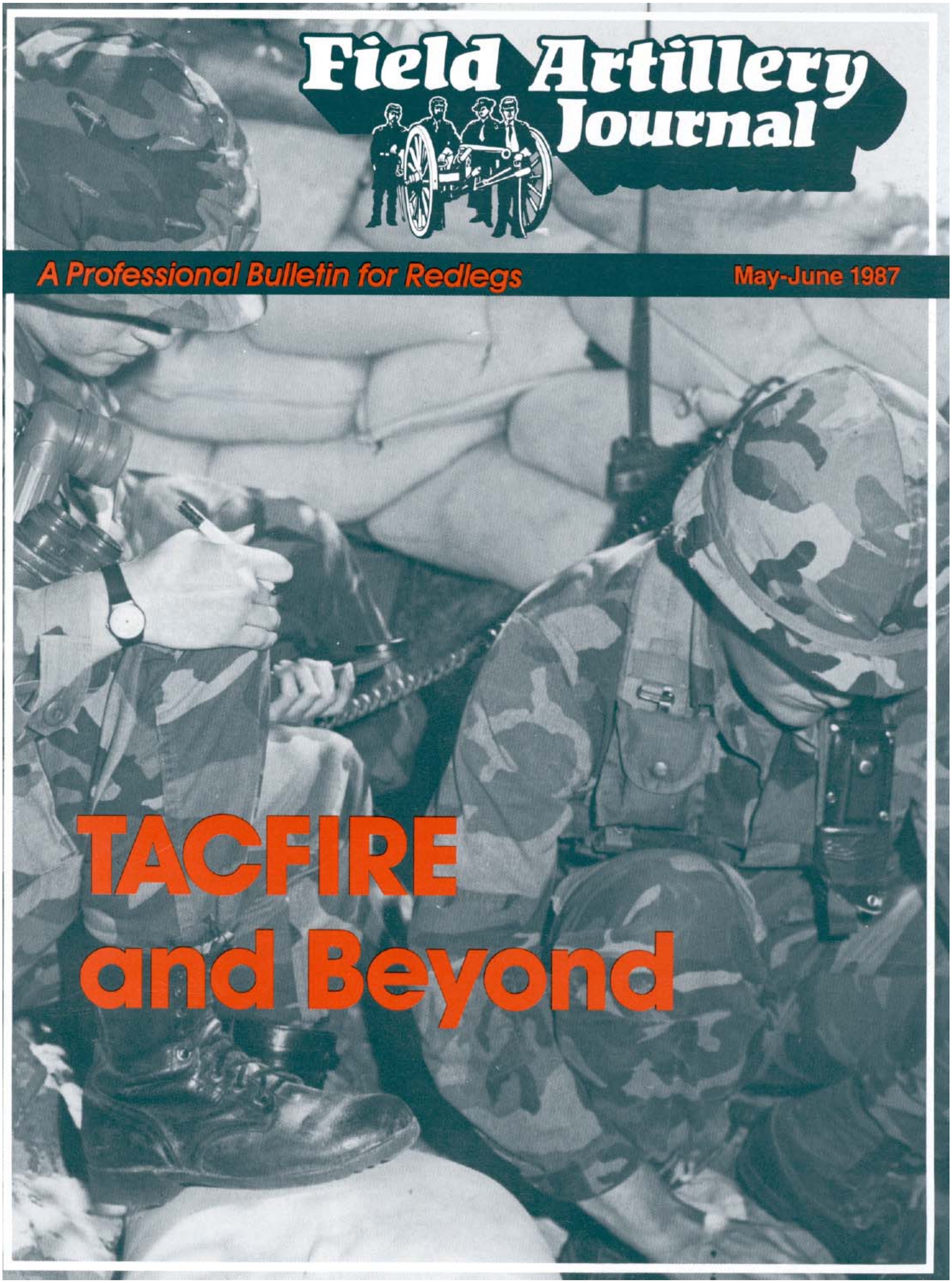
Field Artillery Journal

A Professional Bulletin for Redlegs

May-June 1987



TACFIRE and Beyond

Field Artillery Journal

PB 6-1987-3 *A Professional Bulletin for Redlegs* May-June 1987

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Front cover photo by Jill Ponto
Special thanks to Second Lieutenant Laura Carter

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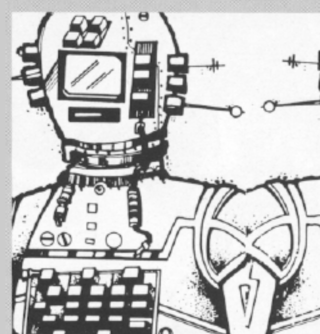

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PURPOSE (as stated in the first *Field Artillery Journal* in 1911): "*To publish a journal for disseminating professional knowledge and furnishing information as to the field artillery's progress, development, and best use in campaign; to cultivate, with the other arms, a common understanding of the power and limitations of each; to foster a feeling of interdependence among the different arms and of hearty cooperation by all; and to promote understanding between the regular and militia forces by a closer bond; all of which objects are worthy and contribute to the good of our country.*"

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On the Move

MG EUGENE S. KORPAL

"The Army's concept will use existing hardware and software to improve mission performance and save Army money and Army time."

The increasing complexity, speed, and lethality of modern warfare dictates that commanders at every echelon make timely, accurate, and effective decisions. Field Artillery commanders—with their finger on the trigger of the massive firepower of the Lance missile system, the multiple launch rocket system, and the 3 calibers of cannons; with their Redlegs dispersed to survive and moving fast to support their maneuver commanders; and with their ability to see deep into the Threat's follow-on echelon—need more than simple automated gunnery. The commanders implementing the Army's AirLand Battle Doctrine need an effective and interoperable command, control, communication, and intelligence network that they can use on tomorrow's battlefield. The answer is the Army Tactical Command and Control System (ATCCS).

The Army plans to use existing hardware and software to improve mission performance and to save Army money and Army time. System developers will combine 5 battlefield functional area subsystems into a single ATCCS. They are:

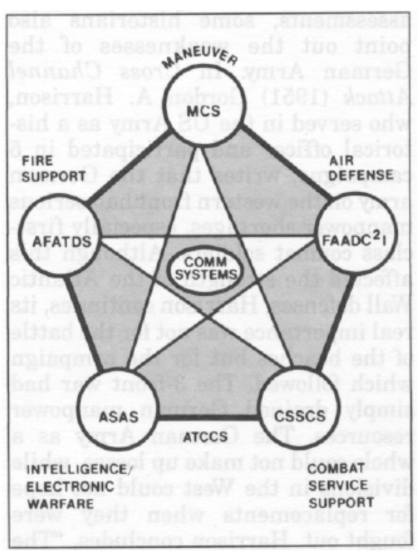
- Maneuver control system (MCS).
- All source analysis system (ASAS).
- Advanced Field Artillery Tactical data system (AFATDS).
- Forward area air defense command, control and intelligence system ($FAADC^2I$).
- Combat service support control system (CSSCS).

Developers will program the ATCCS subsystems in Ada. Standard messages and procedures will ensure interoperability and facilitate the exchange of information while improving mission performance in all battlefield functional areas. The common hardware components will be rugged, small, and as light as possible to ensure it can operate in existing wheeled and tracked vehicles.

As the fire support node of ATCCS, AFATDS will integrate all fire support and attack systems to include close air support, naval gunfire, mortars, Army aviation, offensive electronic warfare and Field Artillery to support AirLand Battle more effectively. The system will assist the commander in the attack of high payoff targets by determining a priority for every target in the system, and by determining which available fire support assets can best defeat a given target. In essence, AFATDS will assist the commander to attack the *right* target at the *right* time with the optimum fire support system.

AFATDS' communications interfaces allow it to accommodate all existing and proposed combat net radio, area communication, and data distribution systems (e.g. SINCGARS, PLRS-JTIDS Hybrid, Mobile Subscriber Equipment, etc.) as well as to hook up to a local area network (LAN). The AFATDS database management system and information management system will use all available communications to distribute data efficiently in near-real time throughout the system.

Pending the fielding of AFATDS, we need to provide a near-term automated fire support capability to the light divisions. We have developed a way to satisfy this requirement by using existing hardware and software that we will continue to use as a part of the objective fire support command, control, and communication (C^3) system. The interim system for the light infantry divisions (LIDs) includes the battery computer system (BCS), fire support team digital message device (FIST DMD), and digital communications terminal (DCT). The system will provide an automated message transmisison and monitoring capability at all fire support nodes between the forward observer and the fire direction center (FDC). It will also improve fire planning and coordination, interoperability, and information management. This near-term fix for the LIDs will be short-lived; we will field AFATDS to the LIDs first beginning in FY90, and their interim hardware will be redistributed to heavy units.



The fielding plan for AFATDS calls for light infantry divisions to receive hardware first followed by a corps each succeeding year.

While we await these systems of the future, we must maintain our expertise with the tactical fire direction system (TACFIRE). Fort Sill's planners will field Version 8 software during FY 88 to effect interoperability with the meteorological data system (MDS), to complete implementation of employment procedures for the Field Artillery family of scatterable mines (FASCAM), and to incorporate the expanded memory capability of the battery computer system (BCS). We will send TACFIRE Version 9 software to the field during FY89 to implement MLRS terminal homing munitions processing, to incorporate procedures for employing the Army tactical missile system (ATACMS) antipersonnel/antimateriel (AP/AM) munitions, Lance AP/AM, and to provide improved message transmission procedures.

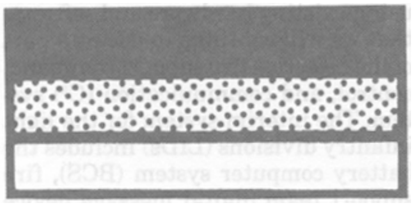
TACFIRE equipped units will also receive a hardware product improvement in FY88-89. This improvement will enable division artillery and Field Artillery brigade headquarters to downsize from 2 shelters to 1 (thus eliminating 2 5-ton trucks and 2 trailer-mounted generators) and it will increase the available memory in BCD TACFIRES to 3 megabytes.

The Field Artillery School's initiatives in fielding and sustaining more capable C^3 systems will allow Redlegs to improve their already accurate and timely fire support.

Incoming

LETTERS TO THE EDITOR

Two Views



Point

Although I enjoy reading the *Field Artillery Journal*, I do have one complaint to address to today's military historians. I refer to Dr. Boyd L. Dastrup's letter to the editor that appears on page 2 of the September-October 1986 issue of the *Journal*. He sounds so typical of many Training and Doctrine Command (TRADOC) historians who describe the derring-do of the Germans and the Soviets, while they give less attention to the American Army of World War II. He, like the others, have succumbed to the writings of the German generals of that era.

For example, his argument that the "German Army the Americans faced was basically second-rate and depleted by action on the Eastern Front," implies that we would have been defeated if we had faced them earlier, say from 1940 to 1941. Hogwash!

The Germans were the poorest practitioners of the art of combined arms warfare. The Russians, on the other hand, knew what the words meant but were unable to implement their doctrine. By mid-1942 on the Eastern Front, there were 2 second- or perhaps third-rate armies fighting each other in a massive bloodletting that smacked of World War I days on the Western Front.

What bothers me more than anything else is the influence these historians are having on our young officers. They have swallowed the German line completely, and one comes away from their classes truly believing that the Germans did not lose World War II. I certainly wish they would spend more of their time learning about the victorious US Army.

Albert N. Garland
Editor
Infantry Magazine

Counterpoint

In his letter, Mr. Albert N. Garland asserts that the typical historian that TRADOC seems to be hiring is filled with the "derring-do of the Germans and the Soviets, thumbs down on the American Army of World War II." Undoubtedly, the US Army defeated the German Army and deserves credit for that. However, historians have a responsibility to examine the past critically, meaning they weigh the evidence found and then draw conclusions. Unfortunately, some distort the past and stray from the goal of being as objective as humanly possible. After all, people analyze the present and the past by drawing upon their own education and experiences. In other words, they see the past through the prism of their own life.

Following World War II, official and academic historians earnestly sought all available documents and wrote their works. Like Mr. Garland, many lauded the American army for defeating the Germans and frequently tended to overlook any weaknesses because many had served in the Army and did not want to do anything that would discredit their service. This often produced histories that *distorted* the accomplishments of the US Army.

Trying to be balanced in their assessments, some historians also point out the weaknesses of the German Army. In *Cross Channel Attack* (1951) Gordon A. Harrison, who served in the US Army as a historical officer and participated in 5 campaigns, writes that the German army on the western front had serious manpower shortages, especially first-class combat soldiers. Although this affected the strength of the Atlantic Wall defenses, Harrison continues, its real importance was not for the battle of the beaches but for the campaign which followed. The 3-front war had simply drained German manpower resources. The German Army as a whole could not make up losses, while divisions in the West could not hope for replacements when they were fought out. Harrison concludes, "The enemy was hollow and he would be shown so in the later phases of Overlord." In fact, Charles B. MacDonald, a company commander during the

Battle of the Bulge, wrote in *The Siegfried Line Campaign* (1963) that many American commanders in late 1944 felt that the German army was "no longer a cohesive force but a number of fugitive battle groups, disorganized and even demoralized, short of equipment and arms." Although Harrison, MacDonald, and others who had a wartime service examine the weaknesses as well as the strengths of the German Army, they generally describe the US Army in sympathetic terms, and there is nothing wrong with this.

Many historians of the 1980s read the same facts and reach different conclusions. Given the lack of manpower and logistical shortages, they often reason that the German Army of 1944 and 1945 was certainly inferior to the one of 1940 through 1941, and it was. This, however, does not say that the German army of 1940 could have totally defeated the US Army at Normandy as Mr. Garland implies my peers are proclaiming. Such thinking is pure speculation which most historians, whether young or old, avoid because no one knows who could have won. Moreover, it does not say the US Army of World War II was a poor one. It could fight well, and the individual soldier was a good soldier. The Battle of the Bulge reaffirms this view.

Those historians, including myself, that Mr. Garland criticizes for distorting the US Army's experience during World War II grew up in a different time, had different experiences, are less emotionally involved with the war, and, therefore, have a different perspective. Coming of age during the Vietnam War and afterwards, many historians became cynical and antagonistic to the US Army. Because of this, they often focus on the weaknesses of the Army and give it little credit. Yet, the historians being hired by TRADOC do not fall into this category. Trained in historical inquiry, they try to write or provide a balanced account. They, including myself, have not succumbed to the writings of the German generals and swallowed their line as Mr. Garland suggests. Equally important, they are spending their time learning more about the US Army as part of their command history responsibilities and trying to provide the Army with lessons learned from the past.

Dr. Boyd L. Dastrup
Command Historian
US Army Field Artillery School
Fort Sill, OK

Old Thoughts

Response to Observations on Fire Planning with TACFIRE

Captain Peter J. Zielinski makes a number of valid observations in the July-August 1986 *Field Artillery Journal* regarding deficiencies in tactical fire direction system (TACFIRE) training. However, his assessment of the situation is not complete. He points out some serious training deficiencies at *unit level* which hamper TACFIRE operations far more than training problems at the Field Artillery School.

Captain Zielinski's criticism of the School's instruction is partially justified. For some time, TACFIRE instruction ignored "real world" applications and discussed system capabilities only. There was some logic behind this, however, in that the TACFIRE courses were supplemented by new equipment training team (NETT) instruction at unit level. Now that TACFIRE fielding is nearly complete, units no longer get the NETT instruction.

And the nature of TACFIRE instruction has changed as well. All of the courses now include command post exercises designed to simulate tactical operations with TACFIRE. As instructors with TACFIRE field experience became available, the School changed instruction to include a more thorough discussion of real world applications for the various system features. Current fire planning classes include a discussion of fire planning doctrine and illustrate the relationship between manual and TACFIRE procedures.

Current fire planning classes include a discussion of fire planning doctrine and illustrate the relationship between manual and TACFIRE procedures.

But the TACFIRE courses cannot provide a thorough discussion of fire planning doctrine. As Captain Zielinski points out, the officer advanced course (along with the various NCO advanced courses) teaches fire planning *doctrine*. TACFIRE instruction assumes that the student already has a working knowledge of fire planning doctrine. To duplicate this instruction would waste valuable training time.

Inevitably, some students come to the TACFIRE courses without training or experience in fire planning. But surely the battalion S3 or brigade fire support officer (FSO) should be able to make up for the fire direction officer's (FDO) lack of experience. The S3 and FSOs share responsibility for fire planning. Both have a computer terminal variable format message entry device (VFMED) which gives them access to TACFIRE. The S3 and fire support officer normally have at least 1 trained VFMED operator. He should be able to combine his knowledge of doctrine with the operator's knowledge of TACFIRE to produce a suitable schedule.

After dismissing current standing operating procedures as inadequate, Captain Zielinski proposes yet another procedure as a solution to the dichotomy between TACFIRE procedures and doctrine. First, it is not clear what the dichotomy is. Captain Zielinski complains of separate sets of procedures for operation elements and fire support elements. The procedures do not divide duties between the operations section and fire support section, but neither does our doctrine. The operations and fire support sections (under supervision of the fire support coordination officer) normally share responsibility for fire planning. The "nuts and bolts" details are left up to the unit.

The School-produced standing operating procedures were not meant to impose a particular solution on all units, but rather to provide a flexible framework which units could mold to their own needs.

Captain Zielinski indicates that units are using NETT and School SOPs without any revision. This would indicate 1 of 2 things: either units are perfectly satisfied with the existing SOPs or (more likely) units are not really looking at them at all. In either case, a new SOP would hardly change anything.

Captain Zielinski is absolutely correct when he says that fire plans must be produced in accordance with established doctrine. But if a unit cannot plan fires, the blame lies ultimately with the unit itself. If commanders, S3s, and fire support officers are satisfied to pass all responsibility for fire planning to their fire direction centers because they are the TACFIRE experts, they should not be surprised when the results are unsatisfactory. The solution is not to train fire direction officers to do everyone else's job, but to force everyone else to learn his own job.

An S3 or fire support officer who lacks a working knowledge of TACFIRE is in the same position Captain Zielinski was when he tried to teach TACFIRE fire planning with no knowledge of fire planning doctrine. It is time to stop treating TACFIRE like some strange aberration. It now represents the standard artillery command and control system for most of the Active Army.

Scott R. McMeen
CPT, FA
Fort Sill, OK

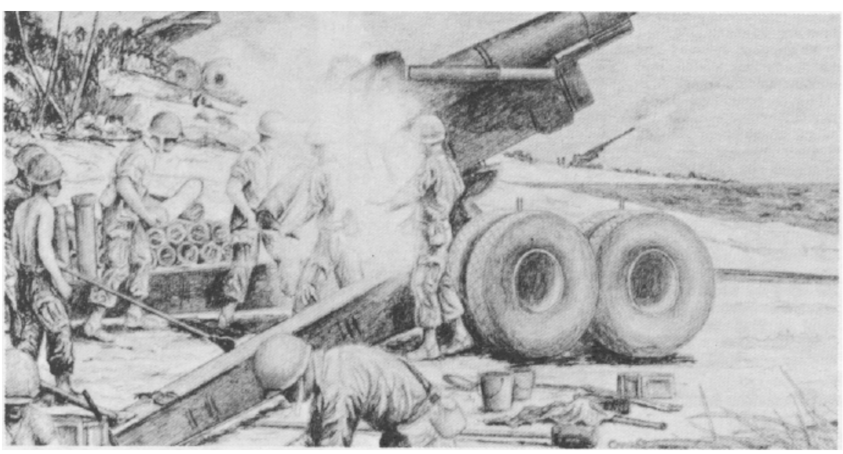


Illustration By: Frank Thomas

Compliments

I enjoyed the article "From the Coast to the Field" by Charles H. Bogart (September-October 1986 *Field Artillery Journal*). I joined Battery B, 252d Coast Artillery on 5 June 1939 and remained in the unit through federal mobilization of the North Carolina National Guard until February 1942 when I left to attend Officer Candidate School. The article brought back a lot of memories.

William E. Stone, Jr.
LTC (Ret), ADA
Lumberton, NC

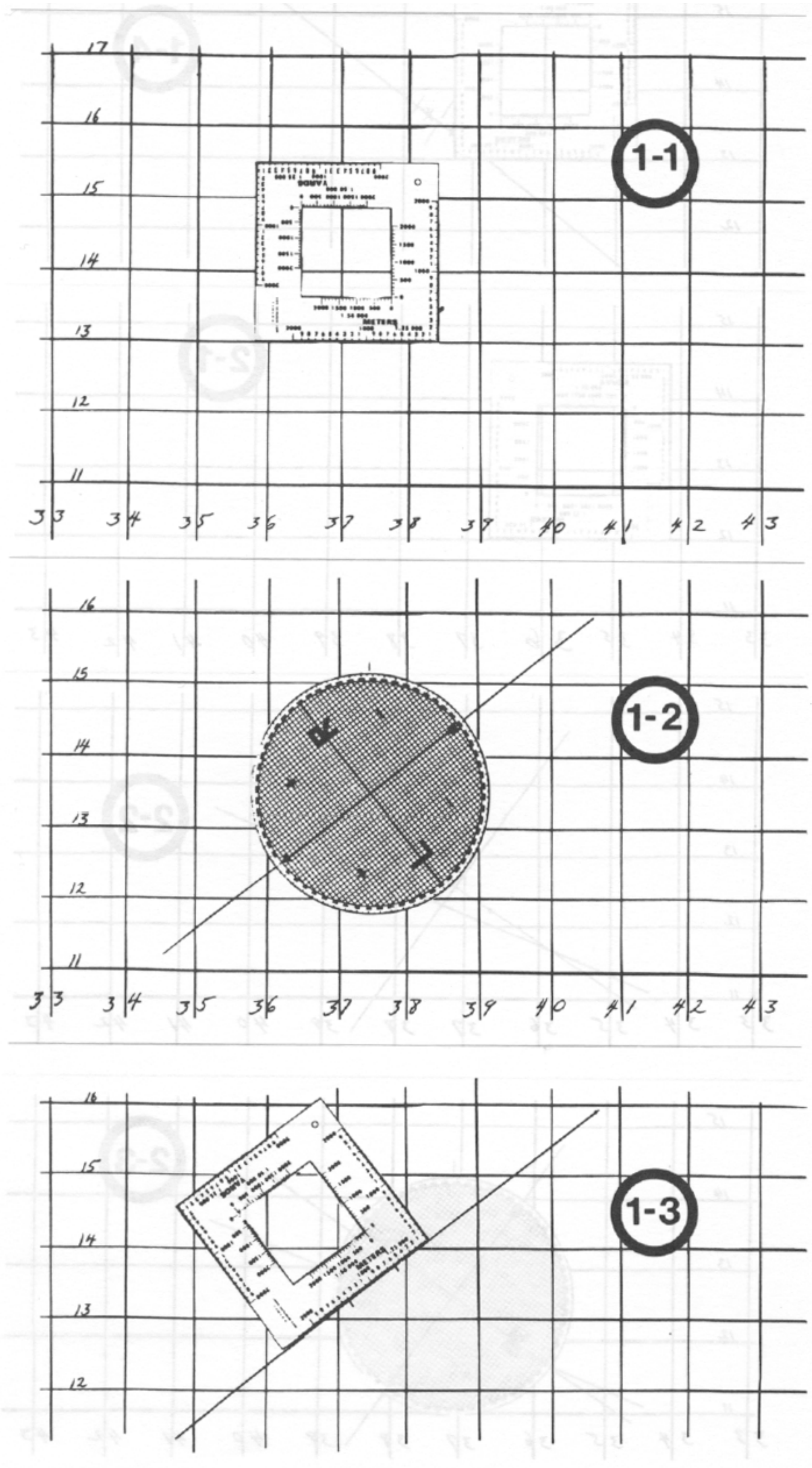
Reminiscing

Many of the *Journal* articles have struck a nostalgic note including past ones on the horse artillery and "L" pilot activity.

When I was commissioned in June 1933 upon graduation from Yale, our summer ROTC encampment was at Fort Ethan Allen, Vermont, with horses and the French 75-pound guns. In World War II, I was a staff officer assigned to the 36th Division Artillery as Artillery Air Officer and flew L4s and L5s in Italy, France, Germany and Austria. The best times I enjoyed were flying from a landing ship tank (LST) into southern France and flying Herman Goering in an L5 from Air Headquarters to 7th Army Headquarters in Augsburg.

As a pleasant result of this, I have been able to present a personal picture of World War II to high school students during the appropriate phase of the American History instruction. I recommend this activity highly to veterans and have found receptive audiences.

M.Y. Foster
BG, USA, Retired
Missoula, MT



Irregularly Shaped Targets

The battalion tactical fire direction system (TACFIRE) doesn't provide an adequate technical or tactical solution for the attack of irregularly shaped targets without manual assistance. Many battalion fire direction centers (FDC) process these types of missions by depicting the targets on the digital plotter map (DPM). Unfortunately, this may introduce an unacceptable error into the gunnery solution.

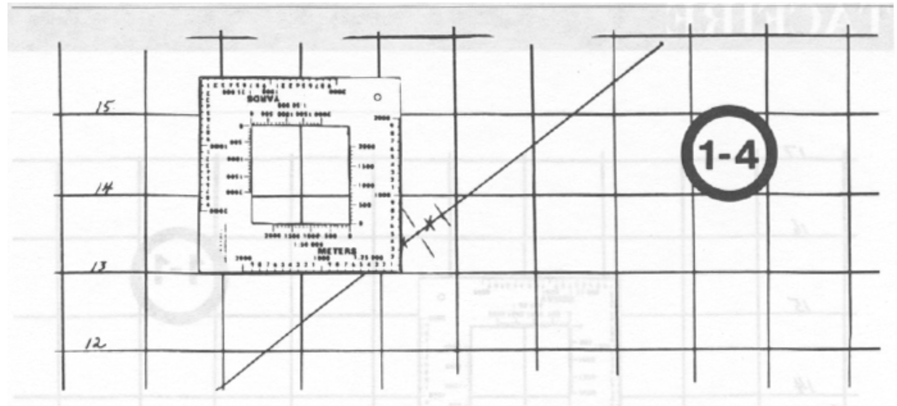
TACFIRE and battery computer system (BCS) equipped units may want to incorporate these methods into their standing operating procedures. The battalion FDC needs a coordinate scale, an observer target grid, a pencil, a few plotting pins, and a lap-sized firing chart.

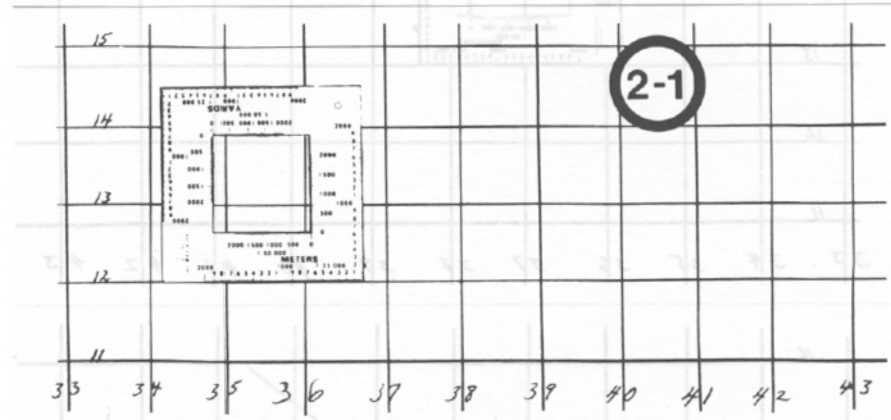
When the battalion FDC receives a target description specifying a length, width, and attitude, the fire direction officer (FDO) pulls out his "lap chart," hastily numbers it and plots the center grid (figure 1-1). Next he orients the observer target grid along the attitude and draws an extended line (figure 1-2). Using the coordinate scale he measures off the length of the target (figure 1-3). Now that the target is shown on the chart, the FDO can segment it and determine an accurate center grid and length of each segment (figure 1-4). The artillery control console operator (ACCO) can now compute separate fire missions for each segment and transmit fire orders to the fire units specifying a length, width, attitude, and center grid location. At the battery FDC, the BCS operator executes the message and computes the firing data.

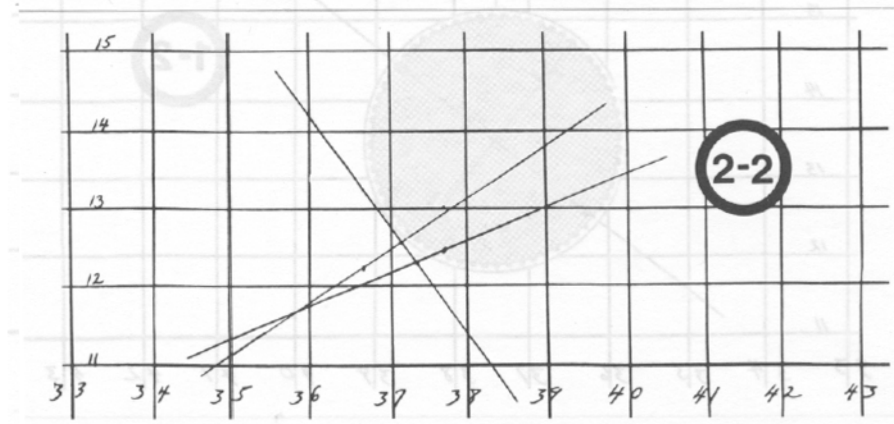
If a fire mission depicts a target location through a series of grids, the FDO can use a similar procedure. He plots each of the points (figure 2-1). Then he connects the points with a series of lines that are extended to measure attitudes (figure 2-2). Using the observer target grid the FDO measures the attitude of each dogleg (figure 2-3). Next, using the coordinate scale, the FDO measures the length of each dogleg (figure 2-4). He segments the target and selects aimpoints (figure 2-5). Now he can determine the grid coordinates of the aimpoints (figure 2-6) and compute and send the fire orders to the fire units specifying a length, width, attitude, and center grid location.

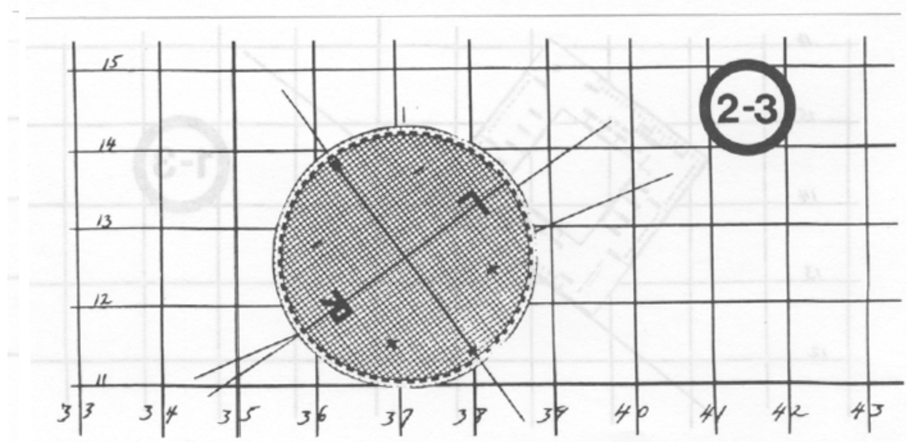
The 2d Battalion, 83d Field Artillery used these procedures with great success during numerous live fire gunnery evaluations. With a little coordination between the battalion FDO, the ACCO, and the firing battery FDCs, irregularly shaped targets can be processed quickly and with the precision that Redlegs are known for.

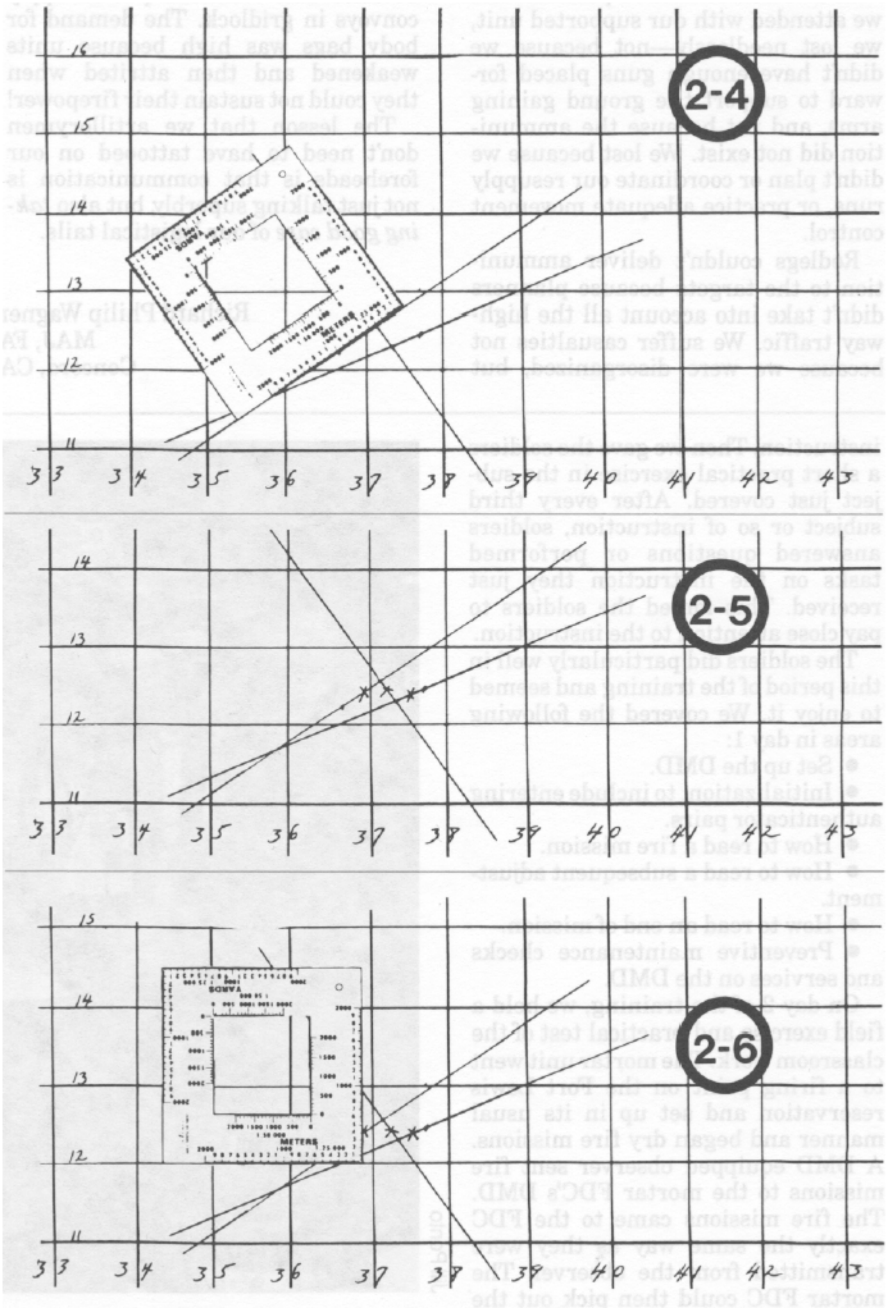
Charles J. Kirchen
CPT, FA
Fort Sill, OK











Lines of Communication

We artillerymen know that it is our business to move, shoot, and communicate. With our improved equipment, our responsiveness and accuracy steadily improve. Digital message devices and other high speed communication devices help us process fire requests quickly. One could surmise from this that we are able to communicate well because we can send more messages at a greater speed.

Do we communicate well? What are our lines of communication, and do we use them well? Lines of communication also include road networks, sea lanes, and air corridors. So resupply, when seen as communication links, is definitely a serious part of artillerymen's business.

Those of us who see gun bunnies (cannon crewmen) handle artillery ammunition know that it's very heavy and takes quite a lot of cargo capacity merely to get a small number of rounds to our firing points.

Practicalities dictate that we don't train realistically for resupply, but we in the command and staff levels need to be acutely aware of the realities of ammunition resupply.

In a recent command post exercise we attended with our supported unit, we lost needlessly—not because we didn't have enough guns placed forward to support the ground gaining arms, and not because the ammunition did not exist. We lost because we didn't plan or coordinate our resupply runs, or practice adequate movement control.

Redlegs couldn't deliver ammunition to the targets because planners didn't take into account all the highway traffic. We suffer casualties not because we were disorganized, but because unit locations put resupply convoys in gridlock. The demand for body bags was high because units weakened and then attrited when they could not sustain their firepower! The lesson that we artillerymen don't need to have tattooed on our foreheads is that communication is not just talking superbly, but also *taking good care* of our logistical tails.

Richard Philip Wagner
MAJ, FA
Concord, CA

Digital Capable Mortars

A problem an infantry battalion fire support officer (FSO) faces in a fully digital capable unit is that the unit *may not* be fully digital! The artillery battalions at Fort Lewis, Washington have the latest technology in fire support. All fire support assets are linked through a digital fire direction net except one. The 107-mm mortars are probably the most responsive of all fire support assets at this infantry battalion, however mortar calls-for-fire still have to be done by voice. According to tables of organization and equipment, there are only 2 radios in the fire support team headquarters vehicle. A digital fire direction net uses 1 radio, and a company command net uses the other. The wise Field Artilleryman can see what to do—give the mortars digital capability and put them on the direct support artillery battalion fire direction net.

Fort Lewis will soon get the mortar ballistic computer (MBC), and we will have our digital capable mortars. However, for those of you who will not be getting this system in the near future you might try to equip your mortars with a digital message device (DMD).

In an experiment at Fort Lewis, we equipped our infantry battalion mortars with a DMD and ran simulated dry fire missions. The results were excellent! The unit ran its missions well, if not better, than when it received them by voice.

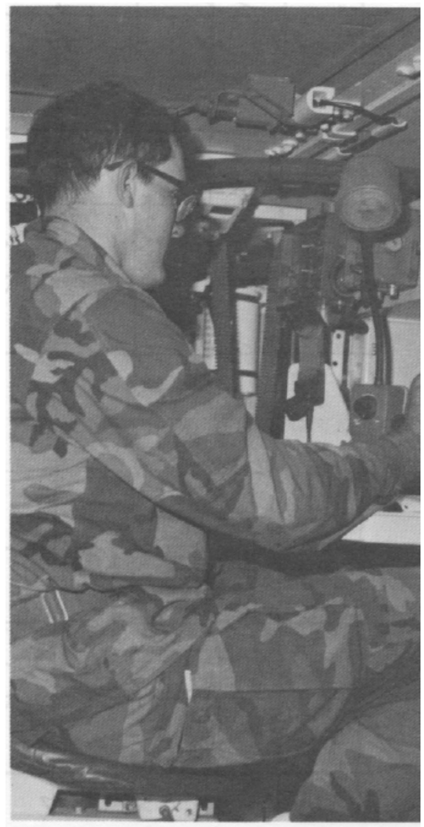
We conducted the experiment in a 2-day sequence. On day 1 the mortar fire direction center (FDC) personnel went through 6 hours of intensive training in care and operation of the DMD. The lecture type training was followed by step-by-step hands-on instruction. Then we gave the soldiers a short practical exercise in the subject just covered. After every third subject or so of instruction, soldiers answered questions or performed tasks on the instruction they just received. This forced the soldiers to pay close attention to the instruction. The soldiers did particularly well in this period of the training and seemed to enjoy it. We covered the following areas in day 1:

- Set up the DMD.
- Initialization, to include entering authenticator pairs.
- How to read a fire mission.
- How to read a subsequent adjustment.
- How to read an end of mission.
- Preventive maintenance checks and services on the DMD.

On day 2 of the training, we held a field exercise and practical test of the classroom work. The mortar unit went to a firing point on the Fort Lewis reservation and set up in its usual manner and began dry fire missions. A DMD equipped observer sent fire missions to the mortar FDC's DMD. The fire missions came to the FDC exactly the same way as they were transmitted from the observer. The mortar FDC could then pick out the information it needed to conduct the fire mission.

Within 2 hours the mortars were firing missions as fast as the observer could send them. In the critique at the end of the day, the soldiers expressed enthusiasm and confidence in their ability to use and understand the DMD. They felt it could be a worthwhile part of their combat operations.

The far-reaching benefits of this program are overwhelming. A digital capable mortar FDC reduces the number of radios a fire support team headquarters must employ because the



Jill Ponto

mortars can conduct fire missions on the direct support artillery battalion's fire direction net.

The battalion's fire support officer also increases his command and control. Now he can control which missions he wants fired and those he does not want fired as fire missions through the fire support officer's tactical fire direction system (TACFIRE) computer. Another benefit of this program is the communications security it gives to the mortar unit and to the observer. The single burst of digital traffic does not allow the enemy to listen to the fire mission, nor does it allow the enemy to locate the source of the transmission.

The real drawback to the whole program is the cost to the infantry battalion. They must obtain a DMD through the supply system, and even getting the equipment approved on the unit's modified table of organization and equipment is difficult. However, the benefits of this program are of such significance that it should entice those who want to improve their military capabilities. You *can* overcome these problems.

Alejandro S. Hernandez
2LT, FA
Fort Lewis, WA

Scott J. Weston
2LT, FA
Fort Lewis, WA

Interoperability: The Test of Combat

Tactical interoperability between units is more or less a common occurrence. It is one that is trained for, inherently anticipated, and expected—particularly where artillery is concerned. The concept in practical application becomes more difficult when an Active Duty unit attempts to integrate its operations with those of a Reserve or National Guard unit. But what of the "real world" contingency mission of an American Field Artillery battalion reinforcing or supporting one of our North Atlantic Treaty Organization (NATO) Allies? That contingency mission is difficult enough once we consider language, equipment, and employment differences.

Now that Army leaders have equipped US artillery units in US Army Europe with the tactical fire direction system (TACFIRE) and the battery computer system (BCS), how will we support NATO units not equipped? What are the practical implications of providing accurate, timely, and responsive fire support to these units?

During November 1985, the 6th Battalion, 10th Field Artillery, a general support, 203-mm artillery battalion assigned to the 72d Field Artillery Brigade in the Federal Republic of Germany, put a solution into practice. On 5 November 1985, units of the 12th Panzer Regiment Artillery and 6th Battalion, 10th Field Artillery conducted a joint live fire exercise at the Grafenwoehr Training Area. The solution to the problem of interoperating with a non-TACFIRE equipped battalion was relatively simple and workable. As illustrated in figures 1 and 2, *any* battalion can employ this solution to operate with a sister unit equipped with TACFIRE and BCS.

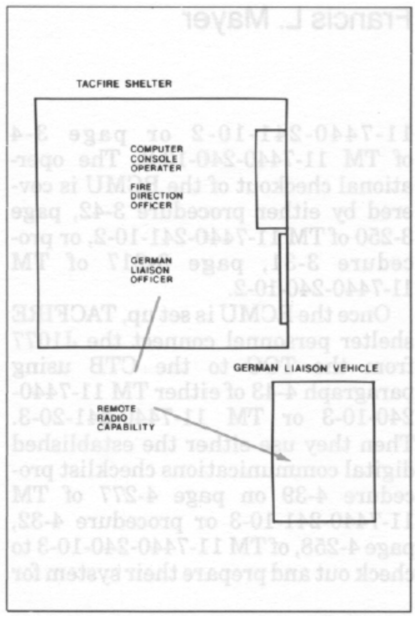


Figure 1.

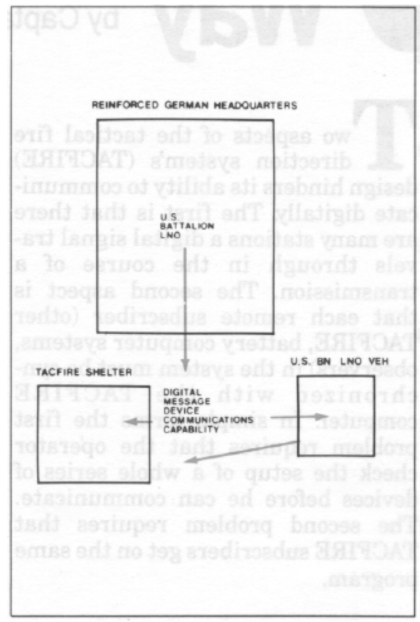


Figure 2.

The 6-10th Field Artillery used the methods illustrated in figures 1 and 2 on the live fire exercise and were successful. In figure 1, the reinforced German artillery battalion liaison officer stayed in the TACFIRE shelter. When the German artillery battalion transmitted fire missions, the German liaison officer provided appropriate fire mission data to the computer console operator and fire direction officer who initiated the mission directly from the console. The method illustrated in figure 2 would have the US liaison officer pass fire missions via the digital message device to the TACFIRE shelter. However, when the German Force artillery headquarters simultaneously initiated a fire mission with the digital message device, the voice transmission to the liaison officer in the TACFIRE shelter was faster.

Results of the exercise proved to be successful in accuracy, speed, delivery, and effects. The battalion consistently proved it can deliver fires in support of the 12th Panzer Artillery Regiment faster than other units operating under their command and control.

This type of arrangement should be redundant. Fire missions may be passed using either method, or both, to take advantage of the built-in redundancy. Units in the Active Army who have National Guard and Army Reserve "round out" units, may use this type of arrangement.

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Communicating the Digital Way

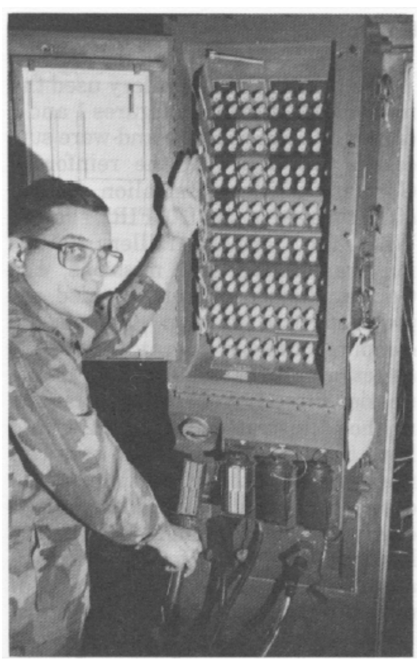
by Captain Francis L. Mayer

Two aspects of the tactical fire direction system's (TACFIRE) design hinders its ability to communicate digitally. The first is that there are many stations a digital signal travels through in the course of a transmission. The second aspect is that each remote subscriber (other TACFIRE, battery computer systems, observers) in the system must be synchronized with the TACFIRE computer. In simple terms the first problem requires that the operator check the setup of a whole series of devices before he can communicate. The second problem requires that TACFIRE subscribers get on the same program.

Looking at the Problems

We can appreciate the first problem when we look at the procedures to establish communications between a tactical operations center (TOC) and TACFIRE. The TOC personnel must check and set up the variable format message entry device (VFMED) using procedure 3-6, page 3-20, TM 11-7440-253-10-1. Next, they hook up the wire lines to the TACFIRE shelter and link the GRA-39 to the J1077 remote terminal box so TACFIRE can use the TOC radios. The TOC crew then hooks up the remote communications monitoring unit (RCMU) to the communications terminal box (CTB) on the back of the TACFIRE S280 shelter. This allows the TOC to monitor all TACFIRE nets, both voice and digital. The RCMU also provides a separate voice link from the TOC to the TACFIRE shelter. The setup of the RCMU is covered on page 3-6 of TM 11-7440-241-10-2 or page 3-4 of TM 11-7440-240-10-2. The operational checkout of the RCMU is covered by either procedure 3-42, page 3-250 of TM 11-7440-241-10-2, or procedure 3-31, page 3-217 of TM 11-7440-240-10-2.

Once the RCMU is set up, TACFIRE shelter personnel connect the J1077 from the TOC to the CTB using paragraph 4-43 of either TM 11-7440-240-10-3 or TM 11-7440-241-20-3. Then they use either the established digital communications checklist procedure 4-39 on page 4-277 of TM 11-7440-241-10-3 or procedure 4-32, page 4-258, of TM 11-7440-240-10-3 to check out and prepare their system for



communications. The operators should use a checklist because there are so many devices to check and set.

The TACFIRE and TOC then establish voice communications to make sure that communications software in the TACFIRE computer matches the switch settings on the VFMED in the TOC. The TACFIRE operator should print a copy of the SYS;1201 subscriber table output report and the SYS;1201 message address switches portion of the output report. The TACFIRE operator uses these reports to ensure that all subscribers are on the same sheet of music before attempting digital communication. They now transmit a digital test message to all remote subscribers (VFMED, fire direction system, digital message device, and Firefinder), to establish digital communications.

Once we establish digital communications, our next problem is to maintain synchronization. Synchronization is nothing more than 1 device sending the authentication that another device expects. Authenticators are never reused.

TACFIRE expects a specific sequence number (the number of a particular authenticator pair) from a subscriber, and the system increments the sets as they are used with each message sent or received. When a remote subscriber sends a message, he notes the sequence number and uses it to look up the associated authenticator in his code book. This procedure is not as complicated as it sounds but the unit's communication security (COMSEC) custodian must ensure that everyone receives the proper code books, keylists, and authentication MATRIX (KTN). The COMSEC custodian also ensures that everyone uses the correct net edition. If this material is not correctly distributed, synchronization is impossible.

Synchronization often misfires—for instance, when the TACFIRE operator does not coordinate properly with the COMSEC custodian and subscribers before the unit goes to the field. Another contributing problem of synchronization is that the technical manuals are not very clear on the "how-to" of subscriber code book use. And the technical manuals are equally vague on how to perform resynchronization. Fortunately, operators can rely on the TACFIRE Operating Procedures Field Circular for Division Artillery and Battalion, and FC 6-1-3 and FC 6-1-4 as better sources of information and an excellent discussion of resynchronization.

Operators can use the following rule of thumb. If you receive a message from a noncomputer remote device out of synchronization, delete the message and make the remote subscriber resynchronize this set. All remote subscribers should be trained to resync in garrison so they do not have to get the shelter operator to resynchronize them manually. If a subscriber can't get a fire request to TACFIRE digitally, the operator can take the fire mission using voice capabilities and then direct the subscriber to a voice net. Do not refuse to provide fire support and do not waste valuable time trying to resynchronize the subscriber before taking action on his fire mission. If 2 TACFIRE centers have to resynchronize, use the "AUTO RESYNC" method by following these rules:

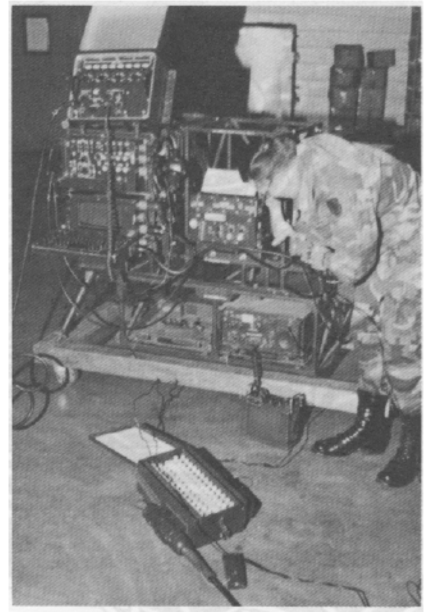
- Spare and RD computer action all 2 line NAK messages.
- Delete all illegal sequence index number messages and 3 line NAKS.
- Follow the directions given in RESYNC messages which do not fall under the above rules.

These rules are explained in detail in the field circulars mentioned before.

Solving the Problem Another Way

If observers have difficulty contacting or resynchronizing with TACFIRE directly, they can still get their message to TACFIRE easily if they use the battery computer system's relay code. When observers use it in the DEST address of their DMD, the message will relay automatically through BCS and go on to TACFIRE. If your radar observers are having problems, it may be due to the lack of common terminology between TACFIRE and Firefinder. You can use the terminology table below to provide better coordination.

Note: To resynchronize with Firefinder, remember that TACFIRE's receive sequence index number for Firefinder must be 1 increment more than the number on Firefinder's receive side. For example, to resynchronize manually, tell Firefinder to go to "100" on the Transmit side and "99" on the receive side. TACFIRE must then go to "100" on both sides.



TACFIRE Term	COMSEC Custodian Term	Firefinder Term
Subscriber's send ID	Type IA code book ID	RCI (Radar COMSEC ID)
Subscriber's (receive ID)	Type I code book ID	DCI (Destination COMSEC ID)
Forward Observer number		Firefinder Radar Designator
Firefinder's Address in TACFIRE	Radar's Address	Firefinder's Sender's ID
TACFIRE's Address (device type "U")	Computer's Address	Destination Address
CAV (Common Authentication Variable)	Net Edition	Net Edition
Matrix	Short Title KTN (i.e. KTN 41A)	Matrix
Q Field		Transmit Receive index number

Conclusion

TACFIRE's interface requirements have grown since we first started using TACFIRE. However, the basics of communications have not changed. New devices (Firefinder, airborne target hand-off system ATHS) are in use now and others are on the way—for example the meteorological data system (MDS) and remotely piloted vehicle (RPV). The challenge to establish communications will only grow as our capabilities expand. To meet this challenge, the entire Redleg Community must share all the information available on how to establish and maintain good communications.

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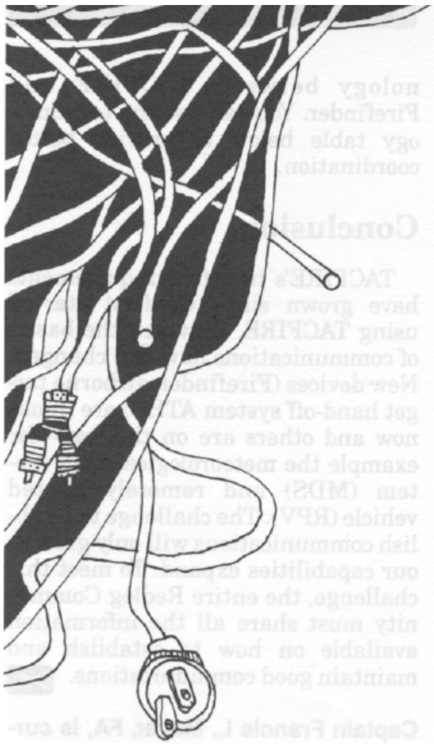


The TACFIRE Stream

Developed by Gunnery Department, Program Management Branch, USAFAS

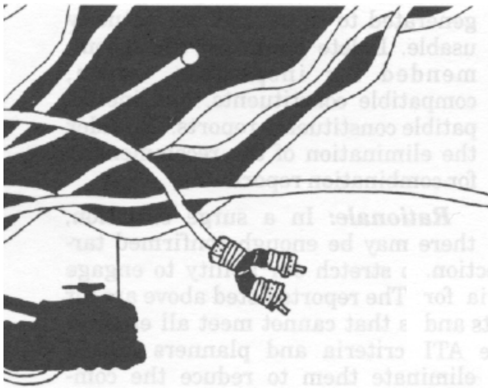
Today's Field Artillery commander has a lot in common with the foreman of a logging operation. Think of the tactical fire direction system (TACFIRE) as a stream that is fed by numerous branches. This stream carries lumber (information and taskings) to a number of mills (executing fire support agencies) further downstream. If the commander stands downstream, he can observe all of the logs (information and taskings) as they pass him. He is in an ideal position to supervise the routing of these logs to the various mills. So long as the number of logs placed in the stream does not exceed the stream's ability to carry them, the commander's operation flows smoothly.

On a modern battlefield, it is likely that a commander will face the situation where he has more logs in the water than his stream will support. In the TACFIRE world this is called surge operations. His only option at that point is to make smarter use of his stream. In the simplest of terms, the commander must prioritize his concerns. He must accept that he may not be capable of handling all taskings or process all of the information that comes to him in a timely manner. This is not a reflection on the commander but rather a realistic limitation of the fire support system. Automation can make difficult tasks somewhat easier, but it has not advanced to a level where it can handle impossible tasks. He must decide what mission areas are the most vital to the success of the operation and place these above all others. He must also realize when a situation calls for decentralized control and implement it before the centralized system becomes completely choked by information and taskings. Commanders must accept this and plan for it.

A Multitiered Approach

Operating under surge conditions is best handled by a 3-step approach. The first step is preventive in nature, while the other 2 are sets of graduated responses to the level of surge. The first step is prerequisite to the successful implementation of the succeeding steps and concerns the construction of a sound initialization database.

The TACFIRE system allows the commander to impose his priorities on the computer. The operating system of the TACFIRE computer governs the scheduling of work within the computer as well as its communications priorities. In turn, the operating system is governed by the initialization



database which the operator can manipulate to reflect the commander's priorities. The primary means of controlling the scheduling of work within the computer is the SYS;PCLD message. This message allows the operator to alter the priority, security classification, logging and processing defaults for most of the messages in the system.

Through careful evaluation and setup, the operator can assign higher priorities to those messages types that are used to perform tasks that the commander designates as critical. The high priority messages should have a priority value ranging from 1 to 3. The lower priority message types should use values that range from 4 through 7. When altering message type priorities, the operator must be careful to spread out the messages evenly across the high and low priority ranges. If 90 percent of the low priority messages are priority 4, a priority 5 message type will have to wait almost indefinitely to be processed—the odds are high that at least 1 priority 4 message type will be in the processing queue at any given time.

Operators can also use the SYS;PCLD to reduce the number of messages sent to the electronic line printer for logging. Because operators will log all transmitted and received messages without regard to the SYS;PLCD log default, we recommend that the bulk of the messages be set to LOG:NO. This has the net effect of reducing the number of processing steps (computer does not have to send message to print queue) needed to complete a job which allows the computer to proceed to the next job faster.

The selection of DISPLAY: YES or NO; determines if the unit will display a message to the operator prior to processing. Operators should use DISPLAY:YES for those messages that control the operating system application files or that normally require specific authorization before processing. The use of DISPLAY:NO; has the net effect of reducing the operator workload as well as reducing the amount of time before a message is processed.

The next message that impacts on message priority processing is the SYS;MISC message format, which allows the operator to establish the parameters for each digital net. The objective in establishing net operating parameters is to develop a set of parameters that allows the maximum throughput of messages for the operating conditions encountered. The NETMODE for each net should reflect the lowest possible keytime that still allows for reliable communications with all subscribers. In the case of a wire net that normally uses 0.7 seconds for keytime, it's possible to operate at 0.2 seconds keytime if the wire runs are short and in good condition. This reduces the amount of time for a message transmission which will increase the message throughput for the system.

Operators use the DELAY field in conjunction with the NETMODE field to establish a message transmission access delay to allow other subscribers an opportunity to access the net. The first 2 subfields govern access delay for high priority messages (priority 1 through 3). The first subfield establishes how long (in half-second increments) it will wait before transmitting a high priority message after sensing a clear net. The second iteration governs how long after receiving an acknowledgement to a high priority message TACFIRE will wait before sending another high priority message. The third and fourth subfields operate in the same manner for low priority messages (priority 4 through 7). The net control station has the lowest entries. All other stations on that net use a delay value consistent with their relative priority on that net. No 2 stations can use the same delay value on the same net.

To illustrate this, we will examine a division artillery operations and fire net. The subscribers on this net are the division artillery computer, a direct support (DS) battalion computer, a reinforcing battalion computer and the Field Artillery brigade

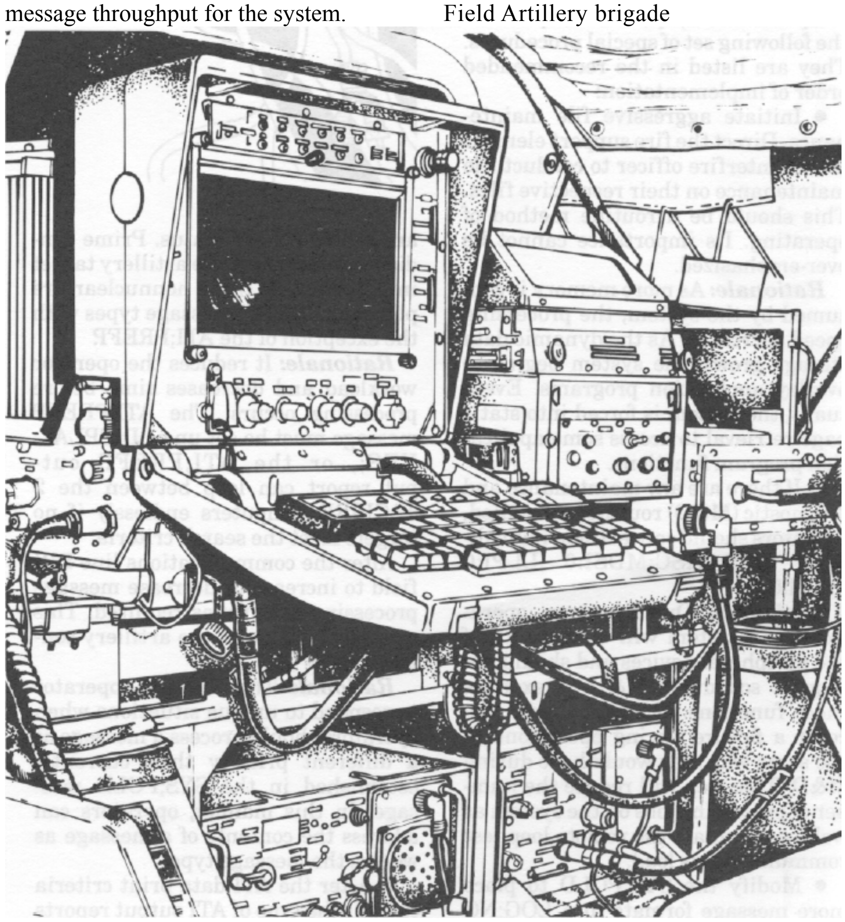


Illustration by: Bobby Hill

computer. The division artillery computer will use delay times of 1/5/9/13. The Field Artillery brigade will use delay values of 2/6/10/14. The direct support battalion computer will use delay settings of 3/7/11/15 and the reinforcing battalion will use 4/8/12/16. In actual use, this means if all subscribers attempted to transmit at the same moment, division artillery will seize the clear net first but would not transmit a second high priority message for 2.5 seconds. This is adequate time for 1 of the other subscribers with a high priority message to seize control of the net.

Procedures for Surge Operations

Beyond the area of initialization, there are a number of special measures commanders can impose to handle surge operations. These special measures fall into 2 categories. The first set of special measures are steps that the division artillery computer center can handle. The other set of measures will require the delegation of missions to other echelons to reduce the processing load at the divarty computer center. Within the computer center, operators implement the following set of special procedures. They are listed in the recommended order of implementation:

● Initiate aggressive file maintenance. Direct the fire support element and counterfire officer to conduct file maintenance on their respective files. This should be a routine method of operating. Its importance cannot be over-emphasized.

Rationale: As more memory is consumed by the system, the processing speed decreases. As the dynamic data storage grows, the system begins to overlay application programs. Eventually, the system is forced into static page retrieval to access some application program functions.

● If there are any maintenance and diagnostic (M&D) routines scheduled, operators should cancel them immediately (SYS;MISC;MDSI:0 ;LLPI:0 ;RLPI:0 ;).

Rationale: During surge operations, the system will exercise all of the peripheral devices and should not require scheduled M&D to exercise their functions. Operators will discover a failure during operations in the same way they would have during M&D. This step will reduce the number of processing jobs on the system as well as eliminate the remote loop test communications load.

● Modify the SYS;PCLD to place more message formats in a LOG:NO

and DISPLAY:NO status. Prime candidates for this are the artillery target intelligence (ATI) and nonnuclear fire planning (NNFP) message types with the exception of the ATI;PREFP.

Rationale: It reduces the operator workload and decreases time before processing occurs. The ATI;PREFP message must be set up as DISPLAY: YES;, or the ATI;PREFP output report can loop between the 2 TACFIRE computers endlessly if no targets meet the search criteria.

Alter the communications line PRI field to increase or decrease message processing priority as required. This can only be done at the artillery control console (ACC).

Rationale: This allows the operator to respond to unique situations when operators should process a message at a different priority than currently established in the SYS;PCLD message. In this manner, operators can address the contents of a message as well as the message type.

● Alter the ATI data print criteria to limit the type of ATI output reports generated to those that are actually usable. Delete output of the recommended for inspection, infan, compatible constituents, and incompatible constituents reports. Consider the elimination of the recommended for combination reports.

Rationale: In a surge situation, there may be enough confirmed targets to stretch our ability to engage them. The reports listed above are for targets that cannot meet all engagement criteria and planners should eliminate them to reduce the communications load between the computer and the counterfire section.

● Use more stringent criteria for the generation of solution targets and automatic fire missions of the ATI program.

Rationale: Unless users set stringent criteria, the ATI program can generate more targets than artillery can engage in a timely manner. These excess missions represent an unnecessary communications load.

● Review all message of interest (MOI) files and reduce the type of messages to the bare minimum (fire mission related messages only). If this does not produce the desired effects, consider the elimination of all MOI files except the files for the fire support element (FSE) and any higher and/or adjacent headquarter's computer center.

Rationale: The MOI process represents a significant portion of the TACFIRE communication load. Unless carefully controlled, MOI files are full of a great deal of nice-to-have information requests. Under surge conditions, do not practice this luxury.

● Review all ATI standing requests for information (SRI). Eliminate any SRIs that are not critical to the commander's concept of operation.

Rationale: SRIs represent a communications load on the system and users should eliminate them if no longer required.

● Consider restricting fire planning functions to certain subscribers during surge periods. Each brigade FSE would perform consolidated fire planning for his subordinate elements and be the sole authorized fire planning subscriber for his brigade area. Additionally, each brigade FSE accesses the divarty ATI target files at different times to spread out the communications load.

Rationale: The single greatest communications load on the DIV ARTY system occurs during the transmission of fire plan targets to remote subscribers. Reducing the number of authorized fire plan subscribers limits the number of fire plan target file transmission requests that will be active in the system. Scheduling these subscribers spreads the communications load out over a greater time span.

If the level of surge operations passes only priority traffic, operators can raise the delay times for low priority traffic. Another option is for DIV ARTY to seize total control of the net by using the same value in the first 2 iterations of the delay field.

Rationale: These are extreme measures which commanders should consider only if the DIV ARTY computer is almost totally backlogged on a particular net, or if it has a large volume of time sensitive information to transmit. Once placed into effect, these delay values ensure that the DIV ARTY computer access delay timer will elapse before that of any other subscriber and allow it to transmit a large number of messages without interruption.

> ***Note:*** *Failure to change this back to the original values may mean that very little information gets back to DIV ARTY when the emergency is over.*

- If the system becomes backlogged for encrypted message transmission, place the system in the encrypt selected messages mode (SYS; COMSEC;ENCALL:OFF;). Declassify selected messages to allow them to bypass the KG-31 encryption queue.

Rationale: When operating in the encrypt all messages mode, all messages (except those transmitted on the corps artillery dedicated digital data terminal [DDT]) must be routed through the KG-31 for encryption. The KG-31 can operate in 1 mode at a time, either encryption or decryption. This is a choke point for the system since this single device services 6 DDTs. Through selective bypassing of the KG-31, users can reduce the size of the encryption queue logjam. Since this is an operational security violation, commanders should do this as a last resort only.

Manage the Battle

Throughout the period of surge operations, the DIV ARTY commander must continuously evaluate his tactical operations center's (TOC) ability to manage the battle. It is quite possible for his computer center to become so overloaded with inputs, taskings and output requests that personnel can't handle missions in a timely manner. Should this become the case, the commander should investigate the possibility of distributing the processing load to other elements under his control.

The fielding of some of the newer target acquisition systems gave us the ability to detect and locate more battlefield targets than was possible using earlier systems. This improved target acquisition capability resulted in an increased processing load for our command and control systems. In an intense battle, the organic Firefinder radar systems of a DIV ARTY can keep the artillery target intelligence program processing continuously. In these circumstances, the computer will either be continuously processing the ATI reports at the expense of any lower priority messages, or it will process higher priority messages. The net result is that the ATI reports will not be processed in a timely manner. In either case, the fire support mission will suffer.

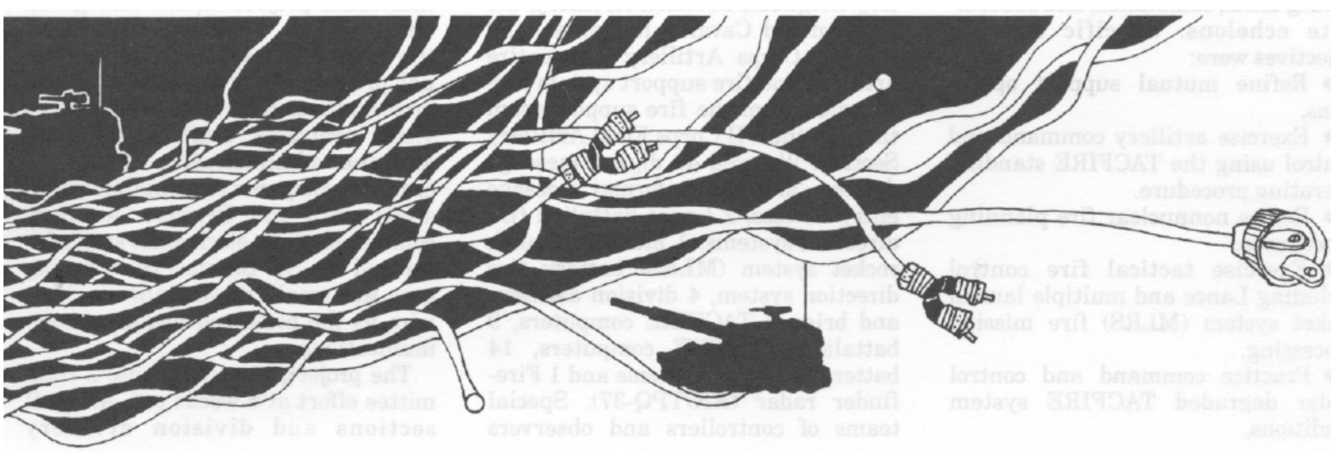
At this point, the commander should consider delegating the counterfire mission to the reinforcing brigade computer. If this is a viable solution, he places all of the division's target acquisition assets under the direct control of the reinforcing brigade. All targeting reports are then sent directly to the brigade TACFIRE for processing. The brigade computer then serves as both the controlling agency for the counterfire mission and as a front-end processor for the division computer. The division stays abreast of the counterfire mission through the use of a MOI file which should limit the ATI exchange between the computers to solution targets. Standard mission fired report (MFR) processing continues to feed the DIV ARTY ATI files.

Another major activity that could be delegated to the reinforcing brigades' computer is the planning for future operations. Subscribers with a planning mission for future operations could store databases and request processing from the brigade computer. This frees the DIV ARTY to manage the current battle more efficiently.

Conclusion

The centralized control concept embedded in our current automated command and control system is the root of our inability to handle surge operations effectively. This problem is addressed in the design of the advanced field artillery tactical data system (AFATDS), which may replace the TACFIRE system in the early 90s. One of the cornerstones of the AFATDS design is distributed processing. Under this concept, instead of having a single processor service all of the DIV ARTY information and taskings, there will be multiple work stations with processing capabilities throughout the DIV ARTY structure.

Until AFATDs is firmly entrenched in the field, surge operations will require a well designed initialization database, special operating procedures and flexible commanders that understand the advantages of decentralizing the processing effort.



Getting Better at TACFIRE

by Captain Dean A. Camarella and Captain Thomas M. Froneberger

The 1st Armored Division Artillery conducted a large scale exercise at Monteith Barracks, Fuerth, West Germany, during the fall of 1985. The Division Artillery designed the exercise to improve individual and collective tactical fire direction system (TACFIRE) skills and ease operational procedures among units, commands, and subordinate echelons. Specific exercise objectives were:

- Refine mutual support operations.
- Exercise artillery command and control using the TACFIRE standing operating procedure.
- Refine nonnuclear fire planning procedures.
- Exercise tactical fire control including Lance and multiple launch rocket system (MLRS) fire mission processing.
- Practice command and control under degraded TACFIRE system conditions.
- Exercise combinations of TACFIRE and manual control.
- Refine TACFIRE data base input and management.
- Practice command and control techniques.

The exercise involved fire support and command and control elements from the 210th and 17th Field Artillery Brigades, Division Artillery, the 2d Armored Cavalry Regiment, and the VII Corps Artillery. The entire artillery and fire support system participated from the fire support team through the VII Corps Field Artillery Section. We used 49 digital message devices, 35 variable format message entry devices, 2 Lance battalion fire direction systems, 1 multiple launch rocket system (MLRS) battery fire direction system, 4 division artillery and brigade TACFIRE computers, 9 battalion TACFIRE computers, 14 battery computer systems and 1 Firefinder radar (AN/TPQ-37). Special teams of controllers and observers monitored the TACFIRE system and its effects upon mission accomplishment.

The exercise was successful and enhanced everyone's feeling of camaraderie. The exercise planners divided the project into a startup phase and an execution phase. They further segmented the startup phase into individual project officer and group effort periods. For unity of purpose, the commander assigned an individual project officer 90 days out. The project officer controlled initial plans, visits, contracts, staff coordination, and the administrative operations order. Participants coordinated extensively with the Division Artillery communications-electronics staff officer and the S4. Because the training area was small, these planners chose wire as the preferred means of communications.

The project intensified into a committee effort at 5 weeks out. All staff sections and division artillery assigned points of contact and held frequent meetings to assess progress. At STARTEX, exercise control went to a team made up of the fire support element (FSE), S3 operations, division artillery signal. Administrative and logistics control went to the supervision of the division artillery S4 and the headquarters commandant.

The control team ensured that the scenario drove the exercise while it enhanced the TACFIRE system levels. A life support area held the administration, mess, medical services, and sleeping zone; and a logistics support area housed the agencies to coordinate maintenance and logistics needs. The physical layout of the exercise is shown at figure 1.

A master events list (MEL), as opposed to a game board scenario, drove the exercise. The MEL gave the controllers a solid hold over the exercise and guaranteed attention to each objective. Daily emphasis varied but the focus remained on 12 TACFIRE exercise disciplines.

The 12 TACFIRE Exercise Disciplines

- Fire Planning
- MSU Operations
- Fire Missions
- Lance Missions
- MLRS Missions
- Nuclear Allocation/Fires
- Degraded Mode Operations
- Ammunition and MET
- FLOT Upkeep
- Geometry Management
- Airspace Coordination
- Chemical Allocation and Fires

Five weeks prior to STARTEX, each Division Artillery battalion sent representatives to the 2- and 3-man teams established to create their fire support team, fire support officer, and operations and intelligence input. They created a 4-day exercise scenario.

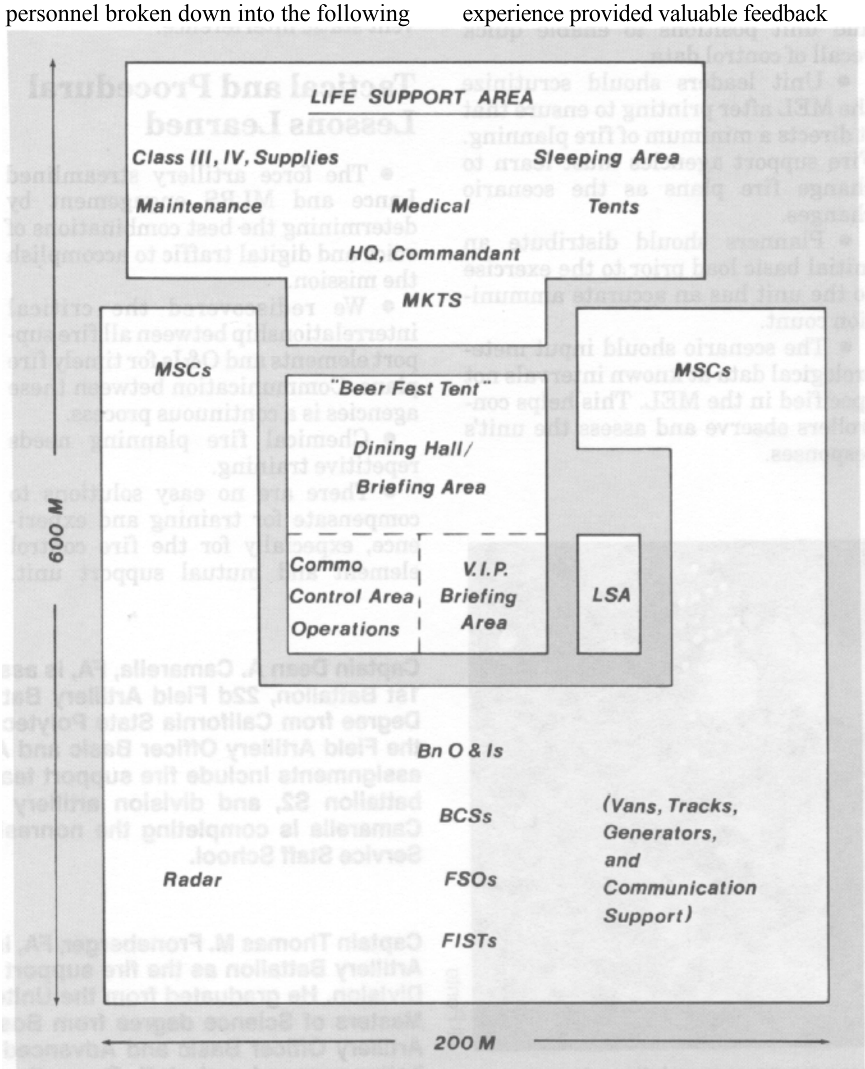
The division artillery S2 representative extracted data to use as a basis for the exercise intelligence summaries. During the MEL development, the team leader moved enemy units on a map board as he believed they would perform tactically. In turn, the work team moved friendly units in position to counter and attack the opposing forces. They recorded data on 3 input type forms: ATI;CDR, FM;RFAF, and general events.

During the exercise, the brigade fire support elements supplied additional information beyond the MEL as player-controllers. Their fire support officers checked the control cell periodically to align their activities with the current situation. This helped to compensate for the lack of maneuver representatives at the tactical operation center (TOC) and kept information fluid. Moreover, the intent of the division artillery's existing operations plan (OPLAN) and directives further influenced the play. In addition, scenario timing dictated fire plans, graphics, and fire support coordination measures. The initial operations order identified changes to the existing OPLAN and served as an administrative control mechanism. Concurrently, the division artillery S2 paralleled the general information flow with corps and division INTSUMS and intelligence net traffic.

The control team consisted of 16 personnel broken down into the following positions:

- Chief of controllers and system analyst.
- Operations officer.
- Systems analyst.
- Two control cell.
- NCOIC and system analyst.
- NCO assistant to the NCOIC.
- Five observers and system commentators from the 7th Army Training Command TACFIRE School.
- Two observers from the US Army Field Artillery School.
- Two NCOs for tracing daily objectives.

This group monitored the activities of different units and performed system analyses of command and control operations and TACFIRE. They held 1-hour control group briefings daily for unit and section representatives which focused on the scenario and stressed the 12 daily objectives. The control group noted shortfalls and improvement techniques, and encouraged open discussion. Naturally, this experience provided valuable feedback



TACFIRE exercise configuration.

for future exercises. Some control team recommendations to improve both scenario play and tactical operations break down into game related or tactical lessons learned.

Game Related

● Planners should increase the number of controller-assessors to 24 allowing 12 per objective per shift.

● They need to add a scenario control group to inject player requirements when delays and communications jeopardize the daily objectives. This keeps the exercise rolling and informs the controller-assessors of changes as they occur.

● Planners should incorporate the fire support element into the scenario control group. This action provides additional manpower and control access to a VFMED.

● Players should use hand-held walkie-talkies for the controllers.

● During MEL construction, planners should make periodic overlays of the forward line of own troops (FLOT) and unit positions to enable quick recall of control data.

● Unit leaders should scrutinize the MEL after printing to ensure that it directs a minimum of fire planning. Fire support agencies must learn to change fire plans as the scenario changes.

● Planners should distribute an initial basic load prior to the exercise so the unit has an accurate ammunition count.

● The scenario should input meteorological data at known intervals not specified in the MEL. This helps controllers observe and assess the unit's responses.

Jill Ponto

There are no easy solutions to compensate for training and experience.

● The housing arrangement should continue to separate the logistics support agency from the main control cell. This shifts administrative burdens to the body that can best solve the problem.

● The planners should continue to keep the CESO and his communications control team as part of the main control cell. In a large TACFIRE exercise, communications and operations must be merged. The main control cell must be able to influence the entire exercise immediately, and that demands responsive communications.

● Planners should integrate both wire and FM radio for communications. Wire works best as a dependable and simple means of sending digital traffic from the battalion computer to subordinate subscribers. FM radio is the best way to conduct mutual support operations from battalion to division artillery or brigade computers.

● Operators and mechanics should ensure the generators and TACFIRE shelters are properly grounded to prevent static interference.

Tactical and Procedural Lessons Learned

● The force artillery streamlined Lance and MLRS engagement by determining the best combinations of voice and digital traffic to accomplish the mission.

● We rediscovered the critical interrelationship between all fire support elements and O&Is for timely fire plans. Communication between these agencies is a continuous process.

● Chemical fire planning needs repetitive training.

● There are no easy solutions to compensate for training and experience, expecially for the fire control element and mutual support unit.

While thousands of procedures and responsibilities are available in TACFIRE manuals and standard operating procedures, the TACFIRE system can overwhelm the user. Valid training experiences emphasize what the user must know for efficient mission accomplishment.

Make the Artillery System Work

In summary, we owe it to our maneuver comrades and to ourselves to make the artillery system work. Subordinate elements must be drawn into the TACFIRE experience so they can discover solutions. We still need to work with mutual support unit operations until we can provide continuous service to each subscriber. We do not use the full capability of the TACFIRE system. TACFIRE is not merely a fire direction system but rather a command and control instrument for the tactical operations center. However, we must not be dependent on TACFIRE to perform the mission of the Field Artillery. It is the responsibility of every Field Artilleryman to provide timely and accurate fire support with or without the aid of a computer.

The TACFIRE exercise was 1st Armored Division Artillery's first attempt to involve all possible participants. I recommend that all division artilleries try a similar exercise. Otherwise, units will never discover the problems, feedback, and solutions which lead to learning. The exercise structure should provide insights on how to tailor, control, and develop objectives. This intensive training exercise decreased our operational problems, resolved them to a manageable level and verified that the "King of Battle" does provide responsive fires.

Captain Dean A. Camarella, FA, is assigned as the fire direction officer for the 1st Battalion, 22d Field Artillery Battalion. He holds a Bachelor of Science Degree from California State Polytechnic University. He has completed both the Field Artillery Officer Basic and Advanced Courses. Captain Camarella's assignments include fire support team chief, firing battery executive officer, battalion S2, and division artillery fire control officer. Currently, Captain Camarella is completing the nonresident program for the Combined Arms Service Staff School.

Captain Thomas M. Froneberger, FA, is assigned to the 1st Battalion, 22d Field Artillery Battalion as the fire support officer for the 2d Brigade, 1st Armored Division. He graduated from the United States Military Academy and holds a Masters of Science degree from Boston University. He completed the Field Artillery Officer Basic and Advanced Courses and held several positions in both command and staff. Currently, Captain Froneberger is completing the nonresident program for the Command and General Staff College.

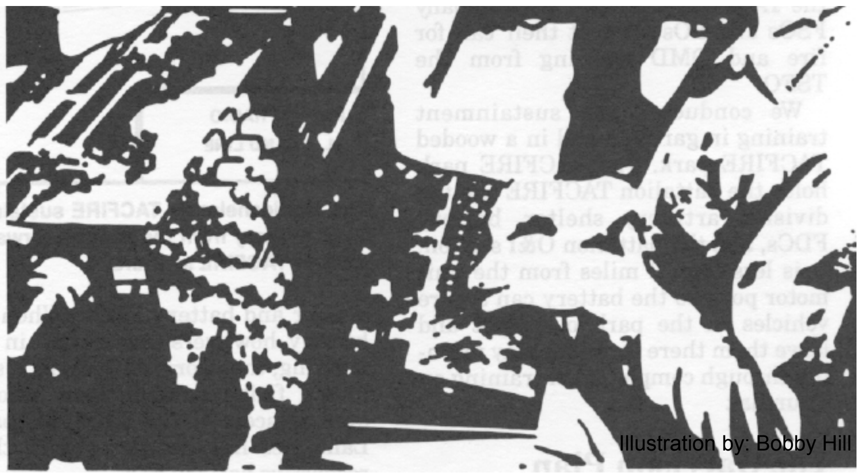


Illustration by: Bobby Hill

TACFIRE—Building Blocks to Proficiency

by Captain David N. Kennedy

The skills and knowledge soldiers need to operate the tactical fire direction system (TACFIRE) tend to peak during intensive periods of training exercises. Units deploying to the National Training Center (NTC) at Fort Irwin, California, or gearing up for an Army training and evaluation program train their fire direction center (FDC) personnel until individual TACFIRE skills are strongest. However, between these periods skills may wane, and the learning curve is on the downslope.

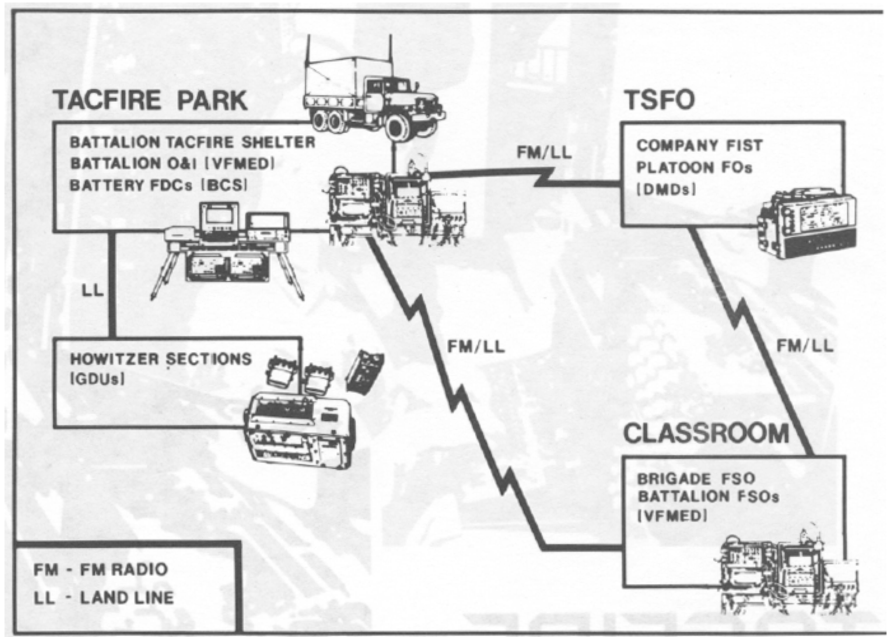
Why do operators experience great difficulty remembering even basic TACFIRE skills on the first field training exercise (FTX) after a break in the training cycle? Simple tasks like initializing the digital message device (DMD) or requesting formats on the variable format message entry device (VFMED) are no longer routine. The answer may be too little or ineffective sustainment training between FTXs. Faced with a constrained budget frequent FTXs may be cut, and the result is greater deterioration of TACFIRE operator skills. Because TACFIRE skills at all levels are highly perishable, leaders must establish a sustainable training program to hone TACFIRE related skills between major training events.

Fire support personnel from the 24th Infantry Division (Mechanized) Artillery developed a multiecheloned TACFIRE sustainment training program. The program exercises all levels of the Field Artillery system from the platoon forward observer up through the battalion and division artillery TACFIRE shelters. We conducted training for 8 hours each Tuesday and Thursday. Although experience at Fort Stewart shows that 16 hours a week is not enough time to conduct effective training, numerous training requirements kept us from devoting more than 16 hours (2 days) a week to this training. The division artillery sets a high priority on TACFIRE sustainment training and units work for 100 percent attendance.

Sections participating in the TACFIRE sustainment training program were the battalion FDC, battery FDCs and the battalion operations and intelligence section (O&I). Fire support personnel participating were the maneuver brigade fire support element (FSE), battalion fire support sections, company fire support teams (FIST), and platoon forward observers (FO). Additionally, once a week the division artillery shelter interfaces with the training. Training can include the firing battery howitzer sections, but this usually happens less frequently.

We used the battalion TACFIRE shelter and battery computer system (BCS) for the FDCs. We also needed the VFMED of the brigade and battalion FSOs and the Field Artillery battalion O&I section. The company FSOs and platoon FOs used their DMDs while the howitzer sections trained with the gun display units (GDU). To make the training more realistic, we incorporated the use of the training set, fire observation (TSFO) or invertron system with the TACFIRE training. The company FSOs and FOs conduct their call for fire and DMD training from the TSFO.

We conducted the sustainment training in garrison and in a wooded TACFIRE park. The TACFIRE park holds the battalion TACFIRE shelter, division artillery shelter, battery FDCs, and the battalion O&I section. It is less than 2 miles from the unit motor pool, so the battery can secure vehicles in the park overnight and leave them there from Tuesday morning through completion of training on Thursday.



The multiecheloned TACFIRE sustainment training program exercises all levels of the Field Artillery from the platoon forward observer up through the battalion and division artillery TACFIRE shelters.

The Garrison Plan

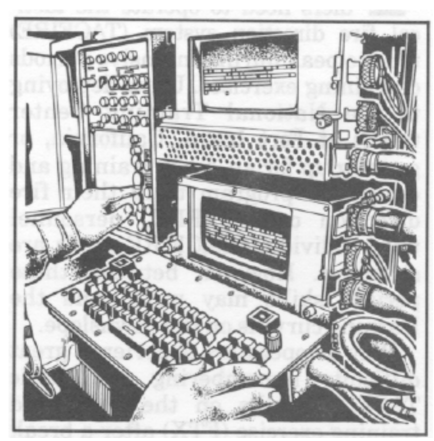
The brigade FSO and battalion FSOs use 2 VFMEDs mounted in a classroom in the battalion area. The VFMEDs and associated radios are powered by a PP 1104 power supply unit which transforms AC power into DC power. Company FSOs and platoon FOs at the TSFO use a locally produced power board to power 4 DMDs from the same power source. Landline communications or FM radio links the DMDs to the TACFIRE shelter and battery FDCs. When the battery howitzers participate in the training, they normally occupy a simulated firing position in a wooded area adjacent to the TACFIRE park. Landlines link howitzers with their respective battery FDC.

TACFIRE sustainment training begins when planners issue the operations order (OPORD) based on a scenario set at the NTC. The brigade FSO develops the OPORD and draws graphics which depict battalion and company battle positions, phase lines, fire support coordination measures and battery locations. The TSFO located on post has 2 different views of terrain at the NTC, and the OPORD reflects this terrain. As a result the company FSOs and platoon FOs can see and adjust indirect fires on the area contained in the OPORD, and fire direction personnel can initialize the TACFIRE shelter and the TSFO with the same data.

The DMDs at the TSFO send fire missions to the shelter. Once data is computed by the shelter or battery FDC, the FDC sends the quadrant and deflection by plain text message (PTM) back to the TSFO. The TSFO operator enters it to his invertron computer and shoots the actual data. The company FSO and platoon FO can actually see the ground they are maneuvering over, and adjust the rounds they called in. This not only trains them as observers, but allows them to become familiar with the terrain at the NTC and with fire planning for the terrain at the NTC.

The sequence of events works so well that we only change the type mission we conduct in the scenario. The scenario begins on the Friday prior to the Tuesday or Thursday training with a meeting of all battalion FSOs, the battalion FDO, battery fire direction officers, and their respective noncommissioned officers. The brigade FSO briefs his OPORD and sets training objectives for the following week's training. Participants can bring up any training distractors at this time. Battalion and company FSOs normally develop a target list and fire plan to support the OPORD on Monday. On Tuesday morning the TACFIRE shelter, battery FDCs, and battalion O&I power up and operate from the TACFIRE park. The FSO

Landline communications or FM radio links the DMDs to the TACFIRE shelter or battery FDCs.



The VFMEDs and associated radios are powered by a PP/104 power supply unit which transforms AC power into DC power.

powers up his VFMEDs in the classroom while the FO DMDs power up at the TSFO. The training can begin once players establish initial voice and digital communications. The brigade and battalion FSOs input their zones to the geometry files and begin to plan fires. Meanwhile, the company FSOs and platoon FOs submit their observer locations to the shelter and continue to work on the terrain sketches.

Once operators enter the zones and initialize data, the FOs begin sending fire missions from the TSFO. As the FOs and company FSOs send fire missions, the brigade and battalion FSOs update their fire plans accordingly. The battery FDCs and howitzer sections receive their training as the mission goes from the shelter to the batteries and on to the howitzers as firing data. Meanwhile, the battalion O&I section collects the various MOI and posts it on the situation map. The O&I also collects data to develop preparations or counterpreparations.

The scenario continues on Thursday. The only difference is that the division artillery TACFIRE shelter powers up in the TACFIRE park and practices interfacing with the battalion. The brigade FSO and battalion O&I section practice passing zones and fire plans to the division artillery shelter. They also practice requesting information from the division artillery target intelligence files. Upon completion of training on Thursday, the participants hold an after-action review. Discussion focuses on strengths and weaknesses identified during that week's training, and on recommendations for the next week's training.

Multiecheloned training is the key to sustaining TACFIRE skills. The training exercises all players of the TACFIRE system. A common scenario is the driving force behind the training, yet individual sections can train for their own particular weaknesses:

- An FO can practice a mission that he is weak on and still provide training to the shelter and FDC.
- FSEs and the battalion O&I section receive training by processing the MOI and updating their situation maps.
- FDCs can inform FOs of what types of missions they need to practice on their weaknesses.
- The leadership at each level can see how their section stands in overall training, as well as how it interfaces with the whole TACFIRE system. They can identify problem areas and develop specific fixes.

Leaders can also refine their standing operating procedures as a result of this training and FSOs and FDOs can identify the best methods to process certain types of fire missions. A module can even shut down to work on another task, and the remaining modules continue to train. The sustainment program is not dependent upon any one section to be present for training; however, if the battalion shelter is not present, then fire planning for the FSOs is impossible.

Sustainment Benefits

The TACFIRE sustainment training program offers numerous benefits. First, it allows the whole TACFIRE system to train as if it were in a field environment. Personnel work on the equipment they will go to war with, yet it saves tremendously on time, fuel, and repair parts by being able to do all this in a near garrison environment. It allows personnel to keep skills current between field training exercises. TACFIRE skills are highly perishable and must be practiced continually. It is an excellent training vehicle to test new standing operating procedures before going to the field. By using the TSFO-invertron system, the training is as realistic as possible for our company FSOs and platoon FOs.

Although it's not quite the same as a 2-week rotation in the California desert, this training option hones skills and helps the unit prepare for excellence at the NTC.

Captain David N. Kennedy, FA, is an ROTC instructor at Salisbury State College, Maryland. He is a graduate of the Field Artillery Officer's Basic and Advanced Courses. His past assignments include FSO with 2d Brigade, 24th Infantry Division (Mechanized), commander of HHB, 2-35th Field Artillery, 24th Division Artillery, and service with the 1-38th Field Artillery in Korea, and the 1st Training Brigade at Fort Jackson, South Carolina.

Right by Piece

NOTES FROM UNITS

A Challenge for the Buccaneers

FORT BRAGG, NC—The telephone rang at 1800 announcing the alert notification for Bravo Battery, 5th Battalion, 8th Field Artillery. They were designated to deploy anywhere, at anytime, as the dedicated fire support asset for the Rapid Deployment Force. The "Buccaneers" of Bravo Battery became the first battery to use 3 types of movement in the XVIII Airborne Corps Artillery's emergency deployment readiness exercise (EDRE).

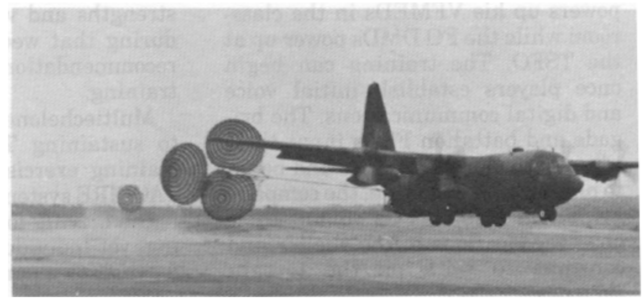
They used:

- Low altitude parachute extraction system (LAPES).
- C130 Airland.
- Ground convoy.

During the 3-day exercise, Bravo Battery gunners placed 2 M198 (155-mm) howitzers and 2 5-ton trucks on Sicily Drop Zone using LAPES. This is only the second time that Redlegs deployed a M198 howitzer using the low altitude parachute extraction system derigged and immediately prepared to fire.

The battery then prepared a second 2-gun platoon for air movement and airlanding onto Holland Drop Zone. Personnel and their guns and prime movers flew together to fire as soon as possible, as required in a combat situation. After the air drop, the rest of the battery, including another 2-gun platoon, convoyed into the assembly area and set up for fire. Despite the heavy rains, lack of sleep, and serious threat of lightning injury, soldiers' morale was high and played a major role in the success of the mission according to First Sergeant Teddy Lee. The Buccaneers drove on and occupied their first firing position ready to support where needed.

The operational readiness test (ORT) portion of the EDRE evaluated many battery operations, including movement; surviving in a nuclear, biological, and chemical environment; and air attacks. Graders used Army training and evaluation program standards on all tasks.



Challenged with many types of fire missions, the Buccaneers started shooting accurately and kept it up. In fact, their skill and training led 1 howitzer section to put steel downrange 9 seconds after receiving the fire order. The EDRE ended with a battery 1-round, time-on-target mission. The forward observer responded: "All rounds on target, on time."

National Guard Takes the Tops!

Four National Guard units—including a Virginia-based Redleg unit—won the 1986 Army Chief of Staff Awards for Supply Excellence. First place went to Headquarters Headquarters Company, 329th Support Group, Virginia (company level) and 111th Field Artillery, Virginia (battalion level). Runner-up winners were Headquarters and Headquarters Detachment, 163d Military Police Battalion, District of Columbia, and 2d Battalion, 175th Infantry, Maryland.

Maxing Out With the Reserves

LAWTON, OK—A remarkable new US Army Reserve unit achieved 108 percent of authorized strength in less than 2 years while organizing from the ground up. However, this is all in a day's work since the 402d Brigade (Training) (Field Artillery) activated on March 16, 1985.

"The development of the unit in less than 2 years is a significant achievement for us because our 809 member Reserve unit is scattered over 6 cities in 2 states," Major Robert E. Henson, 402d Brigade adjutant said.

"The idea for establishing an artillery training organization near Fort Sill originated with a phone call from the US Army Training and Doctrine Command," he said. According to Henson, the concept was studied, staffed, and ultimately approved at Fifth US Army, TRADOC, Forces Command and Department of the Army levels.

The brigade consists of a headquarters and headquarters battery, a training group, and 5 training battalions. Henson said that Lawton was the obvious location for the brigade headquarters and the training group.

Hands-on Training

"The training group provides hands-on training every month at Fort Sill to the cadre of the training batteries and battalions," Henson said. "We also wanted the other 5 training battalions and their batteries to be as close to Fort Sill as possible. We selected sites in Wichita Falls, Amarillo, Dallas and Fort Worth, Texas and Tulsa, Oklahoma, for the battalions. We developed a stationing plan for the 5 battalions in coordination with the United States Army Recruiting Command.

Recruiting Success and Training

Recruiting is 1 of the noteworthy successes for the brigade and is reflected by the personnel strength of 108 percent. The recruiting effort required massive

Class training the new soldier. SSG Norman Bachelor, instructor, Training Group, 402d Brigade (Training) (Field Artillery), explains M102 howitzer nomenclature assisted by SSG David Engel, drill sergeant, Training Group, 402d Brigade (Training) (Field Artillery). (US Army photo by SGT Cholly Covert)

coordination between the US Army Recruiting Commands in Dallas, Oklahoma City, and Albuquerque, New Mexico. The brigade's results attest to the dedication of many people.

While recruiting personnel was a major accomplishment, the next step is to train them up to the standards of a mission capable unit. The brigade trained 288 drill sergeants—then training instructors become their primary interst. The Field Artillery Training Center certified a nucleus of instructors to teach Field Artillery skills. Now the brigade conducts cannoneer courses that run continuously. Most hands-on training takes place during the annual training periods. For example, the 402d Brigade conducted Field Artillery instruction at the Fifth Army Regional Training Center at Fort Chaffee, Arkansas, for the last 2 summers. However, most other training courses are conducted at Fort Sill.

Lineage

Although the 402d Brigade is approaching its second birthday under its present organization, its lineage traces from the World War II era 402d Field Artillery Group. The 5 battalions belong to the 89th Regiment under the Combat Arms Regimental System.

The Brigade developed a unit crest that celebrates its history and mission. It was approved by the Institute of Heraldry. The Brigade leaders also developed and produced a videotape to describe the brigade, narrate its history, and explain its mobilization mission.

The unit's song, originally written by a 95th Division soldier during World War II, was rearranged by the 77th Army Band at Fort Sill. It is now suitable for an orchestra work and is frequently used in brigade and division ceremonies.

Conclusion

In less than 2 years, the 402d Brigade (Training) (Field Artillery) successfully accomplished its mission to organize, recruit, and train its personnel. Now, the soldiers of the 402d brigade are dedicated to continue their mission alongside other Redleg professionals.

Soldiers training *you* to train others. The model of the professionals of the 402d Brigade (Training) (Field Artillery) in Lawton, OK. Instructors and drill sergeants are: (top, left to right) SFC Booker Loud, SFC Michael Gonzales, MSG David Walker, SSG David Engel (bottom), SSG Robert Casher and SSG Norman Bachelor. (US Army photo by SGT Cholly Covert)

FSVs in the 1st Armored Division

ANSBACH, GERMANY—The 1st Armored Division began fielding a new vehicle that enables its fire support teams to locate and direct artillery fire on enemy targets without exposing themselves to hostile fire.

Iron Soldiers from the 6th Battalion, 14th Field Artillery and 1st Squadron, 1st Cavalry were the first in the division to receive the M981 fire support vehicles (FSV). Fielding plans call for soldiers from the 1st Battalion, 22d Field Artillery and 2d Battalion, 78th Field Artillery to get them in the near future.

From a distance, the FSV looks like an improved tube-launched, optically tracked, wire-guided missile (TOW) vehicle (ITV). "The reason for this is that an ITV would be a lesser priority target in an enemy scenario," said Sergeant First Class Peter Jennings, FSV fielding NCO. "If the enemy saw this vehicle, they'd think it was an ITV so they would probably concentrate on other targets first. While they'd be concentrating on someone else, the FSV would be bringing artillery fire down on them."

The main component of the FSV is the ground/vehicular laser locator designator. The G/VLLD allows fire support teams to lase targets for an accurate

SGT Simard displays a G/VLLD which is the main component for the fire support team vehicle.

reading, then designates the target for artillery laser guided munitions. The FSV will also locate and designate targets for attack helicopters and A10 aircraft that come with laser guiding systems. The FSV uses the chassis of the M113A2 armored personnel carrier. The vehicle weighs about 27,900 pounds when combat loaded and can travel up to 42 miles per hour. It has a special 4-channel intercom and an air filtering system to protect its crew in a chemical environment.

Tactical Operations Tournament

Two 435th Infantry Guard Company soldiers work their way around the protection barriers in the Defending Storage Site scenario during the TACOPS Tournament. (US Army Photo by SGT Phil Prater)

FISCHBACH, GERMANY—They came from all directions and 5 different countries to compete in the 1986 59th Ordnance Brigade Tactical Operations (TACOPS)Tournament at Fischbach Army Depot.

PFC David Craigmile, 558th Military Police Company provides suppressive fire for his teammates during the Force on Force Competition.

It was another milepost for the 59th—the first time North Atlantic Treaty Organization (NATO) countries competed in the TACOPS Tournament.

Ten teams of soldiers from the Brigade's military police companies and artillery groups and 8 allied teams converged on the softball field at Fischbach for 1 week of friendly competition. NATO teams came from Holland, Belgium, Great Britain, and from posts around West Germany.

The competition was fierce but friendly, and teamwork and gut determination pulled the 164th Military Police Company ahead of the 435th Infantry Guard Company from Holland. The 435th was the only all-Allied nation team at the tournament.

"It's an excellent training device. It shows soldiers how important basic skills are," First Lieutenant Kerrye A. Glass, 84th United States Army Field Artillery Detachment, said.

While the weather played havoc with the 270 soldiers and the tournament, it did not dampen the morale or spirit of the competitors. According to First

Lieutenant Jerry Schutz of TACOPS, it was a great tournament and the soldiers had a good time.

Each morning the soldiers were greeted by Schutz's force motivator—his bugle. "The order of the bugle is a TACOPS tradition from the previous tournament," Schutz said. While the bugle represents lower achievement the Brigade Cup symbolizes the higher end. "Since my bugle playing ability is less than fantastic, it symbolizes the bottom of the barrel," he said.

After the physical training test, obstacle course, 5-mile combat forced march, land navigation course, and 3 scenarios of force-on-force events, there was only a 4-point difference between the 2 leaders.

But only 1 winner can hold the Brigade Cup, and for 86-2 TACOPS, the 164th won. The 435th from Holland received the NATO Cup and leadership trophy.

In the individual events, the winners were: Forced March, 556th MP Company; Orienteering, 570th United States Army Artillery Group; physical training and Obstacle Course, 164th MP Company; Markmanship, 74th USAFAD; Custodial Agent Knowledge, 435th Infantry Guard Company, and 162d Ordnance Company; Force on Force, 165th MP Company; Defending a Storage Site, 165th MP Company; Defending a Field Storage Site, 435th Infantry Guard Company; Military Working Dog, 165th MP Company; and Volleyball, 74th USAFAD.

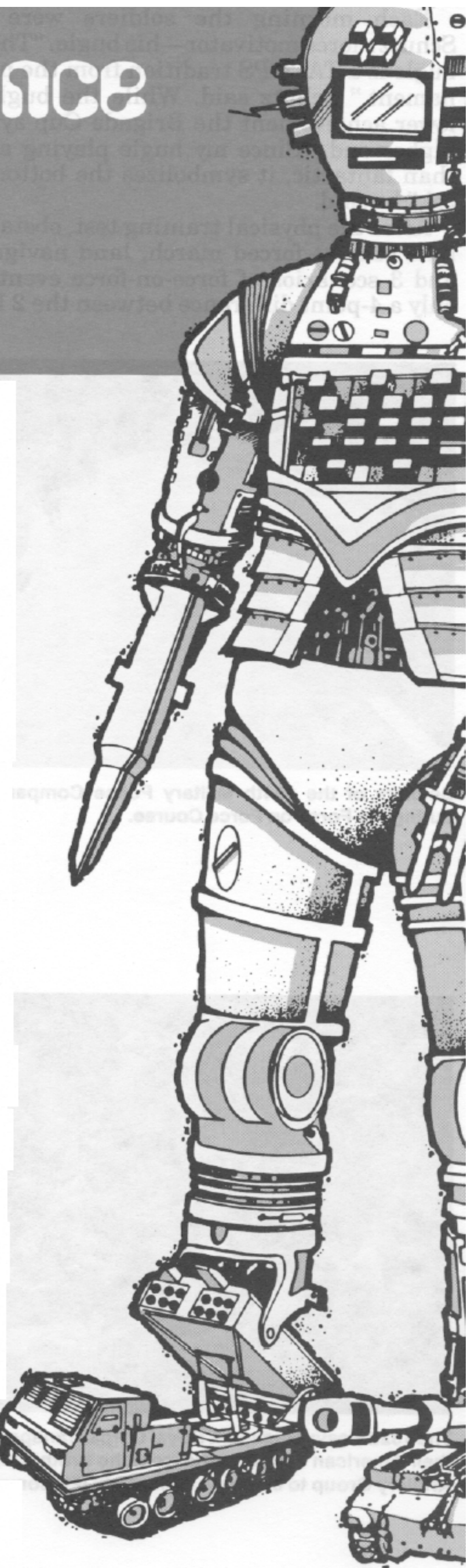
Soldiers of the 164th Military Police Company run for cover during the Force on Force Course.

The 132d Heavy Regiment Royal Corps Transport soldiers joined their American counterparts from the 570th United States Army Artillery Group to compete in the TACOPS competition.

Soldiers of the 83d United States Army Field Artillery Detachment bring it on home during the 5-mile Forced March.

Artificial Intelligence and Fire Support

by Major Philip J. Millis



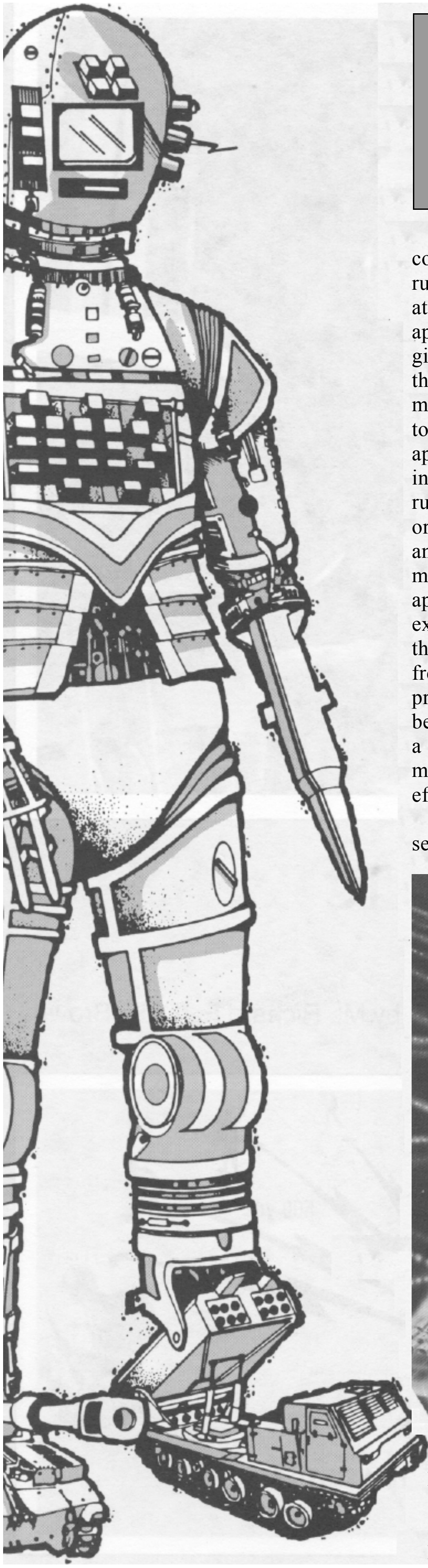
Artificial intelligence (AI) is easily the hottest buzzword in military research and development circles today. This article explains the excitement and takes a brief look at AI programs designed to benefit the Fire Support Community.

Artificial intelligence embraces such diverse interests as machines that understand common spoken or written language, robots that sense and respond to changes in their environment, and computers that solve problems on a par with human experts. Although AI research at the university level has been underway for nearly 40 years, early applications met with failure because AI computer programs were too complex to run on the machines that existed. Today, the availability of a new generation of faster and more powerful computers puts artificial intelligence applications well within our reach. Since the most potentially fertile area for near-term military applications lies in the use of expert systems for tactical decision support, that is the area we will discuss here.

Although conventional computers deal effectively with clerical and number-crunching tasks such as pay and accounting (JUMPS, JACS), personnel records (SIDPERS), and technical fire support, battlefield situations resist numerical description and tend to be highly fluid and often chaotic. Presented with overwhelming amounts of incomplete and often contradictory information, military leaders must make decisions using only their best judgment and what information they can absorb in a relatively short time. To cope with such challenges, decision makers typically resort (sometimes unconsciously) to "rules of thumb" acquired from years of experience. Thus, the commander needs a set of tools that can quickly sort through all available data and suggest tactically sound courses of action. Such a requirement is tailormade for artificial intelligence support.

How are rules of thumb (also called decision heuristics) converted into computer instructions? The first step is to assemble the rules from our field manuals, instructional materials, and interviews or observations of subject matter experts working in the problem area. No single source has all the answers. Guidance found in field manuals provides the broad, doctrinal perspective; instructional materials offer recommended or "school" solutions for implementing doctrine; and subject matter experts provide novel, sometimes unconventional, approaches to problem solving based on their deeper understanding of issue specifics.

Next, computer programmers write the rules in a form that the computer can understand. Although computer programmers have developed a number of new computer languages specifically for artificial intelligence, the use of "conditional statements" remains the most common way to express a rule. A conditional statement becomes true only once its required conditions have been met. For example, a simplified target value analysis rule might read:



> IF....you are opposed by a Soviet *regiment*.
> AND...the regiment is conducting a *deliberate defense*.
> THEN..the highest value targets are *maneuver command posts*.

The computer searches through conditional statements until it finds the rule or rules which apply to the situation at hand, and then it performs the appropriate operation. For the example given here, the computer might reorder the target status board by moving maneuver command post-related targets to the top of the attack list. Should no applicable rules exist, the operator might instruct the computer to employ those rules that come closest to the situation, or to perform its own target value analysis. Whatever the case, the decision maker always retains the option of approving, modifying, or rejecting the expert system-based solution. By saving the expert from mundane tasks, he is free to tackle even more difficult problems. Meanwhile, the force becomes less dependent on the genius of a single individual and more able to maintain a high level of decision effectiveness around the clock.

When might we see AI programs serving fire support decision makers

Magnavox

on an operational basis? The best estimates suggest some type of artificial intelligence support within the next 3 to 5 years, if only on a trial basis. Two programs directly relating to the Field Artillery Community are already underway. The first is the advanced Field Artillery tactical data system (AFATDS), which is the planned successor to the tactical fire direction system (TACFIRE). In addition to the technical fire support capabilities offered by TACFIRE, AFATDS will support the tactical fire planner with a variety of decision aids. Programmers are already developing rule-based artificial intelligence programs for AFATDS to support target attack sequencing and resource allocation decisions.

The US Army and the Defense Advanced Research Projects Agency (DARPA) are jointly sponsoring the second program, AirLand Battle Management (ALBM). It explores the potential for artificial intelligence in maneuver and fire support planning for AirLand Battle operations at the division and corps level. Given a mission statement, friendly and enemy situations, and commander's guidance, ALBM will generate and evaluate alternative courses of action for maneuver and fire support. When the commander has settled on a given course of action, it generates a standard 5-paragraph operations order. As changes to the situation occur, the program issues new guidance and the process is repeated. Although many details are being worked out, current plans call for initial testbed sites at Forts Leavenworth and Sill with user tests in Europe in the 1988/89 time-frame.

In summary, artificial intelligence is an emerging technology which, if successfully implemented, offers tremendous potential as a force multiplier for command and control battle planning. It is not a panacea for the Army's challenges, but a new set of tools giving commanders a different and potentially more productive way to operate. Whether AI will prove an idea whose time has come remains to be seen. What is certain is that with artificial intelligence initiatives, the Field Artillery, which has been in the forefront of tactical computer employment for more than 30 years, will undoubtedly continue in its leadership role for may years to come.

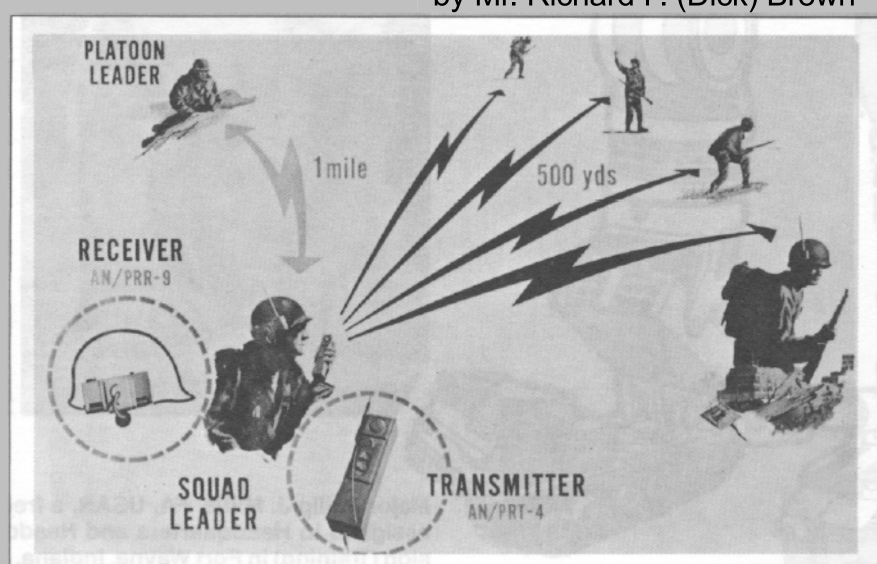
Major Philip J. Millis, FA, USAR, a frequent contributor to military journals, is assigned to Headquarters and Headquarters Division, 3d Brigade, 70th Division (Training) in Fort Wayne, Indiana. He is the manager of Defense Systems at the Magnavox Decision Support Systems Applied Center of Excellence.

A Brief History of the Intrabattery Radio

by Mr. Richard F. (Dick) Brown

In the days before digital traffic and terrain gun position corrections, intrabattery communication consisted of internal wire or an improvised loudspeaker on each piece. Gun crews in Vietnam and designers at the US Army Field Artillery School explored several methods of passing fire commands to each section, moving through several generations of new ideas and testing various radio systems.

The artillery experimented with the PRR-9 and PRT-4 squad radio system during the Vietnam era, but they never adopted it for use. Intended for the infantry, it provided the platoon and squad leaders with a pocket-sized radio and a small receiver mounted on the side of their helmets. Squad members also had the receiver but they



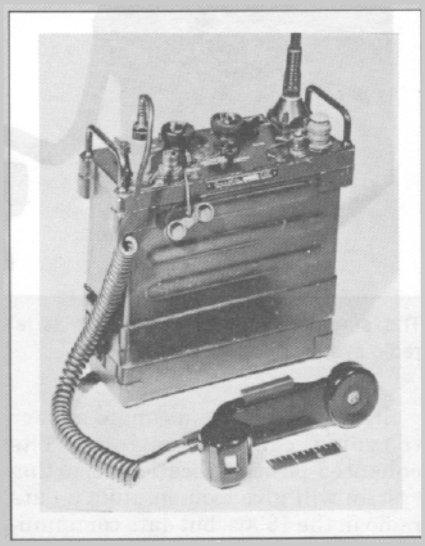
The individual radio concept.

were not afforded the luxury of responding because the device could only receive. They selected frequency by changing crystals inside the radio. As you can imagine, this caused serious maintenance and logistical problems.

The infantry finally rejected this system and Army leaders began a search for a new squad radio. Naturally the Field Artillery did not attempt to use that radio.

Looking for a Radio

During the same era, the US Army Field Artillery Board undertook an innovative test of the AN/PRC-77 radio as an intrabattery radio. They tested radio communications as a backup to the battery's internal wire. The Field Artillery Board's report was impressive. "Hip Shoot" response times tested at Fort Sill in 1974 were reduced by almost a minute, and daylight deliberate occupation times were cut nearly in half. The Board also reported that problems like convoy control and lost or broken down howitzers disappeared. The intrabattery radio concept proved its worth.



The AN/PRC-77 radio.

At about the same time, the Infantry School was preparing a new requirements document for a hand-held squad radio. The Field Artillery School wanted to implement its intrabattery radio concept by initiating a program to equip all self-propelled howitzers with the AN/PRC-77. However, the Communications-Electronics Command (CECOM) (then CORADCOM) stopped this action because the AN/PRC-77 was in short supply—almost 10,000 units were back-ordered. CECOM proposed that the artillery use the new Infantry

Radio set control groups.

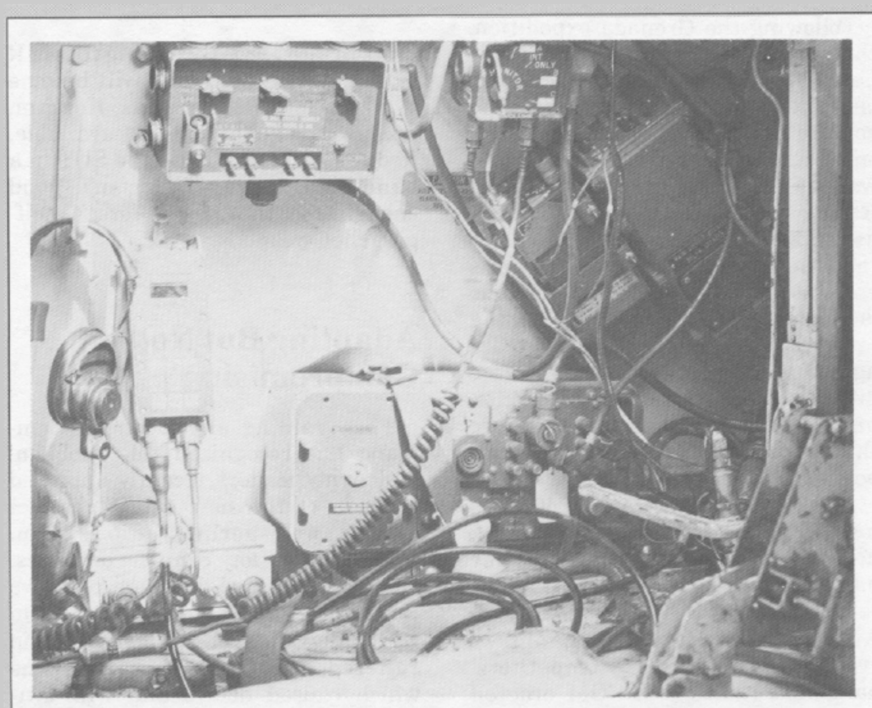
squad radio and offered to develop a vehicular applique which would mount the radio on self-propelled howitzers and in the fire direction center's M577 command post carrier.

The Field Artillery School requested a change to the requirements document for the squad radio, now known as the small unit transceiver or SUT. In 1979, Department of the Army approved the change to the requirements document adding the applique. The Field Artillery School became the proponent for that device.

While the paper mills churned out fodder for the materiel acquisition process, CECOM evaluated several candidates for the SUT. Ultimately, they chose the US Marine Corps' AN/PRC-68. It was tested by the Infantry and Rangers and put into production for the Army through an agreement with the Marine Corps. The Army was planning to buy more than 40,000 radios.

Magnavox, the same company manufacturing the SUT, built 8 prototypes "appliques." The applique, now known as the OG-174/VRC or the mount, provided several features:

- It mounts the SUT to the vertical wall of the M109 howitzer or lets it hang from an overhead surface in the Field Artillery ammunition support vehicle. The system must use an external antenna since the SUT's radio energy cannot penetrate the howitzer's armor. The M110 howitzer mounts the system on the rear of the assistant gunner's seat. The antenna connects directly to the radio.
- The mount allows the radio to use the howitzer's power so batteries are not needed. The OG-174 also conditions the vehicle power, eliminating the voltage fluctuations that destroy data transmissions.
- The mount contains a loudspeaker so voice fire commands can be heard by all crew members.
- The mount connects the radio to the howitzer's VIC-1 intercom. This means that the chief of section can talk to the platoon leader or fire direction



The cable harness for the VIC-OG-174 gun display unit.

center while in convoy. The gunner can also talk directly by radio to the aiming circle operator while he is laying the piece for initial direction.

- The OG-174 provides a radio data link between the battery computer unit in the fire direction center and the gun display unit in the howitzer. The SUT has a range of about 800 meters in thick woods and more than 1 mile over open terrain. This means that platoons can be dispersed and each piece can take full advantage of cover and concealment.

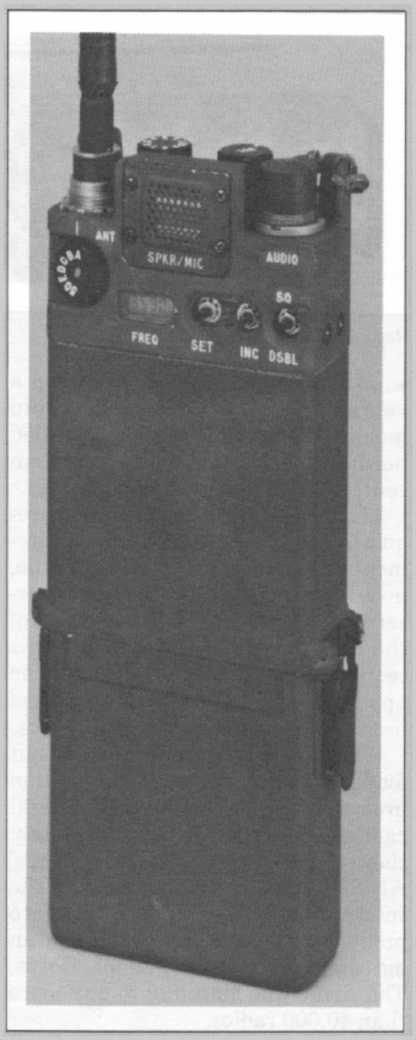
The Fielding Goes On

The Field Artillery Board tested the radio and mount at Fort Sill in 1981. The test demonstrated that the radio could operate under a wide variety of conditions including freezing weather and severe ballistic shock. In fact, the radio won the admiration of some gunners who wanted to use the equipment for their upcoming Army training and evaluation program.

During the following year, the materiel acquisition process continued to march toward the fielding of the OG-174, but in 1983 DA terminated the process because of funding cuts. The Field Artillery School unsuccessfully attempted to reinstate the funding. The program was left with enough money to buy 935 systems, which are coming off Magnavox's production line now and will go to European cannon batteries in 1987.

Following the Grenada expedition, the vice chief of staff of the Army issued a memorandum which concluded that the SUT did not meet the communications requirements of small unit leaders. His memorandum was based on conversations with Ranger units who made the initial assaults on the island. The problems the Rangers and other Infantry units encountered with the SUT include dented cases from parachute landing falls, water seepage, and other breakages from carrying the radio. These difficulties won't transfer to cannon units, because Redlegs have to secure the radios in the mount to gain full potential.

As a result of the vice chief of staffs memorandum, the Army initiated a new squad radio program. They named it the "SUR"—small unit radio—and gave it the nomenclature AN/PRC-126. After the Infantry's evaluation of several competitors' hand-held radios, CECOM ordered more than 4,000 SURs from Magnavox for delivery to Infantry



The PRC-126 intrabattery radio.

units in late 1987. By issuing the SUR to Infantry units, SUTs will become available for artillery units. However, because the applique is not available, Redlegs will have to use the SUT in a hand-held mode. This isn't good enough for the heavy force's self-propelled weapons.

Adapting But Not Compromising

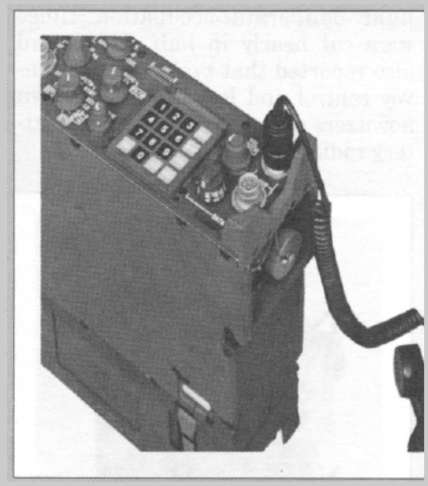
The Training and Doctrine Command has recognized this problem, and Army leaders recently approved the use of the new single channel ground and aerial radio system (SINCGARS) for cannon batteries. However, approval does not mean we can expect an immediate program with quick delivery. The new radio suffered manufacturing problems which caused delays and will ultimately affect the intrabattery radio program.

Conclusion

The battery computer system will never reach its potential nor will the 3x8 cannon battery doctrine be implemented fully without an intrabattery radio.

The AN/PRC-68 will be with us for some time to come and may be useful to towed artillery units. Certainly it will be better than using internal wire, and some units are using it innovatively with the battery computer system.

European units will receive the SUT and the OG-174 in sufficient quantities to equip howitzers and fire direction centers in the entire European force. Because of the limited procurement of the OG-174, its life cycle will probably be quite short as repair parts become hard to find and units start to transition to SINCGARS.



The single channel ground and aerial radio system intrabattery radio.

SINCGARS is the ultimate answer to voice communications. The enhanced position location reporting system will give cannon units a data radio in the 1990s, but data communications systems deserve a separate discussion.

The future of intrabattery communications is not crystal clear. While we have set reachable goals for the near future, it continues to be a task of nailing Jello to the wall.

Mr. Richard F. (Dick) Brown is a Field Artillery specialist at Fort Leavenworth, Kansas. He has been involved with communications analyses for tactical automatic data processing systems and communications support media and has been the principal developer of the intrabattery radio.

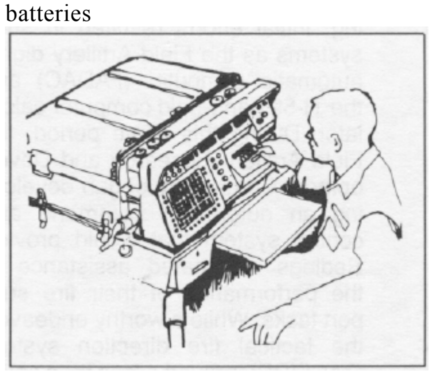
Illustration by: Bobby Hill

by Captain Suzann W. Voigt

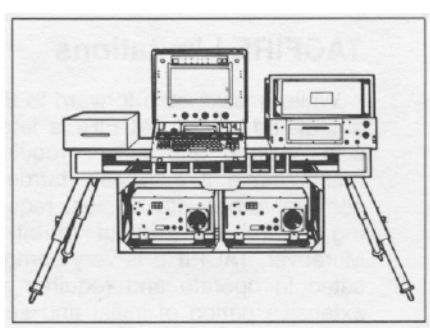
A fire raging from Capitol Hill to the Pentagon is setting off plumes of concern at Fort Sill and the School of Fire Support as lawmakers determine the best system to replace and upgrade the tactical fire direction system (TACFIRE).

The Army launched its automation effort in 1963 by fielding the Field Artillery digital automatic computer (FADAC), a device that provided ballistic solutions for artillery, cannons, rockets, and missiles. Although the computer's capabilities are dwarfed by today's microchip technology, FADAC became the method by which artillerymen were dragged, kicking and screaming, into the twentieth century.

The tactical fire direction system fielded in 1978 contributed major improvements by automating tactical fire control, target intelligence processing, unit status accounting, target analysis, fire support coordination, and fire planning. TACFIRE consists of a digital loop of computer centers at battalion, division, and corps artillery levels, and includes firing batteries via the battery computer system (BCS) and forward observers via the digital message device (DMD). It's not easy keeping up with hardware improvements, and TACFIRE was nearly obsolete just 2 years after fielding began. In 1980 Congress directed that TACFIRE not be improved and allocated funds for its successor, the advanced Field Artillery tactical data system (AFATDS). The Department of Defense approved the mission element needs statement (MENS) for AFATDS in March 1981, and listed requirements that will take the artillery into the twenty-first century.



FADAC.



BCS.

The AFATDS Functional Areas

AFATDS' capabilities are delineated by their 3 main operational categories, and it is easiest to understand them in that order.

• *Fire Support Execution Mode*

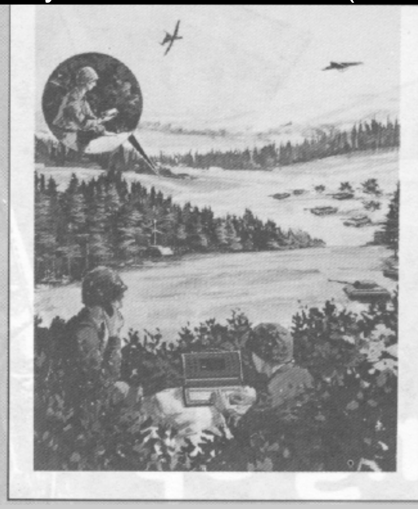
The area that intrigues artillerymen most may be the fire support execution mode (FSX), where sensors and software provide the tactical decisions that used to be the domain of the fire direction officer. AFATDS will maintain a data base of fire support assets input digitally by Field Artillery fire units, command posts and other Field Artillery tactical data systems, and manually from other fire support systems. Targeting data is input from forward observers, fire support officers and other observers, from fire support elements, and from the intelligence and electronic warfare system. AFATDS screens the target data; resolves duplication; determines a target priority based on target value analysis, commander's guidance, and the friendly situation; and produces a list of targets nominated for attack. The attack system analysis function matches the target list against the available assets data base, selects the favored attack system, and automatically tasks the selected delivery system and monitors the status of the mission. Target damage analysis is performed based on criteria established by the fire support coordinator. After processing damage assessment reports, the system will determine if the criteria have been met.

• *Fire Support Planning Category*

The fire support planning category (FSP) assists the Field Artillery commanders from the time they receive the maneuver commander's operation order through the execution of the fire support plan. The planning guidance function allows commanders and fire support coordinators to develop attack parameters (using the existing data base), and applies it to fire support requirements as they occur. Further assistance is provided with a preliminary analysis of the maneuver courses of action (COA), rank-ordered by AFATDS, and 1 identified as the recommended COA. AFATDS conducts a detailed analysis of the phases of the selected COA and proceeds to allocate fire support assets and planning targets to support the operations plan. The fire support paragraph or annex is initiated and when approved is electronically transmitted to upper, lower, and adjacent echelons (hard copy of the plan is available as needed). The Field Artillery support plan is another by-product of the data base containing artillery planning guidance

AFATDS, It's Closer Than You Think!

by Lieutenant Colonel (Retired) Henry D. Urna



The AirLand Battlefield of the future demands that the US and our Allies offset the numerical superiority of our foes with the ability to predict changing battlefield situations and to act in a more decisive manner. This requires that we employ every possible technological advantage to provide our supported commanders with the winning edge. As long ago as the early 1960s, the Field Artillery Community recognized the advantages of employing automation to man-intensive battlefield tasks such as firing data computation and fire plan scheduling. Initial efforts resulted in such systems as the Field Artillery digital automatic computer (FADAC) and the TI-59 hand-held computer calculator. During this same period, the Field Artillery Research and Development Community began developing an automated command and control system that would provide Redlegs automated assistance in the performance of their fire support tasks. While a worthy endeavor, the tactical fire direction system (TACFIRE), proved a less than satisfactory solution.

TACFIRE Limitations

While a large step forward in the automated world, TACFIRE's large size, weight, and power requirements make it extremely burdensome for forces with missions requiring a high degree of mobility. Moreover, TACFIRE is very complicated to operate and requires an extensive period of initial and sustainment training for operators to attain and maintain proficiency. Lastly, the advent of microprocessor technology rendered TACFIRE's design obsolete. Its centralized architecture creates vulnerable nodes that allow easy targeting and destruction, and its few work stations limit access to those soldiers equipped with digital message devices, variable format message entry devices, or TACFIRE computers.

The Army became aware of these and other problems during TACFIRE testing, but before any meaningful changes could be implemented, Congress intervened and cancelled the program. When the Army argued that TACFIRE provided a needed capability regardless of its inadequacies, Congress decided to permit initial TACFIRE fielding, but only to active forces. At the same time, Congress directed the Army to begin development of a new system that would replace TACFIRE and be a true fire support command and control system for the 1990s....thus was born the advanced Field Artillery tactical data system (AFATDS).

The Birth of AFATDS

AFATDS development began in 1982 when combat developers at the US Army Field Artillery School (USAFAS) laid out its requirements by writing a comprehensive operation and organization plan that viewed the system from the user standpoint. Key to this document was the experience USAFAS gained during the development and testing of TACFIRE. Combat developers were determined not to make the same mistakes twice, and as a result were very specific in their guidance on AFATDS capabilities. The Communications and Electronics Command (CECOM) took this guidance to heart, and the result was a very thorough study of AFATDS requirements long before they awarded the contract for development.

In the best tradition of cooperation, USAFAS and CECOM worked side by side to develop a comprehensive yet functional definition of the fire support command and control process. This document was the baseline requirement for the civilian contractor to implement the AFATDS design, and proved a significant factor in the program's progress to date. With CECOM system engineers providing guidance on form and method, USAFAS subject matter experts captured the essence of fire support in a form that the developer could easily translate into software.

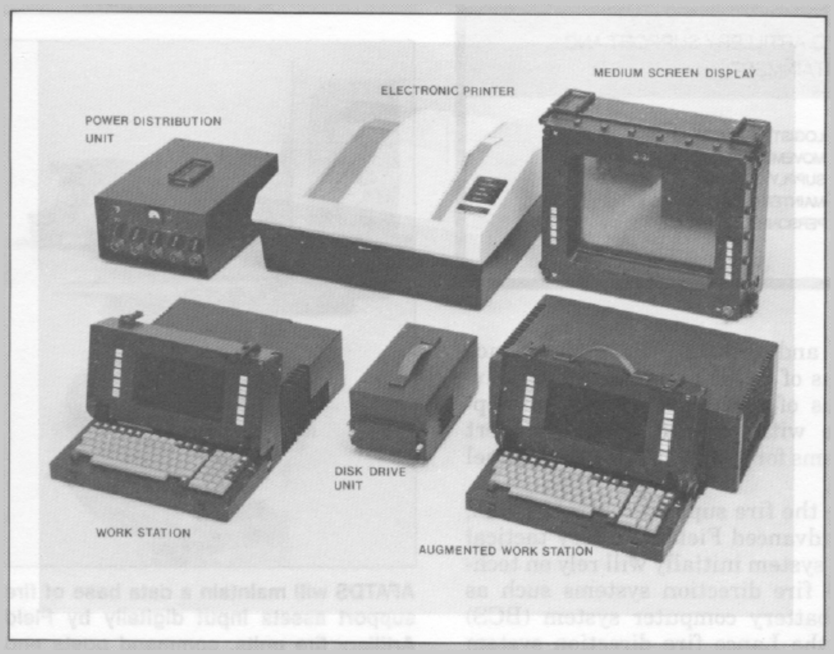
Having once been a victim of the technology explosion, CECOM chose to first develop the software for the system, deferring selection of the most advanced hardware available until the software had been successfully tested. This strategy required that the software is easily transferred from 1 type of hardware to another with the minimum of program modification. CECOM also mandated that contracters write the AFATDS software entirely in the Department of Defense standard Ada language, a first among large software programs in the Army.

Contractors based the hardware design on the user's requirements for multiple work stations distributed over many locations, and some with multiple users at each location. Each user was to have his own work station where he could perform all required functions. The computer would connect work stations within a specific location, such as a fire support element (FSE) or Field Artillery tactical operations center (FATOC) in a local area network, while radio and wirelines would support communications between widely separated FSEs and FATOCs.

Designers predicated AFATDS on the idea that the hardware and software should support current tables of organization and equipment (TOE) for different types of Field Artillery units. In addition to current TOEs, AFATDS must be able to adapt to changing requirements as new TOEs and concepts for organizations evolve. Thus, commanders can group hardware components to the needs of a specific location for such things as work stations, displays, and printers. Soldiers can assemble each grouping from common hardware components that are used at any of the locations. The only difference between stations is the number of components used and the software loaded into them.

Software applications designed to support different fire support jobs divided fire support into 5 functional categories:

- Target generation and processing.
- Fire support control and coordination.
- Field Artillery tactical operations.
- Field Artillery technical fire direction.
- Field Artillery support and sustainment.



The advanced Field Artillery tactical data system hardware design is based on the users needs for multiple work stations distributed over many locations.

Looking at these categories, it is apparent that the first 2 support fire support element personnel, while the latter 3 support Field Artillery unit personnel. We should also note that AFATDS is attempting to provide support to all of the fire support command and control chain, not just selected members as does TACFIRE.

Of special concern to the AFATDS design team was the quality of the support provided to each function. Because a great number of fire support functions rely heavily on graphical representations of information, the design team decided that the system be highly graphics-oriented. They felt this method of presentation would not only be familiar to those using the system, but it would also allow for rapid assimilation of the information and more effective and timely decision making. So, when we look at an AFATDS work station screen, we will see a multitude of decision support graphics to help us perform our required tasks quickly and efficiently.

Another major feature of the system is performance. The design calls for hardware components that process data extremely fast. Not only does the system employ advanced 32-bit microprocessor technology to reach its solutions, but it is capable of dividing the processing load among multiple processors within a work station if necessary.

Until recently, we might have classified AFATDS as merely a "gleam in the developer's eye," but this is no longer the case. To date, contractors have written and tested a record 700,000 lines of Ada software code. This is a tribute to the ability of the Ada language to allow for early error recognition and correction. The user evaluation of the system with the developed software and surrogate hardware begins at Fort Sill in September.

Given a successful evaluation and an accelerated hardware procurement under the Army tactical command and control system (ATCCS) common hardware and software program, Field Artillerymen worldwide should expect to see initial AFATDS fielding in 1990. Once in the hands of the tactical user, AFATDS will not only provide a much needed capability for the Field Artillery, but an example for other branches and services to emulate.

and the Field Artillery requirements in the fire support annex.

AFATDS can help focus the force intelligence planning efforts by determining if anticipated targets can or cannot be covered by current acquisition assets. Meteorological operations are augmented with recommended sites for met stations, determining the frequency of met updates, and producing a dissemination plan. AFATDS also will maintain current data, advise units on which data is to be used, and will ensure that fire units have appropriate data. Other planning assets include a survey support plan based on the fire support plan and the availability of survey and survey assets, and the Field Artillery logistics support plan that will include details of supply, maintenance, and personnel operations.

● *Movement Control*

The third operational category of AFATDS is movement control. Although overall responsibility for movement control lies with the maneuver force headquarters, AFATDS will assist by managing the movement of the Field Artillery based on guidance and specific requirements generated by the computer system. The system will identify movement needs based on the mission and an analysis of vulnerability. AFATDS assumes the role of traffic cop when the movement hour approaches by developing movement tables for the Field Artillery that do not disrupt their ongoing mission. Movement coordination takes place as requests for movement are routed through AFATDS for fire support movement coordination. Validated requests go to the maneuver functional area for integration to the overall movement plan. The maneuver functional area will approve, disapprove, or modify the requests which are then returned to the fire support movement coordination function. Processed movement requests return to the requesting unit while AFATDS maintains a file of movement requests.

The Extras

In addition to these categories, AFATDS provides combat service support with real time support and sustainment information required for operational control. These areas include the status of mission essential supplies (ammunition such as projectiles and rockets), the maintenance status of critical equipment, and the status of personnel. It will interoperate with combat service support systems for the exchange of personnel data.

As the fire support control system, the advanced Field Artillery tactical data system initially will rely on technical fire direction systems such as the battery computer system (BCS) and the Lance fire direction system (FDS), for the preparation of fire commands for weapons. In the multiple launch rocket system (MLRS), soldiers will continue to perform technical fire direction on the onboard fire control system. AFATDS will replace the MLRS fire direction system at battalion and battery levels. The system will be capable of the technical fire direction tasks required to accomplish tactical control of fire support and field artillery assets.

In more routine gunnery problems, AFATDS will maintain the fire unit capability in terms of location, status, and weapons characteristics. The computer system will determine the number and type of rounds required for the target, the weapons to fire, and the aim points; then it will produce a fire order which is sent to the fire direction system for computation of fire commands. AFATDS will report the status of missions to the appropriate

FIRE SUPPORT C2 FUNCTIONALITY

- TARGET GENERATION AND PROCESSING
- FIRE SUPPORT CONTROL AND COORDINATION
- FIELD ARTILLERY TACTICAL OPERATIONS
- FIELD ARTILLERY TECHNICAL FIRE DIRECTION
- FIELD ARTILLERY SUPPORT AND SUSTAINMENT

TARGET GENERATION AND PROCESSING

- TARGET PROCESSING
- TDA REPORTING
- TARGET ACQUISITION SUPPORT CAPABILITIES

FIRE SUPPORT CONTROL AND COORDINATION

- TDA ANALYSIS
- ATTACK SYSTEMS ANALYSIS
- ORDER TO FIRE CONTROL
- FIRE SUPPORT PLANNING GUIDANCE
- FIRE SUPPORT PLANNING
- FIRE SUPPORT MOVEMENT COORDINATION

FIELD ARTILLERY TACTICAL OPERATIONS

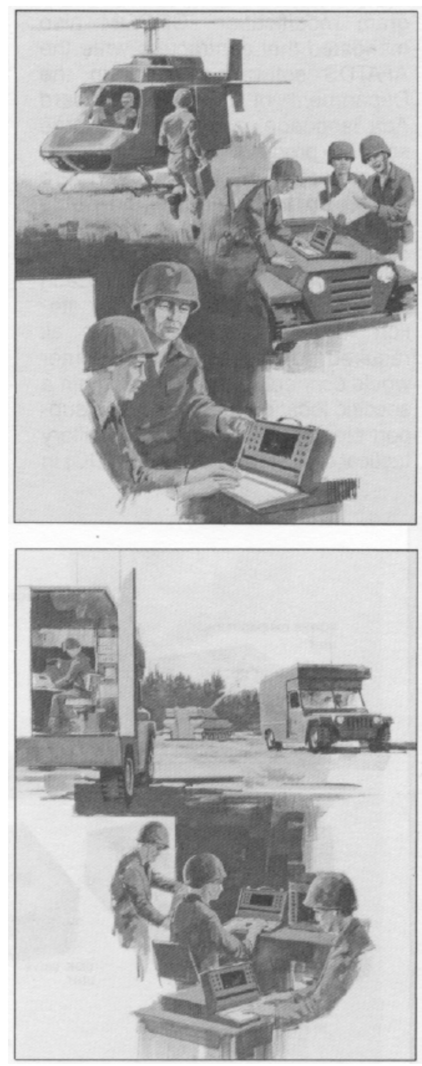
- FIELD ARTILLERY STATUS REPORTING
- FIRE ORDER CONTROL
- FIELD ARTILLERY COMMANDER CONCEPT OF THE OPERATION
- FIELD ARTILLERY SUPPORT PLANNING
- METEOROLOGICAL OPERATIONS
- SURVEY SUPPORT
- FIELD ARTILLERY MOVEMENT COORDINATION
- FIELD ARTILLERY SENSOR OPERATIONS

FIELD ARTILLERY TECHNICAL FIRE DIRECTION

- FIRE UNIT CAPABILITIES
- FIRE MISSION PROCESSING
- FIRE UNIT STATUS

FIELD ARTILLERY SUPPORT AND SUSTAINMENT

- LOGISTICS PLANNING
- MOVEMENT REQUESTS
- SUPPLY CONTROL
- MAINTENANCE CONTROL
- PERSONNEL CONTROL



AFATDS will maintain a data base of fire support assets input digitally by Field Artillery fire units, command posts and other Field Artillery tactical data systems, and manually from other fire support systems.

Field Artillery and fire support headquarters.

Hardware Needs for Light Forces

The need for a digital communication and control link is present in all fire support units, but it is especially critical in the light divisions because they have no automation above battery level. The "lights" currently use the battery computer system for technical data solutions and some digital command and control, but they do not have the electronic command, control, and communication capabilities of the present TACFIRE. However, TACFIRE is a large and cumbersome system demanding such support that in 1983 the Army vice chief of staff reportedly directed there will "be no TACFIRE in the light divisions." Army researchers were directed to "kludge" something together to provide some degree of automation until AFATDS could be fielded. The endeavor yielded several solutions, each with an interested group on Capitol Hill.

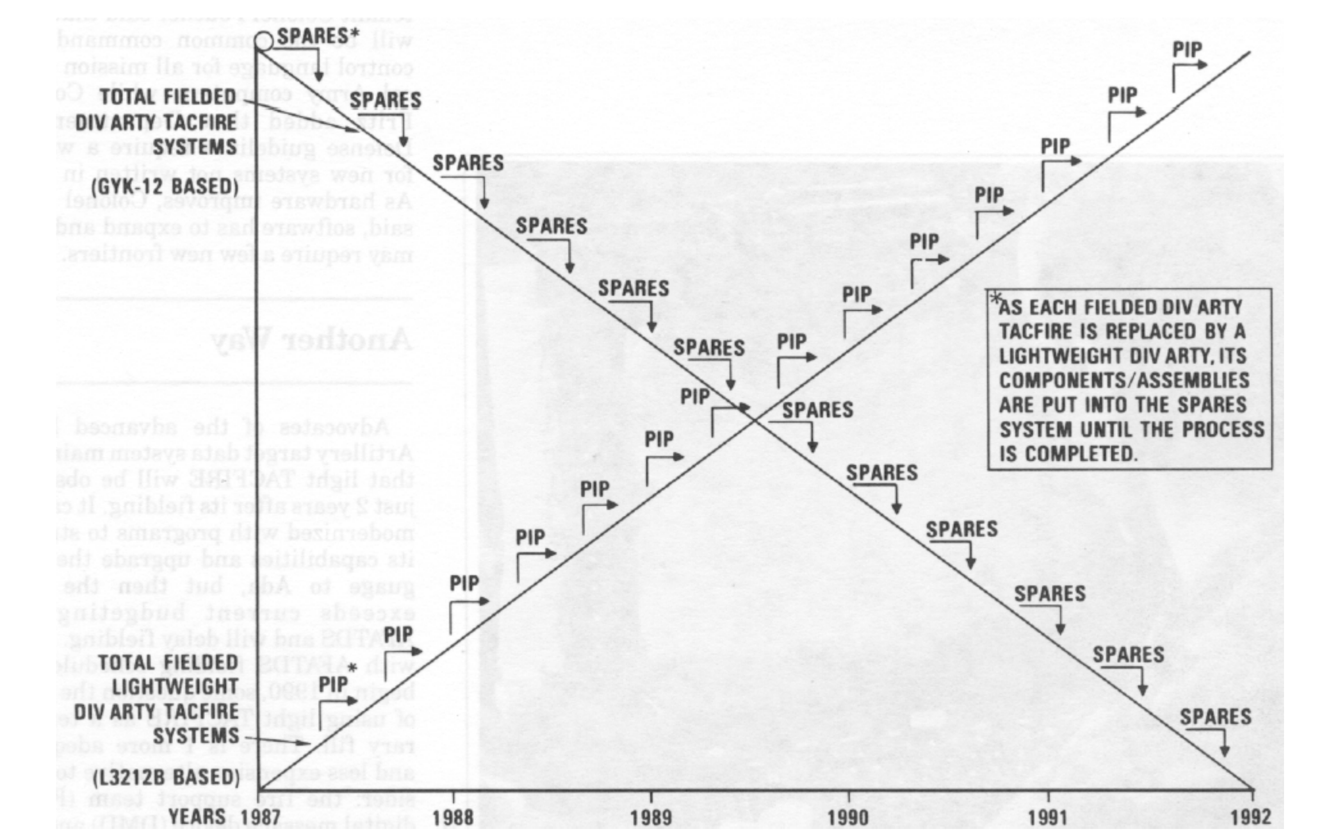
According to Lieutenant Colonel Edward B. Poucher, Chief of the USAFAS Tactical Data System Division, Directorate of Combat Developments, the Army vice chief of staff wanted to use "off the shelf" technology to get the equipment down to the units as quickly as possible. The Army turned to the light TACFIRE system (LFATDS), already in development for the 9th Infantry Division's Quick Reaction Program. LFATDS initially was purchased in 1983 as a 1-time buy of 41 terminals, but if selected as the interim measure it won't go to the light divisions until 1988.

Also known as the briefcase terminal, it is functionally similar to TACFIRE with smaller, lighter hardware. However, it has no capability to tackle the complex software missions of target value analysis, target prioritization, deep battle operations, employment of terminal homing munitions, and integration of all fire support systems. And it is not interoperable with naval gun fire, electronic warfare, and air defense. LFATDS is essentially a miniaturized version of today's TACFIRE and still requires a full-scale model at division artillery level.

There are some on Capital Hill who see LFATDS not only as a short-term fix, but with software improvements it is a cheap, stable, and reliable alternative to AFATDS that will hit the streets 2 years earlier. Congressional critics have called AFATDS a "high-risk" venture and are not enthusiastic about committing defense funds because of new and untried development procedures.

The new and untried route to production includes perfecting the software program before marrying it to hardware. While this has been termed a revolutionary approach, Lieutenant Colonel Poucher recognizes the logic, noting that software is the most time consuming and costly part of a new system. Developing the

LIGHTWEIGHT DIV ARTY TACFIRE IMPROVEMENT PLAN



This chart highlights the money-saving method to field TACFIRE improvements. As each new system or item replaces its older counterpart, the replaced item goes into the spares system. This technique saves money by avoiding the cost of buying new TACFIRE spares, which currently cost more than $30 million a year to support the fielded TACFIRE units.

Magnavox

The augmented work station of AFATDS.

Magnavox

The medium screen display of AFATDS.

program may take as much as 12 to 18 months and can push the system into obsolescence when mated to existing hardware. Because of this "revolutionary" approach to compatibility, we can take advantage of the very latest in computer technology. Light TACFIRE, for instance, uses the 16-bit processor of today while the advanced Field Artillery tactical data system's hardware uses a 32-bit processor that will be around for tomorrow. Colonel Martell D. Fritz, the TRADOC System Manager for Fire Support Command, Control, and Communications, notes that "the feeling in the Army and in industry is that the 32-bit processor is where technology will stay for a while."

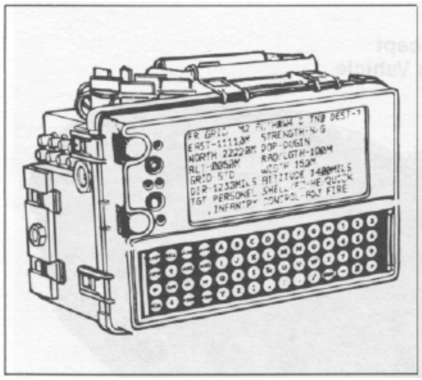
Further apprehension stems from Ada, the computer language used in programming. "Ada is a new, higher order language," Lieutenant Colonel Poucher said, "there are no major systems developed in Ada yet."

"LFATDS is written in "C," a computer language that is less capable than Ada, and is not designed for modularity, portability, or ease of documentation," according to Colonel Fritz. "Ada is designated specifically for advanced applications. It's mandated by Department of Defense to be the DOD and NATO standard." Lieutenant Colonel Poucher said that Ada will be the common command and control language for all mission critical Army computers, while Colonel Fritz added that Department of Defense guidelines require a waiver for new systems not written in Ada. As hardware improves, Colonel Fritz said, software has to expand and that may require a few new frontiers.

Another Way

Advocates of the advanced Field Artillery target data system maintain that light TACFIRE will be obsolete just 2 years after its fielding. It can be modernized with programs to stretch its capabilities and upgrade the language to Ada, but then the cost exceeds current budgeting for AFATDS and will delay fielding. And, with AFATDS fielding scheduled to begin in 1990, some question the logic of using light TACFIRE as a temporary fill. There is 1 more adequate and less expensive alternative to consider: the fire support team (FIST) digital message device (DMD) and the digital communication terminal (DCT).

The FIST DMD may provide the cost effective interim solution for



The fire support team digital message device may provide the cost effective interim solution for automated fire support command and control for light divisions.

automated fire support command and control for the light divisions. It offers a digital loop between forward observer, FIST headquarters, fire support elements, fire direction centers and firing batteries, eliminating voice transmissions in fire missions. It satisfies the need for digital input to the battery computer system and improves fire planning and coordination by transmitting fire planning targets and battlefield information to fire support elements. It provides interoperability with units using TACFIRE and will be compatible with AFATDS when fielded. In addition, the FIST DMD is now in production. The FIST DMD went to the 7th Infantry Division in April to begin a period of training and evaluation prior to fielding to all light divisions. If the program is successful, fielding to all light divisions will be complete in 1 year.

Captain Suzann W. Voigt, FA, is Acting Editor for the Field Artillery Journal. She received her commission through the Officer Candidate School and is a graduate of the University of Arizona and the Field Artillery Officer Basic and Advanced Courses.

Fragments

FROM COMRADES IN ARMS

Hughes to Test TOW Guidance Without Wire

The US Army recently awarded a $2.97 million contract to Hughes Aircraft Company to build and test a wireless command guidance link for the tube-launched, optically tracked, wire-guided (TOW) missile.

The new wireless link would allow a secure electronic data link, rather than the existing wires, to transmit guidance commands. Six modified TOW 2 missiles will be ready for flight tests at Redstone Arsenal, Alabama.

The modifications will provide the potential to increase the missile's velocity, reduce its flight time, and extend its lethal range.

Hughes Aircraft has built more than 400,000 of the wire-guided missiles in 3 versions (basic TOW, improved TOW and TOW 2) for the armed forces.

Some New Smoke

Army chemical units recently received a new smoke generator known as the M3A4 mechanical pulse smoke generator. A significant improvement over the Korean War vintage M3A3 smoke generator, the new system provides maneuver commanders and fire support officers with more reliable smoke support on a highly mobile battlefield.

In the past, the M3A3 generator had difficulty meeting smoke requirements because of its questionable reliability and limited mobility. All that has changed. Engineers have improved the carburetor, fuel pump, and starter system. Mounted on the M113A2 armored personnel carrier designated as the M1059, the new generator can take on rough terrain and keep up with the supported forces.

Letterkenny Army Depot at Chambersburg, Pennsylvania, will make the technical improvements on the M3A3 generators in the United States; and the Mainz Army Depot in Germany will upgrade generators assigned to Europe. The Chemical School at Fort McClellan, Alabama, and the Ordnance School at Aberdeen Proving Ground, Maryland, will be the first Training and Doctrine Command installations, to receive the M3A4s because they will train system operators and maintenance specialists. The 9th Chemical Company of the 9th Infantry Division (Motorized) at Fort Lewis, Washington, will be the first Forces Command unit to receive the generators.

A "Hull" of a Contract

The US Army Materials Technology Laboratory (MTL) in Watertown, Massachusetts recently awarded a contract to demonstrate the military capability of molded thick laminate composites (reinforced plastic) in the construction of lightweight combat vehicles. The $13 million, 4-year contract is a major step toward providing materials technology for the next generation of combat vehicles in the United States military.

The composite used in this project is Owens-Corning's S2 fiberglass woven fabric with a resin for bonding. Three molded composite sections will replace 23 welded aluminum plates while still incorporating aluminum reinforcing members for strength in the hull structures.

According to William E. Haskell III, an MTL senior engineer, "the Bradley fighting vehicle was selected as a demonstrator for evaluating composite hull structures because of its complex shape and mission objectives which optimized the composite application. The Bradley fighting vehicle is currently in production and provides a unique opportunity for materials engineers to compare the composite hull to an existing data base."

Previous Army projects have proven the advantages of using molded reinforced plastic (RP) armor.

"In comparison to conventional aluminum armor, composites provide reduced weight with equivalent crew protection, reduced interior spall (metal fragments), enhance corrosion-resistance, and lower

maintenance costs over the life of the system," according to Major Steven P. Medaglia of MTL. "Getting composites into future systems can offer better protection for our soldiers in the years ahead," he added.

The contract awarded to FMC Corporation at San Jose, California, calls for the corporation to conduct materials and processing refinement, hull design, tooling fabrication, and molding and outfitting of the hull, followed by field durability testing. MTL will conduct in-house projects involving materials improvement, characterization, and quality control, complementing the contractor's effort.

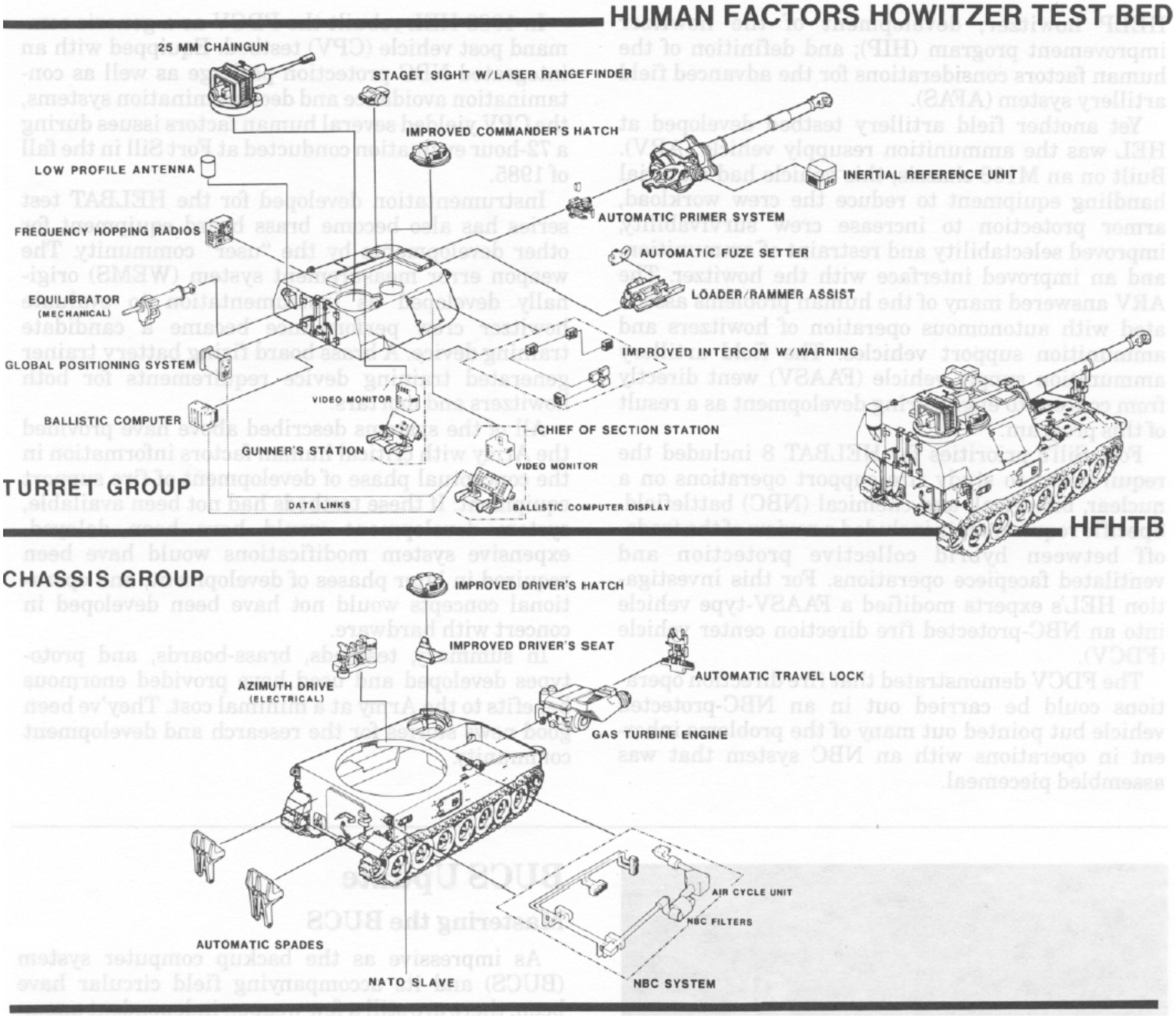
View from the Blockhouse

FROM THE SCHOOL

The Tools of Research

Over the past 15 years, the Fire Support and Target Acquisition Directorate (FSTAD) of the Human Engineering Laboratory (HEL) has used testbeds, brass boards, and prototypes to improve human performance, reduce human workload, increase soldier survivability, and improve training capabilities. The results of their efforts have been a better Field Artillery.

The human engineering laboratory produced several early brass-board tripods for laser equipment which demonstrated the accuracy the forward observers could locate and adjust artillery fires. Experience gained from these 1971 vintage brass boards transferred well to the human factors design of the Army's ground laser locator designator (G/VLLD), the GVS-5 laser rangefinder, the Marine Corps' modular universal laser equipment (MULE), and the tri-service lightweight target designator (LTD). What's more, experience with those systems



carried over into the human factors evaluations of the Copperhead, HELLFIRE, and fire support vehicle (FSV).

From 1973 through 1979, HEL's experts developed a brass board fire control computer and digital data transmission system for human engineering laboratory battalion artillery test (HELBAT) 4 and its successor tests. These efforts studied the interaction of forward observers, fire direction centers, and firing batteries in a digital communications environment. In fact, this brassboard system allowed HEL to study these interactions for 4 years before engineering development hardware was available to do similar work. Experience gained by HEL and Training and Doctrine Command personnel with this system contributed to the digital message device (DMD), the fire support team (FIST DMD), the battery computer system (BCS), the M109E4 howitzer extended life program (HELP), the ground/vehicular laser locator designator (G/VLLD), and the Copperhead programs.

The Fire Support Directorate produced several testbed weapons for HELBAT 7, a 1979 evaluation of firing battery operations. The first of these was Howitzer Testbed 2 (TB2)—the first M109 to have an onboard inertial reference and navigation system. Although it did not meet accuracy requirements for a fielded howitzer system, TB2 did demonstrate the significant advantages of using an inertial reference and navigation system.

Based on these encouraging results, Fort Sill's leaders requested that firing battery performance investigations be continued in the 1981 HELBAT 8. The resulting Howitzer Testbed 4 (TB4) had improved position and navigation capabilities as well as enhanced data handling and communications devices. During HELBAT 8 and associated follow-on tests, TB4 demonstrated that a properly equipped howitzer can function in a spread-battery configuration which enhances survivability and increases weapon availability.

Experience gained with these testbeds contributed to the source selection for the enhanced self-propelled artillery weapons system (ESPAWS); concept development, development of testing procedures, and proposal evaluations for the M109E4

HELP howitzer; development of the howitzer improvement program (HIP); and definition of the human factors considerations for the advanced field artillery system (AFAS).

Yet another field artillery testbed developed at HEL was the ammunition resupply vehicle (ARV). Built on an M108 chassis, this vehicle had material handling equipment to reduce the crew workload, armor protection to increase crew survivability, improved selectability and restraint of ammunition, and an improved interface with the howitzer. The ARV answered many of the human problems associated with autonomous operation of howitzers and ammunition support vehicles. The field artillery ammunition supply vehicle (FAASV) went directly from concept to engineering development as a result of this program.

Fort Sill's priorities for HELBAT 8 included the requirement to study fire support operations on a nuclear, biological, and chemical (NBC) battlefield. Specific requirements included a review of the tradeoff between hybrid collective protection and ventilated facepiece operations. For this investigation HEL's experts modified a FAASV-type vehicle into an NBC-protected fire direction center vehicle (FDCV).

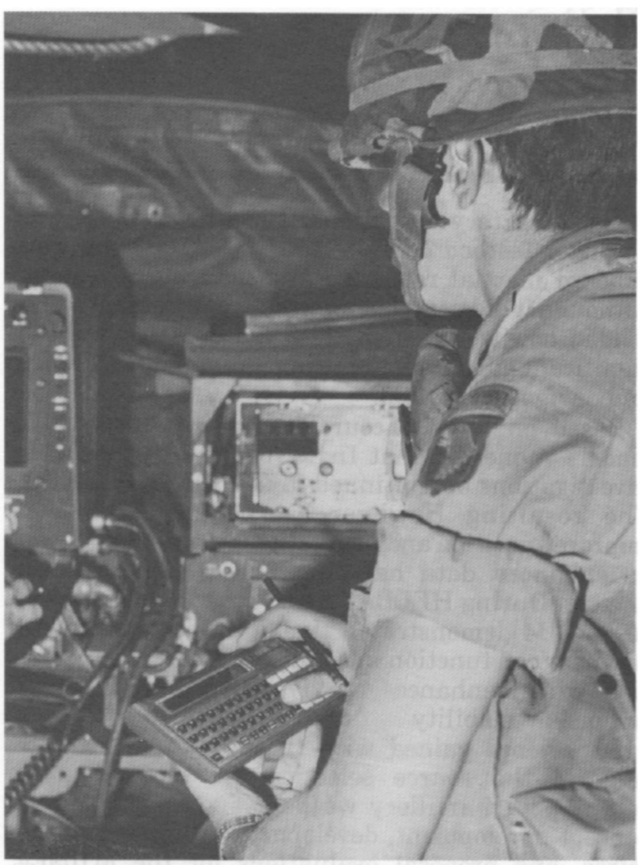
The FDCV demonstrated that fire direction operations could be carried out in an NBC-protected vehicle but pointed out many of the problems inherent in operations with an NBC system that was assembled piecemeal.

In 1983 HEL rebuilt the FDCV as a generic command post vehicle (CPV) testbed. Equipped with an integrated NBC protection package as well as contamination avoidance and decontamination systems, the CPV yielded several human factors issues during a 72-hour evaluation conducted at Fort Sill in the fall of 1985.

Instrumentation developed for the HELBAT test series has also become brass board equipment for other developments by the "user" community. The weapon error measurement system (WEMS) originally developed as instrumentation to evaluate howitzer crew performance became a candidate training device. A brass board firing battery trainer generated training device requirements for both howitzers and mortars.

All of the systems described above have provided the Army with critical human factors information in the conceptual phase of development of fire support equipment. If these testbeds had not been available, system development would have been delayed, expensive system modifications would have been required in later phases of development, and operational concepts would not have been developed in concert with hardware.

In summary, testbeds, brass-boards, and prototypes developed and used have provided enormous benefits to the Army at a minimal cost. They've been good news stories for the research and development community.



BUCS Update

Mastering the BUCS

As impressive as the backup computer system (BUCS) and its accompanying field circular have been, there are still a few weapon independent anomalies of the program which only the most advanced BUCS operators have encountered. Users discovered the software limitations after fielding, and although they create no problems during normal operations, they will be corrected in a follow-on program. These irregularities are not listed in any significant order, nor does one affect another.

If the operator enters more than 1 character for the projectile lot, the computer erroneously modifies the ammunition file. This modification may be information lost, deleted, or a combination of both.

Range and deflection probable error entries in the high burst/mean point of impact (HB/MPI) and radar registrations must be nonzero values. If the operator enters a value of zero in either field, the mission may terminate itself when displaying rounds outside 4 probable errors.

When fire direction center personnel update the ballistic met, they should enter the introduction line in its entirety rather than entering only those values which change. Otherwise, the station height reading in tens of meters will be seen as a value in meters. This causes incorrect calculations for air density which lead to errors in firing data of 1 to 2 tenths in fuze setting and time of flight, and 1 to 2 mils or more in quadrant elevation.

When the operator overrides the BUCS-selected propellant lot in an adjust fire mission, BUCS will not default to the new lot in the subsequent correction. The operator must ensure the proper propellant lot is displayed in the PROP LOT subfield of the subsequent adjustment format.

The following points are not anomalies and will not be changed with a new program revision. However, they merit the attention of fire direction center (FDC) personnel.

BUCS will conduct registrations with M483A1 (HEF) with self-registration in precision and HBMPI registrations. The special instructions portion of the fire commands must include the command to use the self-registration shaped charge subassembly. Additionally, BUCS will not display the fuze setting of (black triangle) 98.0 used in the impact phase of the precision and MPI registrations. This must be announced in the fire commands.

Once the operator enters the TGT LOC field and presses ENDLINE, he can't enter an override even if the field is displayed and the prompt changed. He must end the mission at the FM field and reenter TGT LOC.

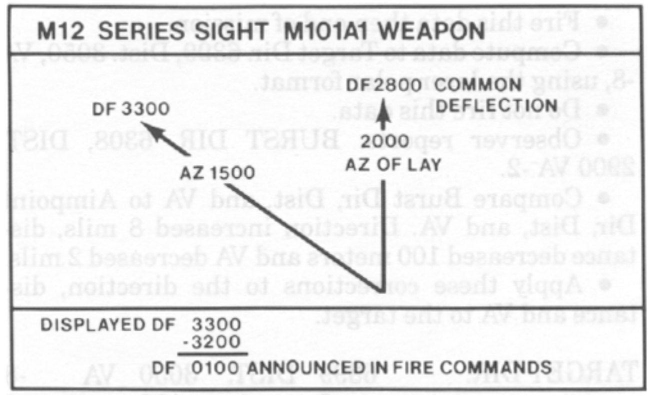
In weapon systems using semifixed ammunition, operators must enter the specific propellant lot in the propellant files. Normally, operators use the same lot designator as the associated projectile lot.

The warning message BAD DATA LN# indicates the first line of the computer met where operators did not enter the temperature. Note that although the BUCS program does not use air temperature in its calculations, you must enter the values for temperature in the computer met to compute accurate values for air density in the converted ballistic met.

If the BUCS will not load a program or if the computer will not turn off after the appropriate keys are pressed, try taking out all batteries and holding the ON key down for a period of approximately 30 seconds, then replace the batteries. The display should show MEMORY LOST. The computer should now allow access to the program. Note that this procedure eliminates all data stored in random access memory (RAM) and you should attempt it only as a last resort.

If you create a program other than BUCS in RAM, you must purge that program prior to conducting FDC operations. If you don't, processing may terminate without warning. The command to purge a program is PURGE *program name,* entered from the basic mode.

FC 6-40-31, page 2-41, indicates that the sheaf created by a 2-gun solution will default to an open sheaf, but this is not true. The burst locations of an open sheaf must be separated by 1 effective burst width perpendicular to the gun-target line. BUCS will attempt to create its default circular sheaf with the 2 guns. The aimpoints selected will be 1 burst width apart, but oriented north and south of the target. If an open sheaf is desired, you must specify OPEN



in the SHEAF subfield during mission processing.

When using the M12 series sight, take care in determining the azimuth and deflection to fire. If the deflection to fire is greater than 3200, you subtract 3200 from the displayed deflection.

To determine the azimuth for the special instructions portion of the fire commands, subtract the common deflection from the displayed deflection. Then subtract this value from the azimuth of lay. The result will be the azimuth that should be announced to the guns.

BUCS Displaced Aimpoint Mission

The BUCS equipped FDC can conduct laser adjustment missions using the displaced aimpoint method of shifting fires. This involves transmitting an offset aimpoint, the target location, and the burst location. To process this mission:

- Compute data to the aimpoint location with the laser polar format and send this data to the guns and end the mission.
- Compute data to the target location using the laser polar format, but do not send it to the guns.
- Receive the observer's laser direction, distance, and vertical angle to the burst location.
- Record and compare the differences in the observer's laser direction, distance, and vertical angle between the aimpoint and burst location.
- Apply this difference to the laser direction, distance, and vertical angle to the target direction, distance, and vertical angle.
- Call up the laser adjust format and input the corrected direction, distance, and vertical angle to the target.

EXAMPLE:

OFF: K24 THIS IS K35, ADJUST FIRE, OVER.
AIMPOINT DIRECTION 6300,
DISTANCE 3000, VA O.
TARGET DIRECTION 6399, DISTANCE 3050,
VA -8.
SELF-PROPELLED ARTILLERY BATTERY
EMPLACING, DPICM
IN EFFECT OVER.

- Compute data to Aimpoint Dir. 6300, Dist. 3000, VA O, using the laser polar format.

- Fire this data then end of mission.
- Compute data to Target Dir. 6399, Dist. 3050, VA -8, using the laser polar format.
- Do not fire this data.
- Observer reports: BURST DIR. 6308, DIST. 2900 VA -2.
- Compare Burst Dir, Dist, and VA to Aimpoint Dir, Dist, and VA. Direction increased 8 mils, distance decreased 100 meters and VA decreased 2 mils.
- Apply these corrections to the direction, distance and VA to the target.

TARGET DIR.	6399	DIST.	3050	VA	-8
	+ +8		+ -100		+ -2
CORRECTED	6407	DIST	2950	VA	-10
CORRECTED DIR.	0007				

- Compute data with the laser adjustment format using the corrected direction, distance and VA. This is FFE data.

BUCS Database Transfer

Database construction can be a time consuming process. Depending on the data, it could take as much as 30 minutes to type in a database from scratch.

Mr. John Higgins of the Armament Research and Development and Engineering Center (ARDEC) at Dover, New Jersey, developed a program which allows for the data base transfer between BUCS. Fire direction center personnel should continue to construct independent databases for each BUCS and conduct a "check" mission to find input errors.

These procedures apply to both cannon and Lance BUCS applications and can be found in the BUCS Job Aids Lance Application FC 6-40-32.

- Enter SEND and RECEIVE programs into the HP71B containing the database.
- Type OFF 10 into both BUCS. Press ENDLINE. . Connect the computers with 2 special purpose cables (NSN: 6145-01-199-8679) and the computer subassemblies (NSN: 7010-01-199-8717). Note the HP71 will not accept the SEND or RECEIVE programs until you install computer subassemblies.
- Type RESTORE IO @ RESET HPIL and press ENDLINE for both computers.
- Type RUN SEND and press ENDLINE for the HP71 containing the database.
- When the receiving component displays TRANSFER COMPLETE, type OFF IO, press ENDLINE on both HP71s, and disconnect them.
- Type PURGE SEND in the HP71 with the original database and press ENDLINE, then type PURGE RECEIVE, and press ENDLINE again.
- Both HP71s can now be used. Note that if SEND and RECEIVE are not purged, the Lance program on the HP71 with the original database will only be able to compute fire missions with standard met. The cannon program on the HP71 with the original database may cause an INSUFFICIENT MEMORY display during fire mission processing.

SEND PROGRAM

```
EDIT SEND
AUTO
IO OFF IO @ RESTORE IO @ RESET HPIL
    @ CONTROL ON
20 PRINTER IS * @ DISPLAY IS *
30 LOCAL
40 D = DEVADDR ("HP71(1)")
50 REMOTE :D
60 OUTPUT :D ;"PURGE RECEIVE"
70 OUTPUT "D ;"COPY :LOOP TO RECEIVE
    @ RUN RECEIVE"
80 COPY RECEIVE TO :D
```

RECEIVE PROGRAM

```
EDIT RECEIVE
AUTO
10 OFF IO @ RESTORE IO @ RESET HPIL
    @ CONTROL ON
20 PRINTER IS * @ DISPLAY IS *
30 DIM F$ [10]
40 D = DEVADDR("HP71(1)")
50 LOCAL
60 RESTORE
70 REMOTE :D
80 OUTPUT :D ; "'COMMO ESTABLISHED';
    @ BEEP" @ WAIT 3
90 READ F$ @ IF F$ = 'END' THEN 170 ELSE
    PURGE F$
100 OUTPUT :D ; "DISP 'TRANSMITTING -"; F$;'"
    @ BEEP
1500,.5"
110 WAIT 1.5
120 DISP 'RECEIVING -';F$
130 OUTPUT :D ; "COPY ";F$;" TO :LOOP"
140 COPY :D TO F$
150 BEEP 1000,.5
160 GOTO 90
170 LOCAL
180 DISP "TRANSFER COMPLETE" @ BEEP 500,.5
190 OFF IO @ PURGE RECEIVE
```

For cannon application only:

```
200 DATA 'METCM','BACKUP', 'MAPMOD', 'UPDATE',
    'PIECES', 'AMMO', 'AMMO1', 'MVV', 'AIMPT'
210 DATA 'FDATA', 'FDATA1', 'TGT', 'OBS', 'METB', 'REG',
    'REG1', 'TEMP', 'TEMP1", 'END'
```

For Lance application only:

```
200 DATA 'BTY', 'FU', 'RP', 'FP', 'TGTFIL', 'METFIL', 'AMO',
    'COORD'
210 DATA 'TEMP','PNT','FM','END'
```

BUCSkin

Leaders at the US Army Field Artillery School authorized the purchase of a hard case for the backup computer system (BUCS). The new case, known as BUCSkin, will be available in the supply system by the fourth quarter. The national stock number and nomenclature are, Case, Computer, 7010-01-247-0643, and it costs approximately $125.00.

BUCSkin is water resistant and constructed of steel and plastic. BUCSkin will protect BUCS from impact and will allow a soldier to operate the computer while it is enclosed in the case.

Terrain Gun Position Corrections

Terrain gun position corrections (TGPC) used with the backup computer system (BUCS) computed firing data can vastly improve the responsiveness of your fires. Or it can provide battery computer system (BCS) data when digital communications is lost with 2 or more howitzers.

In the critical first moments of a fire mission, announcing only 1 set of fire commands modified by TGPCs provides quick and accurate fires.

Center-of-battery to center-of-target (COB-COT) firing data modified with TGPCs will not severely degrade our accuracy. In fact, using the BUCS or BCS to compute these corrections will produce the BCS circular sheath. As a bonus, computing TGPCs with either computer takes less than 5 minutes after operators build a data base. When you compare this time to the old manual standard of 25 minutes, you gain a new appreciation for "degraded" operations. However, there are limitations with computer assisted TGPCs which reflect the manual limitations:

- The fire unit must be in a position no larger than 200x400 meters.
- The corrections are valid 2,000 meters beyond and short of the range used in the computations.
- The azimuth limits are 400 mils left and right of the direction used in the computations (figure 1).

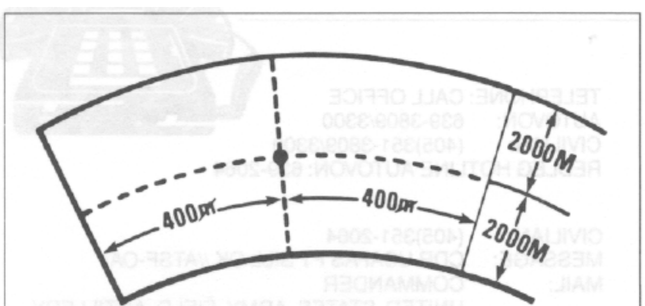


Figure 1. Transfer limits.

These limitations are not severe. A 4-gun firing platoon can achieve a lateral dispersion of more than 133 meters on a 400 meter front. When you add 200 meters of depth, you can see that the platoon retains survivability through dispersion in the 200x400 meter box.

The battery or battalion fire direction officer (FDO) selects a mean range corresponding to the center of the most likely target area. From this point, he constructs the primary TGPC sector 2,000 meters beyond and short, and 400 mils left and right. If this primary sector does not encompass your area of responsibility, the FDO computes additional sectors left, right, beyond, and short of the original.

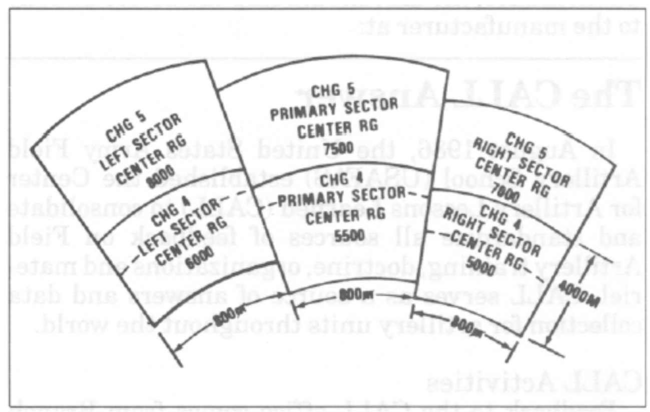


Figure 2. Three sectors/different ranges and overlapping sectors for different charges.

When you have built the data base, extract the COB grid coordinate. Establish this location as an imaginary observer (#99) and howitzer (#8 with BUCS or #12 with BCS). Now conduct a *dry* POLAR fire-for-effect mission with OBS 99 specifying the imaginary piece (#8) as the piece to fire (PTF). Specify HE/TI or improved conventional munitions (ICM) as the shell fuze combination. Which shell/fuze combination you choose depends on the situation and if you intend to fire, ICM or HE/TI primarily. You may compute data for both shell/fuze combinations, however dual corrections on the gun line could prove confusing. The direction for the dry polar mission corresponds to the azimuth of lay. The distance should be equal to the mean range to the target area discussed earlier. The firing data displayed is the BASE firing data and must be recorded.

Now, reshoot the same dry mission specifying all the pieces to fire. The computer will compare individual firing data to the base data to determine the TGPCs. The differences by piece represent the position correction for that howitzer. For example:

BASE DATA: #8 TI 20.4, DF 3206, and QE 344

	FZ CORR,	DF CORR,	EL CORR
#1 TI 20.0, DF 3220, and QE 336	–0.4,	L14,	–8
#2 TI 20.8, DF 3217, and QE 351	+0.4,	L11,	+7
#3 TI 20.4, DF 3199, and QE 344	0.0,	R 7,	0
#4 TI 20.5, DF 3187, and QE 347	+0.1,	R19,	+3

Computer derived TGPCs are better for adjust fire missions than manual corrections. The miniscule loss of accuracy may be worth the responsiveness gained when adjusting on a target.

A final point to keep in mind is that you must know when to apply the corrections to gunner's aid and correction counter. During the adjustment phase of the mission, the adjusting piece will not use the position corrections. Upon entering the fire-for-effect phase, the adjusting piece will then apply the corrections to the gunner's aid and correction counter.

When Your Velocimeter Goes Kaput

In the past few months the New Systems Division of the Weapons Department, USAFAS, received many inquiries from units concerning repair procedures for their M90 radar velocimeters.

The 3 most common problems found are:

- Antenna unit seals broken.
- Leakage from US Army supplied batteries.
- Cables with end connectors either broken or pulled off.

These problems arise from units attempting unauthorized maintenance and failing to maintain the battery in the test units. Proper attention to the battery should alleviate these problems as well as the abuse of cables.

If an M90 requires anything other than operator maintenance, the unit should ship the device directly to the manufacturer at:

DCASMA Englewood
Lear Siegler Inc.
2400 Airport Avenue
PO Box 442
Santa Monica, CA 90406-0422
ATTN: Maggie Woolsey

A DA Form 2407 must accompany each velocimeter, and the sending unit must ensure that the complete return address is on the DA Form 2407 along with the outercase serial number. Concurrent with the shipment of the M90, the unit must submit a report of shipment to:

Commander
US AMCCOM
ATTN: AMSMC-TMP-G(R)
Rock Island, IL 61299-6000

The CALL Answer

In August 1986, the United States Army Field Artillery School (USAFAS) established the Center for Artillery Lessons Learned (CALL) to consolidate and standardize all sources of feedback on Field Artillery training, doctrine, organizations and materiel. CALL serves as a source of answers and data collection for artillery units throughout the world.

CALL Activities

Feedback to the CALL office comes from Branch liaison team (BLT) visits to units in the field, the National Training Center (NTC), major exercises, and the BATTLEKING Program.

The CALL teams visit units to collect feedback on USAFAS training and training products, and to provide a forum for the exchange of information between USAFAS and artillery units worldwide.

CALL analyzes reports from major exercises such as REFORGER, divisional exercises, and the NTC to identify trends and issues that need to be addressed at USAFAS. CALL analysts review the NTC out-briefing is reviewed to determine if the artillery problems at the NTC were due to doctrine, training, force structure, or materiel malfunctions.

CATA CALL

The Combined Arms Training Activity (CATA) at Fort Leavenworth developed a lessons learned computer data base to provide solutions to combined arms problems. USAFAS CALL maintains a computer link with CATA to coordinate answers between the Field Artillery and other branches of the Army. This interface is a vital factor for the modern AirLand Battle doctrine.

The School's CALL office is a continually developing program to interface not only with other Redlegs, but also with other service schools and army units in the field. CALL will be our source of information worldwide. Units are encouraged to contact CALL any time with ideas or fire support issues the unit cannot resolve.

TELEPHONE: CALL OFFICE
AUTOVON: 639-3809/3300
CIVILIAN: (405)351-3809/3300
REDLEG HOTLINE AUTOVON: 639-2064
CIVILIAN: (405)351-2064
MESSAGE: CDR USAFAS FT SILL OK //ATSF-OA//
MAIL: COMMANDER
UNITED STATES ARMY FIELD ARTILLERY SCHOOL
ATTN: ATSF-O
FORT SILL, OK 73503
VISIT: BUILDING 1655W, SECOND FLOOR, FORT SILL, OK

Adapting the DMD

Fire support officers in aviation brigades, divisional cavalry squadrons, and attack helicopter battalions are tackling the problems of providing adequate fire support to these new maneuver organizations. One of the biggest problems faced is forwarding the observers' call for fire to the supporting artillery's tactical fire direction system (TACFIRE). Although aviation brigades are beginning to receive OH58D helicopters with the equipment to interface with TACFIRE, these aircraft are not scheduled to go to attack helicopter or cavalry units. Fire support officers assigned to these units still use the digital message device (DMD) in UH1 and OH58 helicopters.

The most field expedient method for the fire support officer is an AN/PRC-77 radio with a whip antenna and an external battery pack for the DMD. This can be a cumbersome arrangement in the limited space of a helicopter, and the FSO must also bring extra batteries for both the radio and the DMD. An alternate method would be to use the aircraft's radios and construct a power cable to tap the aircraft's power supply for the DMD.

The DMD is connected to the aircraft's radios with a cable assembly, special purpose (NSN 5995-01-1110-6945) which is available through normal supply channels. This cable is attached to the rear of an intercom system (ICS) box in the passenger compartment of the helicopter and to the DMD's radio connector.

The cable assembly, vehicular battery, SM-D-875489 (NSN 5995-01-098-2613) is also necessary. It is a component cable for the DMD.

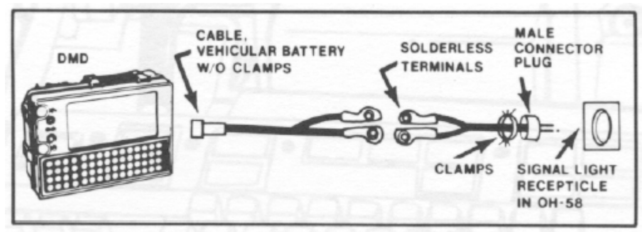
The fabrication procedure is to:

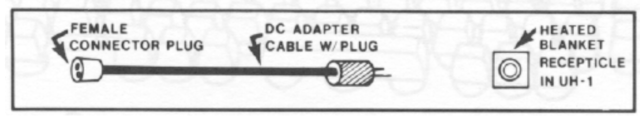
● Remove the alligator clamps from the DMD vehicular battery cable. Do not discard because you may need to reassemble it someday.

● Attach 2 feet of cable, PN A4335 to the male connector plus. Use solderless terminals on the DMD vehicular battery cable. Connect the 2 cables with self-locking nuts and use shrink tubing to insulate the connection.

● Attach the DC adapter cable to the female connector plug.

The cord described above is necessary to power the DMD from the signal light receptacle in an OH58. Both cords are connected to power the DMD from the heated blanket receptacle in a UH1.





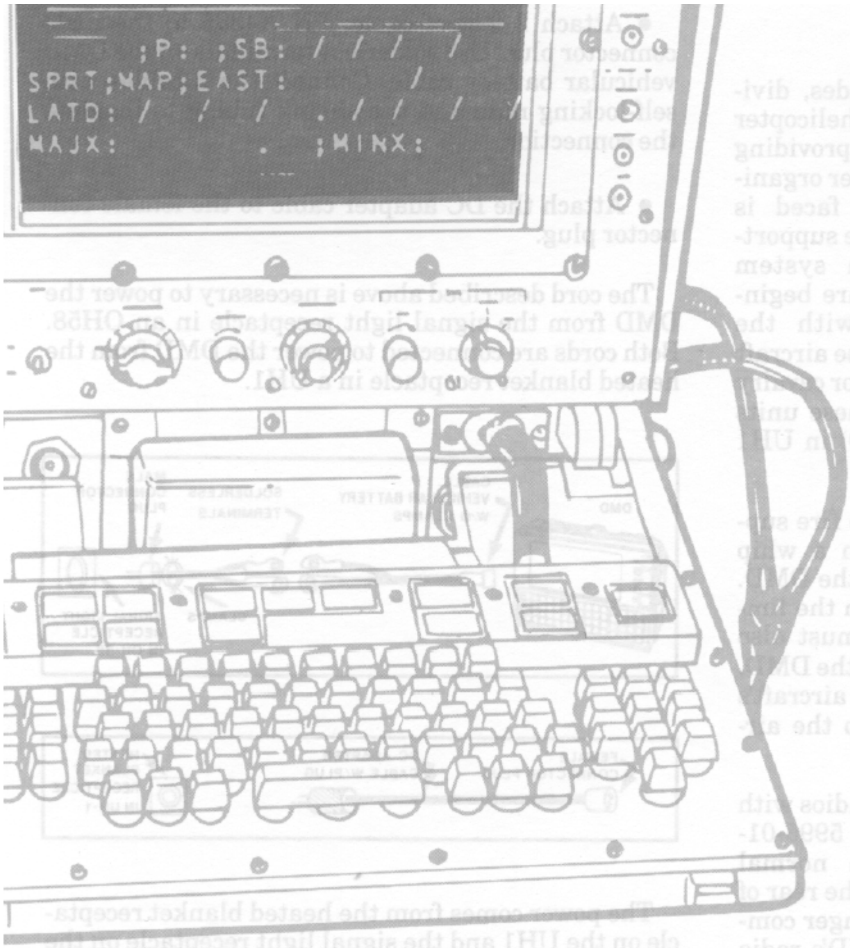
The power comes from the heated blanket receptacle on the UH1 and the signal light receptacle on the OH58. The construction materials are available through aviation supply channels. They include:

Nomenclature	NSN	Quantity
Cable, DC Adapter, B83140-5	4920-01-086-1511	1 Each
Cable, PN A4335	None	2 Feet
Plug, Connector	5935-00-199-3335	1 Each
Clamp	5935-00-688-4026	1 Each

Journal Notes

The *Journal's* editor, the newly-promoted Lieutenant Colonel Roger A. Rains, leaves Fort Sill this May to take command of the 3d Battalion, 35th Field Artillery (8″) in Wertheim, FRG. LTC Rains' editorial guidance spanned more than 2 years and gave Redlegs the best branch journal in the Army. LTC Rains successfully steered the *Journal* staff through the rough waters of office automation and the transition to a TRADOC professional bulletin. His motto—work, work, work, and more work (W^3MW)—will challenge us long after he's hip-deep in German mud. Major Charles Pope, the *Journal's* new editor, will arrive by 1 July 1987.

The *Journal* staff also says farewell to our managing editor, Mrs. Tammy Wyant. Mrs. Wyant leaves after more than 2 years of dedicated service to the magazine and to the worldwide Field Artillery Community. Although we will sorely miss her enthusiasm and her expertise, we wish her health, happiness, and success in her future pursuits.



Artillery Without Maps

by Captain Eric L. Ashworth

As modern as we Redlegs are, we could face severe problems if we tried to get fire on target without accurate maps. We may also wonder what we can do with our modern equipment if we didn't have maps.

The gunnery team can use their manual fire chart training to establish a common grid within the battery computer system (BCS). This will allow them to mass fires on a single target without using a map. But first, we have to check our assumptions. We know that the firing battery has a general direction for the enemy location. And we know that each battery can find a rough relationship from its present location to the other batteries and maneuver forces. Finally, even the lightest equipped fire support team has a compass and a means of communicating with the FDCs.

The Procedure

Select any 99,999 by 99,999 meter-scale grid and input these coordinates into the BCS as the MAPMOD. The FDC then selects any grid that falls within the BCS MAPMOD and inputs it as the adjusting piece of the battery. The FDC also chooses an observer number not currently in use and assigns him the same grid as the adjusting piece.

The FDC conducts a polar mission from the battery location using the observer just selected. Essentially, the battery is acting as its own observer. The fire direction officer (FDO) will ensure the observer's distance and direction will impact safely but within view of the maneuver forces. By placing a "false" observer in BCS with the same grid location as the howitzer adjusting the round, the FDC covers the requirement that BCS must have an observer in its database to conduct a polar mission. In turn, BCS will give a 10-place grid to the impacting round in relation to the adjusting howitzer's location.

A forward observer (FO) will report a spotting of the round in direction and distance from his location using his compass and flash-to-bang time. NOTE: the battery can assist the FO locate the round by using white phosphorus ammunition or an air burst for spotting prior to starting the procedure.

The FDC may now determine the FOs location in relation to the firing battery. By placing the grid coordinates of the impacting round into BCS as another "false" observer, BCS can now back plot the grid location of the actual FO. The FDC calculates a polar mission using the distance and a back azimuth, plus or minus 3200 mils, given by the FO's previous spotting. BCS will compute grid coordinates to the FO's location. (See figure 2)

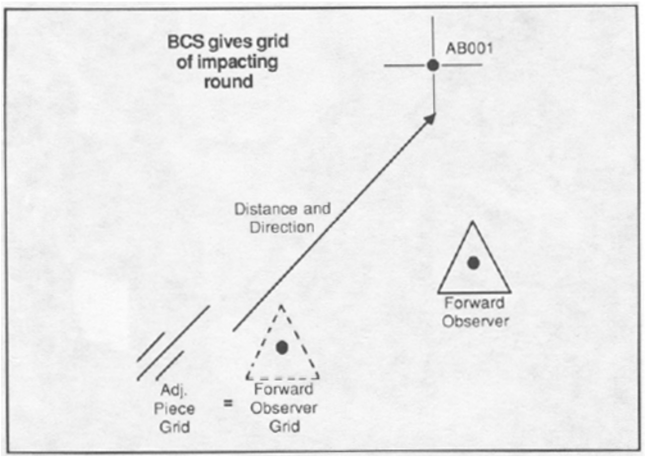


Figure 1.

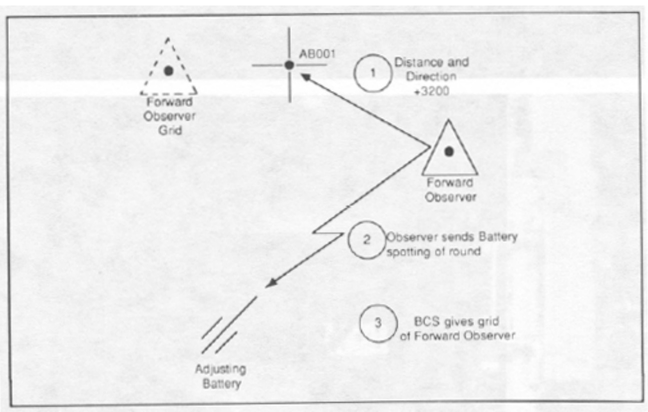


Figure 2.

Now the FDC has a grid system where the firing battery, the FO, and a target—impacting round—are positioned relative to each other.

If the FO can't see the shell crater from the impacting round, he can select a nearby prominent terrain feature or stationary target and send a correction to the FDC that will adjust the round onto the new target. The FO continues to adjust rounds until a successful precision registration is completed. The FDC and FO now have an accurate registration point from which to shift later fire missions. Subsequent spotting from the FO on the registration will give the FDC a more accurate grid coordinate of the FO's location.

Now the FO can call in artillery fires using the polar plot or shift-from-a-known-point method. However, he is only able to receive accurate fires from 1 battery. When he needs a battalion mass to defeat certain types of targets, the adjusting battery must pass along the following information to the remaining batteries:

- The rough grid location of the new battery in relation to the adjusting battery. This grid should be accurate enough to place the round close to the registration point.
- The FO's location.
- The grid location to the registration point in a "FM:OBCO" as a "false" observer.

Using the same FO and registration point, the remaining batteries should be able to conduct their own precise registrations. Using this method, you can produce accurate grids to the subsequent firing batteries in relation to the original adjusting battery. However, during the back plotting step the coordinates of the registration point remained fixed while subsequent firing batteries grid locations change. (see figure 3)

Up to this point, we assumed that the ground is level. The executive officer's high-burst mission corrects for differences in vertical interval between each battery and the target. On completion of the high-burst mission, adjustments in height are made to each corresponding battery. Note that the batteries' altitudes and not the altitude of the registration point were adjusted. Each battery may now send the updated coordinates and altitudes to the battalion FDC and allow the FO to call for massed fire missions. The FO may update his target list and other FOs may be added at this time.

When more accurate survey information is available, you can update all grid locations by taking the change in northing and easting, then correcting all other positions by the same factor. Each element is properly positioned again. You can also complete the process more efficiently using the position and azimuth determining system (PADS) and laser range finders.

Summary

The goal is to make BCS to work for us. Starting with any grid location, a battalion or higher sized artillery unit is effectively able to mass fires without the use of a map.

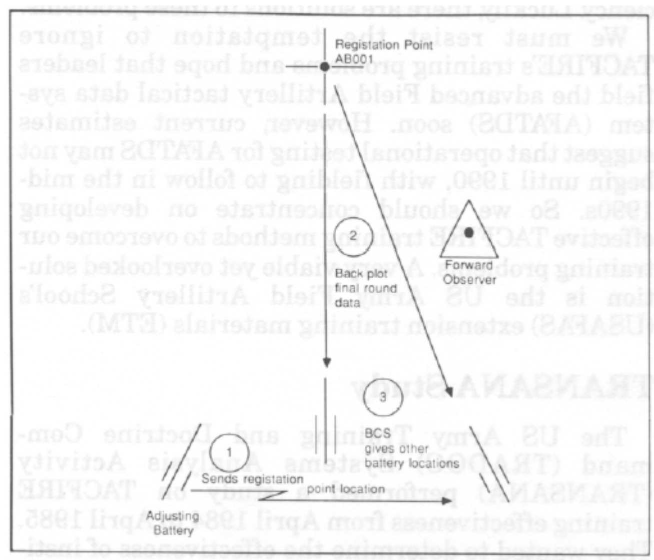


Figure 3.

Captain Eric L. Ashworth, FA, is assigned to the Officer Student Battalion, Fort Sill, Oklahoma. He received his commission from Siena College and is a graduate of the Field Artillery Officer Basic Course, TACFIRE Long Course, and the Ranger and Airborne Schools. Captain Ashworth has served as a battalion fire direction officer, battalion motor officer, battery fire direction officer, and AST chief within the 3d Battalion, 3d Field Artillery, 2d Armor Division, Fort Hood, Texas,

TACFIRE Training Problems

by Captain Jeffrey K. Longar

The automation offensive sweeping the Field Artillery doesn't please all of the Redlegs all of the time. In fact, the artilleryman's reluctant acceptance of the tactical fire direction system (TACFIRE) is similar to the cool reception cavalrymen gave to the first tanks in World War I. The current system gives us numerous reasons to hesitate: its hardware is big, prone to breakdown, and requires substantial resources to keep it operational; and while the software is fairly limited for today's standards, it's still difficult to use properly. Even battalion- and brigade-level commanders have difficulty understanding the programs. And a bigger problem is the significant training that it requires to maintain operator proficiency. Luckily, there are solutions to these problems.

We must resist the temptation to ignore TACFIRE's training problems and hope that leaders field the advanced Field Artillery tactical data system (AFATDS) soon. However, current estimates suggest that operational testing for AFATDS may not begin until 1990, with fielding to follow in the mid-1990s. So we should concentrate on developing effective TACFIRE training methods to overcome our training problems. A very viable yet overlooked solution is the US Army Field Artillery School's (USAFAS) extension training materials (ETM).

TRANSANA Study

The US Army Training and Doctrine Command (TRADOC) Systems Analysis Activity (TRANSANA) performed a study on TACFIRE training effectiveness from April 1984 to April 1985. They wanted to determine the effectiveness of institutional and unit training for operators and maintenance personnel on TACFIRE and the variable format message entry device (VFMED). The study tested 93 personnel in USAFAS classes, 192 unit-level personnel in 5 brigade-sized units, and it interviewed 33 commanders and S3s. It gathered information by survey questions and hands-on and written tests. The personnel sample consisted of both continental US (CONUS) and outside of the continental US, (OCONUS) soldiers.

The results of the study gave insight to the TACFIRE training issue. The data indicates that all USAFAS TACFIRE system classes—both computer and VFMED—are effective programs and that all students have very favorable impressions of their school training. While institutional TACFIRE training appears to prepare soldiers here, training at the unit apparently does not sustain TACFIRE technical expertise—particularly with respect to VFMED operators. The report concludes that if a soldier is school-trained on the equipment and receives frequent training either in garrison or during field training exercises (FTX), he will be proficient on the VFMED or TACFIRE computer. The key question facing the Field Artillery Community is how to develop effective unit training on TACFIRE.

Another finding from the study impacts directly on the unit training issue. The study finds that neither CONUS nor OCONUS units are not using the School's TEMs. In fact, only a few of the units sampled use this significant asset regularly. In a recent sample of 12 TACFIRE operators (MOS 13C) most had some knowledge of ETS. However, in the same discussion most of the NCOs expressed mistaken impressions of the role the equipment can play in an effective unit training program. Trainers and training managers must understand what ETM materials are and know how to use them effectively.

Extension Training Materials

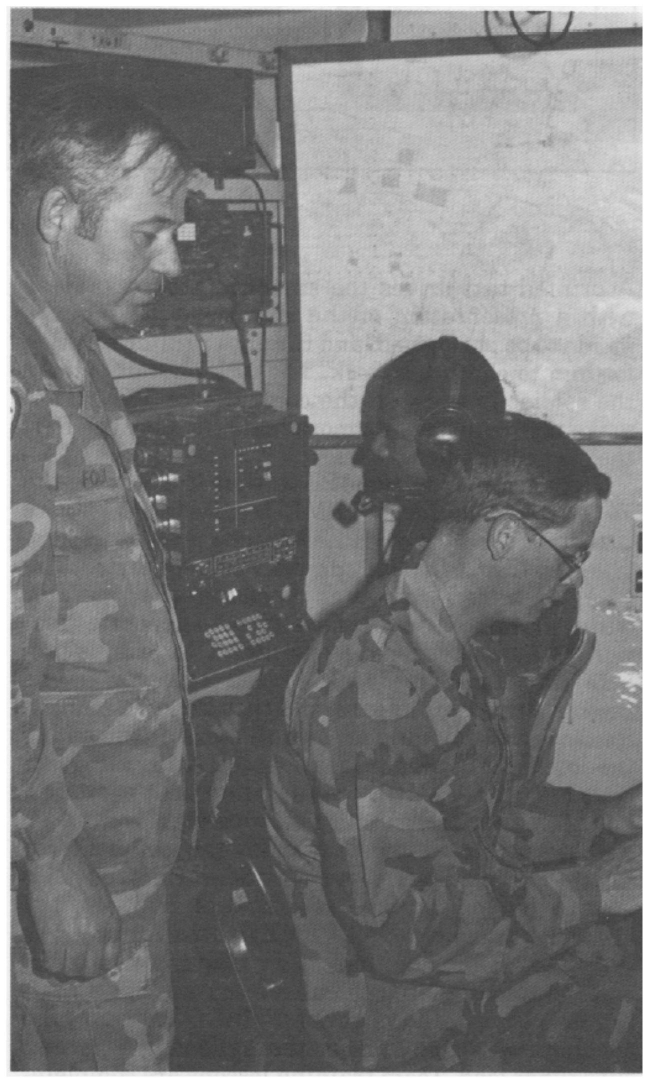
The *TACFIRE Training Manager's Guide* can implement ETMs as a part of an overall TACFIRE training program. The guide breaks down TACFIRE training into 3 phases. Phase I is individualized training and can reinforce the School's classes. Phase II is subsystem team training that teaches both computer and VFMED operating skills as those devices communicate together. Phase III is complete system training and it involves all digital Field Artillery equipment used on ARTEP tasks and command post exercises (CPX). ETM media enhance the first 2 phases of TACFIRE training.

Two personnel are key to implement TACFIRE training in a unit—the training manager and the on-site supervisor. The training manager typically is a battalion training NCO and he will be the primary coordinator between the soldier and the program. He assigns soldiers to particular training paths, maintains records, certifies training block mastery, and monitors the soldier's progress. As an administrator, he doesn't need to be TACFIRE trained. The on-site supervisor who actually administers the training is the technical expert on location. He answers questions, resolves difficulties, provides amplification on technical matters, and acts as a test monitor.

ETM materials modules span the entire spectrum of TACFIRE technical knowledge. They can train soldiers in as many as 35 different TACFIRE duty positions. Module teaching subjects begin with an introduction to the subject area and they end with a comprehensive test to evaluate the soldier's level of expertise in that area. Module booklets are self-contained and furnish all the printed information needed to complete the module.

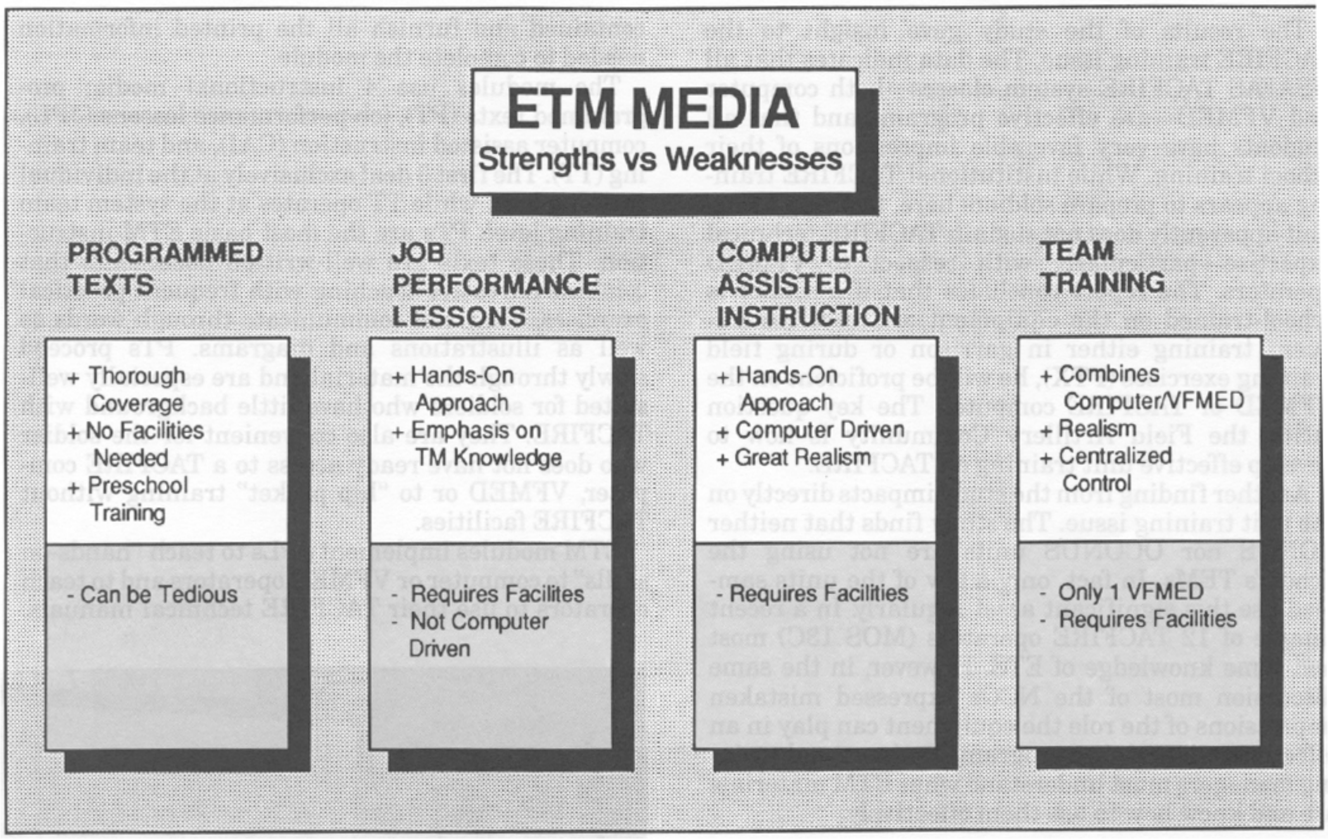
The modules use 4 instructional media: programmed texts (PT), job performance lessons (JPL), computer assisted instruction (CAI), and team training (TT). The first 3 deal exclusively at the individual training level while TT operates at the system team training level. PTs are the most basic ETM instruction. These texts are well-written documents that combine narrative teaching with frequent practical exercises. They can communicate through words as well as illustrations and diagrams. PTs proceed slowly through the material and are especially well-suited for soldiers who have little background with TACFIRE. They are also convenient for the soldier who does not have ready access to a TACFIRE computer, VFMED or to "hip pocket" training without TACFIRE facilities.

ETM modules implement JPLs to teach "hands-on skills" to computer or VFMED operators and to teach operators to use their TACFIRE technical manuals.



Jill Ponto

ETM team training scenarios integrate computer and VFMED training into joint exercises, and each device communicates with the other.



A printed text drives the student's progress, along with a presentation of the situation, the requirements to be performed, and finally a printed solution for him to check his work. The JPL actually allows the soldier to work on the computer or VFMED to make the requirements more realistic. Like the PTs, they are methodical.

CAI is similar to the JPL in that it also uses the TACFIRE computer or VFMED. However, it is more realistic than PTs or JPLs because a software program called PLANIT drives the scenario. The PLANIT-loaded computer presents the operator with a graduated series of exercises to generate "real world" challenges for the operator. CAI lessons provide immediate feedback to the operator as he responds to requirements, and they give the student feedback by providing an overall score at the end of the lesson. ETM team training scenarios integrate computer and VFMED training into joint exercises, and each device communicates with the other.

TT scenarios tie together many critical technical tasks. The modules cover a wide variety of operator skills that involve coordination between the TACFIRE computer and VFMED. Team training is easier to administer than other training media because it allows more centralized control; but a limitation is that it allows only 1 VFMED to run on the computer at a time, rather than allowing a normal subscriber load. Team training lessons are completely computer driven and require the use of PLANIT tapes.

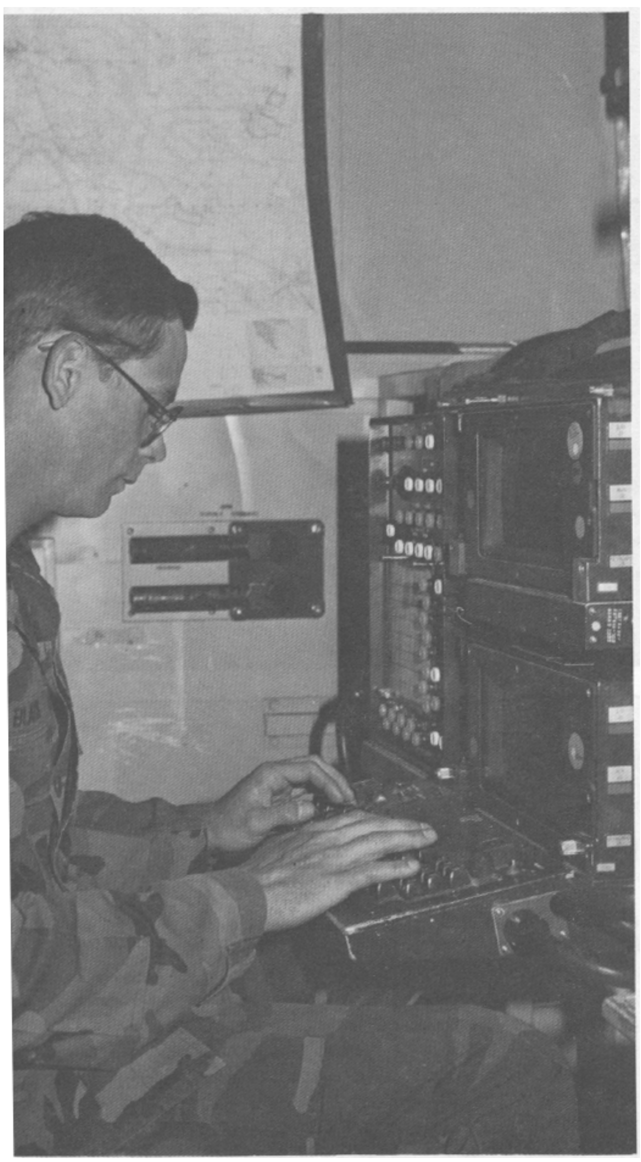
Implementing an ETM Program

ETM products are useful training tools but they require careful implementation to maximize their effectiveness. Each training media has its own capabilities and limitations that must be understood before trainers can develop a productive TACFIRE training program. These strengths and weaknesses are summarized in figure 1. The programmed text lessons are very thorough in their coverage of a subject and are especially useful in training soldiers who have not attended formal TACFIRE schooling. This is an important consideration to a training manager because only soldiers in grade E5 and up are eligible to attend the new basic technical course for TACFIRE computer operators. The fire support element and liaison course and the TACFIRE tactical operation center course for VFMED operators have similar restrictions for soldiers E4 and above.

In addition to training soldiers who can't return to Fort Sill for refresher training, PTs are also useful for trained computer and VFMED operators who do not have access to TACFIRE equipment. PTs are less useful because their detailed approach can become tedious to a trained operator. For this reason, a well trained soldier should not go through every module. A better approach might be to tailor the training for specific weaknesses of individual operators. A training manager can give "challenge" tests to his trained TACFIRE operators to spot weak areas in their technical knowledge. All ETM modules have end-of-module tests and these perform very well as challenge tests.

Job performance lessons and computer-assisted instruction are similar training tools and are used similarly. Both emphasize hands-on training with the computer or VFMED. While they require access to TACFIRE equipment, both make individual technical instruction much more stimulating and lifelike. This realism makes JPLs and CAIs suitable for training both unschooled operators and experienced TACFIRE users who want to brush up on certain areas.

Team training scenarios offer a training possibility for computer and VFMED operators simultaneously because they require both devices to work together as they do in real life. A common criticism of TT modules is that they do not incorporate the battery computer system (BCS) and the digital message device (DMD) into training exercises. This is a valid concern, but by the end of this year all BCS equipped units should receive the interface training simulator (ITS) for BCS and gun display unit (GDU) training. There will be 1 per BCS and it provides realistic hands-on training for BCS users. ITS creates situations and generates message traffic similar to the way JPL and TT lessons drive TACFIRE training. The ITS also has training scenarios for Lance and multiple launch rocket system (MLRS) fire direction system (FDS) training. Thus, a unit will soon be able to train its TACFIRE operators with TT modules while its BCS operators conduct training with the ITS.


Jill Ponto

Both job performance lessons and computer-assisted instruction emphasize hands-on training with the computer or VFMED.

There are other considerations for implementing ETM in a unit training program. Trainers should realize that ETM's emphasis is on the development of individual and TACFIRE subsystem skills. It is not intended to replace FTXs or CPXs that train a unit's gunnery system as a whole. ETM modules are also limited because they only have one scenario to train with. Although these lessons are lengthy, a soldier may exhaust the learning value from a module by becoming too familiar with it. There is also some concern over the version changes of TACFIRE software and whether ETM modules will be up to date. Fortunately, the Army sends updated ETM materials to units at the same time that they field the new software versions. In the case of the recent version 7 fielding, the units received their updated ETM materials by May 1986. It is also noteworthy that units found only 3 of the 397 PLANIT tapes defective.

Conclusion

The TACFIRE computer system has some software shortcomings as a tactical fire control system. While most of these problems cannot be controlled by Field Artillerymen in the field, units can attack the real problem of unit training. ETMs can't solve the problem entirely but they represent a significant asset available to commanders that enables them to counter this deficiency. The TRANSANA report sternly recommends that units emphasize the use of ETMs for unit training. In the future, trainers can expect even better ETM products. Future developments may include scenarios that pertain to specific geographic areas in the Federal Republic of Germany and Korea. But even before you see these developments, you should incorporate ETMs training tools to your unit's training program. Use them!

Captain Jeffrey K. Longar, FA, is a counterfire officer/brigade fire direction officer in the 42d Field Artillery Brigade, Geissen, FRG. He is a graduate of the United States Military Academy and served in the 2d Battalion, 36th Field Artillery and as a TACFIRE instructor in the Gunnery Department, USAFAS.

Soviet Heat Seekers

by Captain George Norris, USAR

The US Army Field Artillery School maintains a continuing interest in the ability of Field Artillery batteries to survive on a future battlefield—the great hide, harden, hustle triad. At the same time that we determined our need to perform target value analysis (TVA) and identify and engage high priority target, we may think that the Soviets simply will try to kill everything. It is the ultimate folly to assume that a potential adversary is less likely to reach the same logical conclusions that we reach. The Soviets will undoubtedly also seek to identify and engage our high value targets.

In almost every battlefield situation, the first priority for the Soviet commander will be the enemy's nuclear delivery systems. With the exception of the 105-mm howitzer and multiple launch rocket system (MLRS), that targeting includes almost all of the US Field Artillery. Do the Soviets have the capability to destroy all of our artillery if we do not apply some kind of survivability techniques? YES. Will they do that? Probably not. Just as we cannot devote all our time to any single mission, the Soviet Field Artillery must also perform several battlefield tasks, and

The Mi-2 and Mi-8 helicopters comprise two-thirds of those assigned to the helicopter squadron of some Soviet divisions.

counterfire is only one of them. Because nuclear delivery systems are priority targets and the bulk of our artillery is nuclear capable, that seems to indicate that Soviets can eliminate our artillery by attacking the fire direction center (FDC). This may be even easier as units convert to the tactical fire direction system (TACFIRE). The only problem would be determining the location of the central TACFIRE computer.

To that end, the Soviets continue to emphasize that target acquisition, although an artillery responsibility, must have other assistance. Ground-level reconnaissance doesn't allow the artillery to see the battlefield. Aerial reconnaissance must fill that need. Evidence indicates that the Soviets fielded an aerial system with direct Field Artillery applications.

The Soviet Forestry Service employs an airborne thermal imaging system called the TAIGA. Named after the expansive forests of the Soviet Union, the system allows Soviet soldiers to look through the smoke of a forest fire to find the "hot spots" of body heat that give away enemy positions. The imager is mounted in a variety of fixed and rotary wing aircraft. Reports show it operating on the Mi-2 and the Mi-8 helicopters, which comprise two-thirds of the helicopters assigned to the helicopter squadron of some Soviet divisions.

The Forestry Service reportedly employs the TAIGA at 300 to 600 meters. This gives the imagers a 120-degree field of view, or a path about 2 kilometers wide. Although Soviet forces may not be able to use the imager itself for direct targeting, it is an acceptable method of refining other data or of confirming other targeting assets. This is significant when you combine it with other assets.

Touted as joint developments by several countries, the East Germans exhibited one such system. At the Leipzig Spring Fair in 1980, they advertised a digital image processing system. Tied to several 16-bit microcomputers, it is compatible with other plotters. By incorporating the TAIGA and a digital image processing system in a single aircraft, a Soviet aerial observer would have the capability to receive data on probable targets, fly to the site, sense a heat source, and combine that with the data in the computer. The computer develops a direct target location and feeds that to the Chief of Missile Troops and Artillery and the target is then engaged. This system would solve several stated needs for the Soviets:

- First, it would provide the kind of timely data necessary for the support of combat.
- Second, it adds a method of verifying possible false reports from other sensors.
- Third, it ranges far enough on the battlefield to be useful to any commander who owned aircraft and artillery.

After howitzers, the battalion FDC with its TACFIRE computer would be a secondary Soviet target. Although the computer shelter itself may not be vulnerable, the computer power station forms a unique target array with its particular generator.

In February 1985, Admiral Bobby Inman, the former head of the National Security Agency, addressed the banquet of the annual C3CM Symposium. He stated that the leaders in the US have to harness emerging technologies for intelligence. It appears that the Soviets are doing just that. They have the capability to identify critical targets within our force structure, assets to allocate for their detection, and the firepower to apply against them. While we banter about discussions on how to improve the survivability of our howitzers we need to remember that every Field Artillery element is essential for our mission on the battlefield. The future belongs to the Field Artillery—but only if we are able to fight. More importantly, if we can ensure the survival of all portions of the Field Artillery family.

George T. Norris, USAR, was a threat and military intelligence instructor in the Tactics and Combined Arms Department at the US Army Field Artillery School when he wrote this. He is now a civilian analyst in the artillery branch of the US Army Foreign Sciences and Technology Center in Charlottesville, Virginia.

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