, 75th Group Army, Southern Theater Command, 73rd Artillery Brigade, 73rd Group Army, Eastern Theater Command, and the 308th Independent Artillery Brigade, Tibet Military District, which borders India.[I]

Recent Chinese press articles have touted the PCL181 as being well suited to high altitude operations due to its lighter weight, a less than veiled threat to India, with whom recent border clashes have resulted in Chinese and Indian casualties. Some of those reports also claim the PCL181 outclasses its US military rivals. Depending upon your perspective, the PLA may have found a way to fill a gap in the artillery world that the US regards as already filled.

It is worthy of consideration that China is a leader among global sales of military arms and equipment , in fact, Pakistan already has its first SH-15s, the export version of the PCL181[K].

PLA Ground Forces still field many thousands of artillery systems that are obsolete by the standards of most world class armies, systems like the 152mm Type 66 howitzer (aka D-20) which entered initial service with the Soviet Union in 1947 and in the PLA in the mid-

Figure 5&6. Inside 6-man armored cab. Photos MilitaryReport.cn

Figure 7&8. Front passenger has digital panels to his front and left. MilitaryReport.cn

Figure 9. PCL181 Gun crew loading the gun. Photo CCTV7

Figure 10. A PCL181 from the 75th Artillery Brigade, 75th Group Army, Southern Theater Command, is fired in the direct-fire mode. Photo from China Defense Blog

1960s. There are many videos online published by CCP mouthpieces, like CCTV, that depict PLA artillery units training with their varied systems. These videos often depict a level of discipline and care (or lack thereof) among gun crews that US artillerymen would consider unsatisfactory.

Chinese military modernization and its artillery component have continued apace but it may have been affected by the current COVID-19 pandemic. As of yet, it seems too early to tell.

The views expressed in this article are those of the author and do not reflect the official policy or position of the Defense Intelligence Agency, the Department of Defense, or the U.S. Government.

The author is a former US Field Artilleryman and a current senior intelligence officer with the Defense Intelligence Agency. He focuses on hostile capabilities that pose a threat to US and Allied forces globally.

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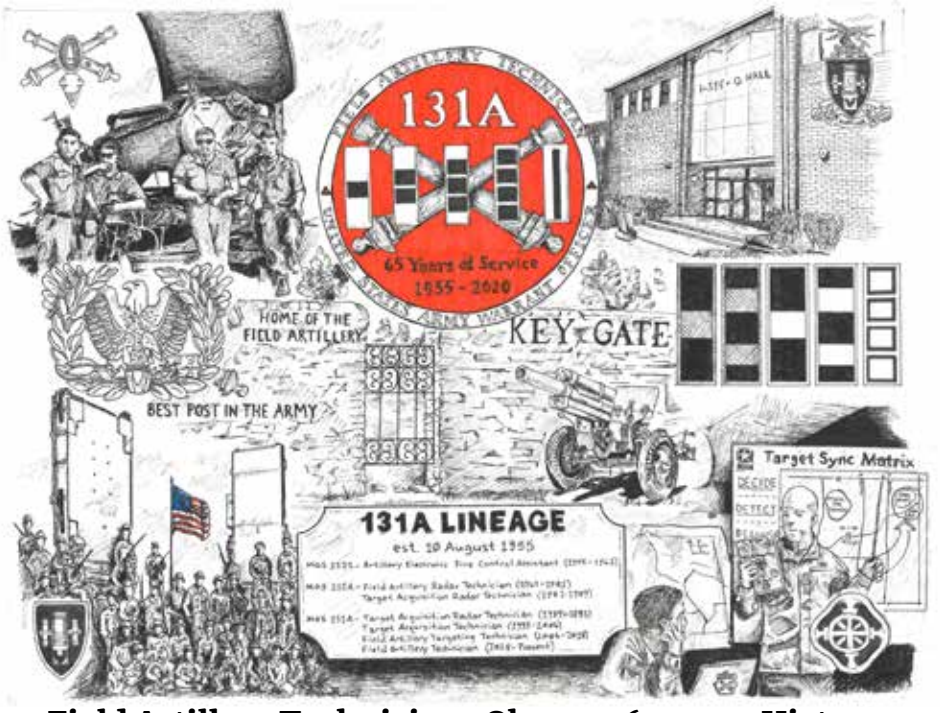
1. As of July 29th, 2020, the satellite in the BeiDou constellation has been launched and joined the network. https://www.globaltimes.cn/content/1196024.shtml
2. Different Chinese sources claim the system weighs 20 tons, 25 tons and 30 tons.
3. This claim comes from www.chinamil.cn, but may not be accurate based upon the interior dimensions of the Y-9.
4. A late June 2020, article in the South China Morning Post claimed the max speed was 100km/h.



Field Artillery Technicians Observe 65-year History with Commemorative Print

CW3 Michael Sexton

Following the advent of radar, and its use by artillery units in World War II and the Korean War, the Field Artillery quickly identified the need for a technician to maintain its radar systems. On August 10, 1955, Military Occupational Specialty 1121, Artillery Electronic Fire Control Assistant, was established to fill this need. Today's modern-day 131As trace their lineage back to MOS 1121.

Artillery Electronic Fire Control Assistants were trained to supervise the employment and maintenance of the AN/MPQ-10 and AN/MPQ-4 counter-mortar radar systems, as well as the AN/TPS-25 ground surveillance radar. In July 1962, MOS 1121 was recoded to MOS 211A and the specialty renamed as Field Artillery Radar Technician.

As the war in Vietnam escalated, Field Artillery Radar Technicians assumed responsibilities as radar section leaders replacing lieutenants and captains. 211As were responsible for the maintenance, tactical employment, and operation of the AN/MPQ-4 and AN/TPS-25 radar sections, the AN/MPQ-10 having since been retired. FA Radar Technicians in charge of these sec tions aided in the force protection of supported maneuver elements, base camps, and other fixed installations in Vietnam.

At the end of the 1970s, the AN/MPQ-4 radar was replaced by the AN/TPQ-36 and AN/TPQ-37 Firefinder radar systems. The AN/TPQ-36 detected and located mortar firings, while the AN/TPQ-37 located artillery units.

In 1981, the Field Artillery Radar Technician specialty was renamed Target Acquisition Radar Technician and in 1989, MOS 211A was officially changed to MOS 131A. Throughout the 1980s, Target Acquisition Radar Technicians stood ready, around the globe, to counter Warsaw Pact aggression.

In August 1990, Operation Desert Shield commenced, followed by Operation Desert Storm, in January 1991. Target Acquisition Radar Technicians deployed with their radar sections and played a critical role in silencing Iraqi artillery, rendering those systems combat ineffective, for fear of being targeted.

In 1993, the Target Acquisition Radar Technician specialty was renamed Target Acquisition Technician and officially took over roles of counterfire officer, FA intelligence officer, and targeting officer, from battery through corps echelons. As targeting officer, the 131A facilitates the targeting process, in support of the combined arms commander.

After the terrorist attacks of 9/11, Target Acquisition Radar Technicians deployed in their traditional roles, as well as a myriad of non-standard positions during operations Enduring Freedom and Iraqi Freedom. Radar section leaders and counter-fire officers played key roles in the counter-fire fight, and provided early warning detection of rockets and mortars on forward operating bases. Field artillery intelligence officers and targeting officers transitioned to counterinsurgency targeting, focusing their efforts on high value individuals in terrorist networks.

Renaming the specialty to Field Artillery Targeting Technician in 2006, and then Field Artillery Technician in 2018, field artillery warrant officers can be found today from battalion to combatant command levels, serving as integral members of conventional, special operations, and cyber units worldwide.

The 131A Commemorative Print highlights a Field Artillery Radar Technician in Vietnam with his AN/MPQ-4 Radar Section (upper left); I-See-O Hall, where 131As attend WOBC and WOAC (upper right); Target Acquisition Radar Technicians at the conclusion of Operation Desert Storm with their AN/TPQ-36 and AN/TPQ-37 Radar Sections (bottom left); a Targeting Officer and Field Artillery Intelligence Officer facilitate a targeting meeting at JMRC in Hohenfels, Germany (bottom right); and Key Gate at Ft. Sill, OK (center). The Eagle Rising insignia (left center), was worn by warrant officers until 2004, when it was replaced by branch insignias. The old ranks of WO1 to CW5 (right center) were replaced by the current ranks in 1972 (WO1-CW4) and 2004 (CW5). The Coast Artillery Mine Planter device (upper left) pays homage to the Army's first warrant officers in 1918. The US Army Field Artillery School is represented in the upper right and bottom left, and the 428th Field Artillery Brigade is represented in the bottom right.

CW3 Michael Sexton is the Targeting Officer at United States Army Pacific. He first published the history of the 131A in the August 2015 edition of the 131A quarterly newsletter, The Targeteer.

ATTENTION:

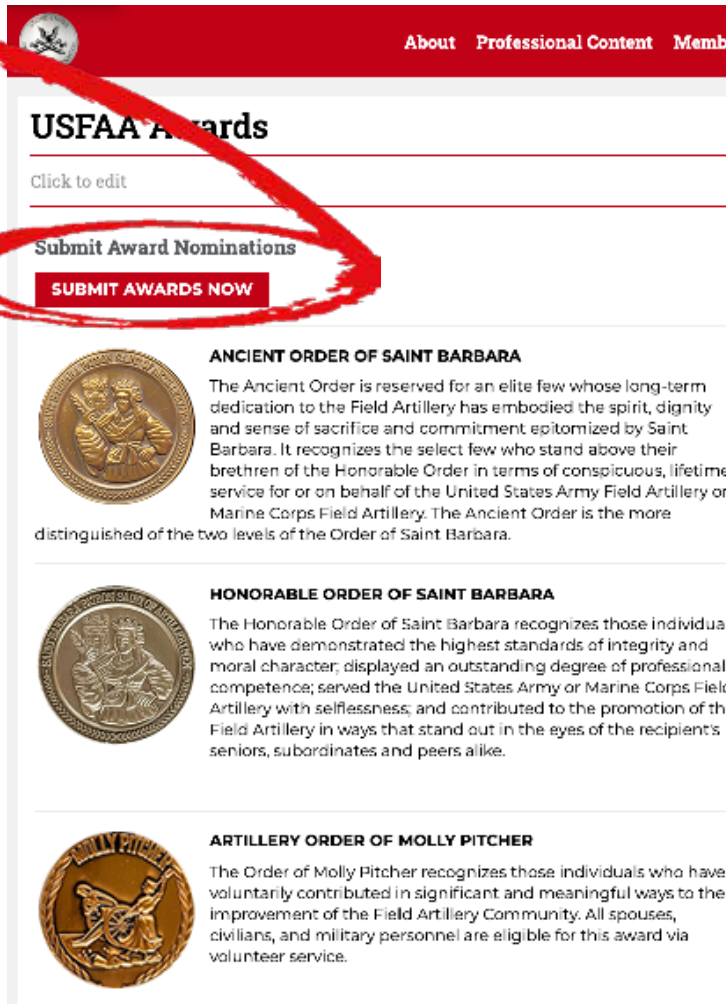
IMPORTANT INFORMATION FOR ST. BARBARA AWARDS

Starting 1 July 2020 Honorable Order of Saint Barbara, Ancient Order of Saint Barbara and Artillery Order of Molly Pitcher Awards will only be accepted through electronic submission on the USFAA website www.fieldartillery.org. Use your member log-in to access the award submission page.

POC's can use the membership directory on the website or use the look-up field on the award submission page to check which nominees have current memberships. Chapter rosters can also be accessed through the membership directory by clicking on filters, then using the drop down menu to select chapter name.

Memberships can be obtained through the membership link on the website. Awards packets can be paid using a credit card or check electronically at the end of the submission. We no longer process memberships and awards together.

If you need assistance or have questions please email awards@fieldartillery.org or call 580.355.4677.



FA Journal Submission Guide

The Field Artillery Journal serves as the professional forum of the branch across all ranks, Marine, Army, and Civilian. We exist to inform on new developments in the Branch and winning ideas from the field. The Journal is seeking articles and short features on past, present or future programs, equipment, tactics, techniques, procedues or other issues affecting our Branch. Approximately 40 percent of our readers are company-grade Field Artillery Soliders and Marines. The other 60 percent is comprised of more senior-ranking Redlegs, servicemen from other branches and services, our Allies, corporate executives and politicians. We are a total-branch publication.

What to Subit:
Article submissions do not have to agree with current doctrine, official policy or approved techniques or procedures. Ask yourself how the topic is going to help the artillery community. Only unclassified information can be published in the FA Journal. Articles must promote safe techniques and procedures. Be accurate, logical and complete in your writing. Submissions must be clearly written with an evident thesis, no more than 2500 words. Strive to educate, not impress. A message is most clear when written in simple language, An abundance of adjectives, adverbs and words that the reader will have to look-up detracts from the message. If possible please include graphics, charts or photographs to supplement your article.

Preferred Topics:
- Counter-fire at the DIV/Corps Level
- Targeting
- Training at homestation for LSCO
- Fires Support Issues within the EUCOM/PACOM AOR

All submissions must be emailed to director@fieldartillery.org with the subject line FA Journal Article Submission. Please email submissions in an attached word doc format. DO NOT place images or graphics into the word document. Send them as attachments in jpeg, png, pdf, or eps files. Incude footnotes where appropriate, though we may not publish them with the article. Also include a short biography, highlighting the experience that makes you credible as a author on that subject. Include your name, email address and phone number so that we may contact you with follow-up questions.

The USFAA Staff reserves the right to edit an article and put it in the magazine's style and format. If you have questions on themes, subject matter or publication deadlines, please call 580.355.4677.

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PURPOSE: The FA Journal continues the tradition begun with the first Field Artillery Journal published in 1911. To publish a journal for disseminating professional knowledge and furnishing information as to the Artillery's progress, development and best use in campaigning to cultivate, with other arms, a common understanding of the power and limitations of each to foster a feeling of hearty cooperation by all and to promote understanding between the regular and militia forces by forging a closer bond, all of which objects are worthy and contribute to the good of the country.

ASSOCATION MEMBERSHIP: Subscriptions to the FA Journal comes with membership in the Association. Individual or corporate memberships may be obtained through the USFAA website at www.fieldartillery.org or by calling 580.355.4677. Dues start at $25.00 per year for an individual membership to US and APO addresses (International rates may vary).

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WE WANT YOU!

On the eve of Saint Barbara Celebrations….
We want you to join us. During the month of September we are hosting our annual membership drive!

As Artillerymen we are a unique breed. Our colors are red and yellow. We celebrate and seek the affection of Saint Barbara. We recognize the devotion and fighting spirit of Molly Pitcher. We recognize our final resting place as Fiddlers Green. We tend to be a little rowdy and our social gatherings are usually the most popular, because there truly is not a party without "Arty". We are distinct from the other combat arms. It is important to retain these traditions and practice them routinely so they are never lost nor forgotten.

As professional Soldiers we strive for expertise in our craft. To fight and win in large scale ground combat operations, we need to be at our best. Your professional association- The United States Field Artillery Association strives to assist you in being the best Field Artilleryman you can be.

USFAA Member Benefits:
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Which Chapter is the strongest?

Every Chapter that reaches 25% growth receives a $250 grant on top of their annual chapter check.
Our top three chapters with the highest percentage of growth during the month of September will receive an additional grant of up to $1500.00.

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