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WILL THE "KING OF BATTLE" REIGN ON THE FUTURE HIGH INTENSITY BATTLEFIELD?

A Monograph

by

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artillery ammunition

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The paper concludes with three main points. First, both the U.S. and the Soviets have a formidable artillery force with which both sides will attempt to win a large scale artillery-on-artillery duel. Second, the Soviets are attempting toestablish a quantitative advantage and technological parity with U.S. artillery. Finally, U.S. artillery is qualitatively and technologically sufficient. However, to accomplish its multitude of missions, it is quantitatively deficient.

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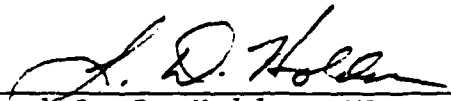

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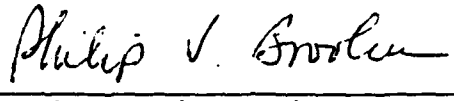

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ABSTRACT

WILL THE "KING OF BATTLE" REIGN ON THE FUTURE HIGH INTENSITY BATTLEFIELD? by Major H. L. Ware, III, USA, 56 pages.

This paper analyzes the U.S. Army's field artillery fire support system's ability to deliver devastating and timely fires on the high intensity European battlefield of the 1990s. In an era of budget cuts and manpower constraints, the artillery has counted on strong innovative leadership, quality soldiers, sound training and flexible doctrine, and creative advanced technology to give the U.S. the edge over the Soviets. Meanwhile, the Soviets have modernized and restructured their artillery force. This paper shows that current artillery force structure is inadequate for the high intensity battlefield.

A variation of the Combat Power Model is used to conduct a comparative analysis of U.S. and Soviet artillery systems. Following a brief discussion of artillery doctrine, U.S. and Soviet artillery delivery systems; command, control, and communications (C^3); sustainment and support; and target acquisition capabilities are evaluated.

This comparison shows that U.S. and Soviet delivery systems are qualitatively quite similar. The U.S.'s only significant advantage is in the area of "smart" munitions. The Soviets have a tremendous advantage in cannon, multiple rocket launcher, and missile quantity. American C^3 and target acquisition systems are automated and use modern technology; these same Soviet systems do not. However, that does not necessarily mean the Soviet systems are deficient. Sustainment problems possibly exist in both countries' artilleries.

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INTRODUCTION

World War I with the advent of telephones, big guns, massive artillery preparations, and rolling artillery barrages ushered in a new era for the field artillery. A sharp upward curve in the destructiveness of improved artillery accounted for the fact that artillery inflicted 55 percent of the casualties of World War I. [1] Smokeless powder, rifling, and breech-loading in conjunction with recoil-absorbing, non-recoil carriages resulted in highly accurate, long-range, quick firing artillery pieces. Explosive improvements enhanced artillery shell fragmentation. For example, during World War I, a three inch, high explosive shell delivered 1000 fragments compared to 20-30 fragments per shell during the Franco-Prussian War and 2-5 fragments per shell during the American Civil War. [2] The field telephone played a significant role in the control of artillery fires in that forward observers could watch artillery effects on the target without the need for being in view of the gun line. The guns could shoot indirect fires, the observer could make adjustments, and instantly relay those corrections to the guns. The telephone also improved artillery command and control by enabling the use of massed artillery fires and rolling barrages, thus integrating fire and maneuver. These technological innovations in conjunction with the psychological impact of intense artillery bombardments made artillery more predominant than in any period of history. [3]

The "king of battle's" dominant position as the greatest killer on the battlefield was reconfirmed during World War II. American

artillery specialized in time-on-target concentrations of numerous batteries and battalions. As a result, artillery accounted for more that half the casualties of World War II battles and was considered a major strength of the American army. [4] At Leyte alone, artillery and mortars accounted for 85 percent of the Japanese 1st Division's losses. [5] In addition to the physical destructiveness of the artillery, it also had a strong psychological impact on those soldiers subjected to it. One author said, "No matter how long a man is exposed to shellfire, he never develops an immunity to the fear of it." [6] A study of more than 700 U.S. Army enlisted men wounded in North Africa shows that 48 percent believed artillery to be the most frightening German weapon, while 62 percent perceived it to be the most dangerous. In second place, 20 percent perceived the German dive bomber to be most frightening, and 17 percent thought that mortars were the most dangerous. [7] In World War II the U.S. artillery was known for efficient, flexible use of massed fire. General George S. Patton's well-known testimonial was appropriate: "I don't have to tell you who won the war. You know. The Artillery did." [8]

On the eastern front of World War II, the Soviets relied heavily on artillery and its devastating effects. During the war, Soviet artillery strength increased to a level of approximately 335,000 guns, howitzers, and heavy mortars; over 10,000 truck mounted rocket launchers; and between twelve to fourteen million rockets. [9] To use the Vistula-Oder operation of January 1945 as an example, the Soviets employed 7,600 guns and mortars in a two

hour, thirty-five minute preparation along a 33 kilometer breakthrough frontage. A total of 33,500 pieces was involved in the operation equalling an artillery density of 223 guns and 30 rocket launchers per kilometer. [10] Obviously, it was effective:

> "German officers who experienced the Soviet bombardments agree that they were devastating. Anti-tank weapons were soon shot to pieces, however well sited or dug in, and reserves 'were battered to pulp.'" [11]

Battle analysis indicates that Soviet artillery inflicted approximately 70 percent of the personnel and material losses experienced by the German Army on the Eastern Front, while 51 percent of the casualties sustained by the Soviets during the war were caused by artillery fire. [12] Traditionally, the artillery has been dominant in the Soviet Army.

Over forty years ago, the Soviets and U.S. learned the value of artillery support. Are those lessons still relevant today? In October 1973 Israeli forces on the Golan Heights faced Syrian forces supported by no less than 140 batteries of artillery. [13] The Syrians located Israeli positions one by one and shelled the Israelis off them. On 6 October 1973 the Israelis suffered most of their casualties as a result of artillery fire. Equally important, Israeli tank commanders were faced with the dilemma of fighting buttoned up or opening their tank hatches "to face death in the swirl of fragments and blast." [14] In his book, On Infantry, John English refers to effects of artillery when fired in accordance with modern Soviet norms:

> "In 1976, the German Infantry School at Hammelburg fired artillery and mortars, with the intensity

> prescribed by Soviet doctrine, on various field positions in which infantrymen were represented by dummies. Results of the test showed that infantry, prone in the open, would suffer 100% casualties. Men in trenches without overhead protection could expect 30% casualties, while those dug in with overhead protection would encounter 10% casualties." [15]

Among his list of lessons learned thus far in the Iran-Iraq War, Chris Bellamy stresses the "continued importance of massed artillery fire, [and] the ability of SSMs to substitute for expensive manned aircraft. [16] Thus, if one accepts these examples as evidence that the artillery will have a major role on the future European battlefield, how do we stack up against our most potent adversary--the Soviets?

This paper analyzes the U.S. Army's field artillery fire support system's ability to deliver adequate and timely fires on the high intensity, European battlefield of the 1990s. In the past, we've counted on our strong innovative leadership, quality soldiers, sound training and flexible doctrine, creative and advanced technology, and quality delivery systems to give us the edge over the Soviets. [17] While we have made significant progress with systems like the M109 Howitzer Improvement Program, Multiple Launch Rocket System, Army Tactical Missile System, Tactical Fire Direction System, Advanced Field Artillery Tactical Data System, and a host of support systems, have we done enough? Have our manpower constraints, budget, doctrine, modern combat experiences, parochialism, and "can do" attitude led us to a complex fire support system that just won't work? This paper attempts to answer these critical questions.

METHODOLOGY

As a guide to my analysis of the artillery system, I used a variation of the Combat Power Model designed by COL Huba Wass de Czege, [18] one of the authors of FM 100-5. COL Wass de Czege's model is presented in its very basic form in Appendix A. My adaptation of his model is presented in Appendix B. Superficially, there may not appear to be much similarity between my adaptation and COL Wass de Czege's Combat Power Model. This lack of similarity, however, is only noticeable at the first level of abstraction. At the first level, COL Wass de Czege deals with the effects of firepower, maneuver, protection, and leadership of a combat force in relation to an opposing combat force. On the other hand, at the first level of abstraction, I am concerned with how each artillery sub-system (delivery; command, control, and communications [C^3]; sustainment; support; and human factors) relates to the sub-systems of an opposing system. At the second and third levels of abstraction, one finds many of the same variables identified by COL Wass de Czege.

While a detailed analysis of the artillery system requires a thorough evaluation of all the sub-systems addressed above, in this monograph I focus heavily on the delivery sub-system, and although I will look at C^3, sustainment, and support, I will do so in less detail. I have not analyzed the human element at all due to its extremely subjective nature. For the purpose of the monograph, I have assumed that the soldiers of both armies will respond in

combat in the manner in which they have been trained with a high degree of proficiency.

DOCTRINE

Before continuing further, it is necessary to look briefly at doctrine and how artillery fire support fits into the AirLand battle. FM 100-5 states:

> "firepower provides the destructive force essential to defeating the enemy's ability and will to fight... maneuver and firepower are inseparable and complementary elements of combat...the principal fire support element in fire and maneuver is the field artillery." [19]

The mission of the field artillery as stated in FM 6-20 is to... "destroy, neutralize, or suppress the enemy by cannon, rocket, and missile fire and to help integrate all fire support assets into combine arms operations." [20] Signal to our concept of artillery fires is that the effects of artillery fires are planned to support the combined arms operation and maneuver. Combat power is generated through a skillful integration of firepower, maneuver, leadership, and protection. One element is not normally viewed as the dominant component.

In contrast to our use of artillery, the Soviets view "fires" as the decisive factor in achieving victory over the enemy. Artillery and rocket forces are expected to deliver 80 percent of the ground force firepower. [21] The Soviets do not refer to 'fire support,' they refer to 'fire destruction.' The difference between the two terms represents a significant difference between the East and West. [22]

> "According to the Warsaw Pact military art, artillery is the most decisive element in modern combat. Concentrated firepower is the principle method of achieving the desired force ratio over a defending enemy on the battlefield." [23]

In keeping with the primacy of artillery in the Soviet system, they have developed a massive artillery organization consisting of organic artillery at the regimental level, divisional artillery, artillery groups and brigades, and an artillery division. Additionally, the return to a nonnuclear, battlefield with its anticipated heavy attrition, demand for reinforcements, and need for reserves brought back an interest in heavy artillery. [24] As a result Soviet artillery has undergone significant quality and quantity changes over the past twenty years.

In essence it helps to view the Soviets as possessing two artillery forces. One which is decentralized at the regimental level, and another which is centralized at the disposal of the formation commander at division level and higher. The decentralized artillery is based on the organic regimental artillery. It is the maneuver unit's close support and often direct fire force. [25] This regimental artillery is often augmented from higher echelons, thus the regimental commander has considerable firepower available to him in his regimental artillery group. The second force, the centralized one, is composed of divisional, army, and front artillery assets. At the operational and higher tactical levels these powerful groupings of artillery forces are deployed and employed as part of a master plan. [26]

DELIVERY SYSTEMS

With 2,440 weapons fielded, [27] the M109A2/A3 is the the work horse of the U.S. Army's direct support artillery. It is a 155mm, self-propelled howitzer that fires a wide variety of munitions. Its maximum range is 18,100m at maximum charge; it reaches 23,500m when firing a rocket assisted projectile. The M109A2/A3 is fully tracked, aluminum armored, and air transportable. It possesses excellent ground mobility and all-weather operational capability. [28] It is linked to the TACFIRE System in that it has gun display units which show firing data inside the turret when the information is sent from the fire direction center. Introduced in 1963, variants of the M109 will continue to serve the U.S. Army into the 21st century.

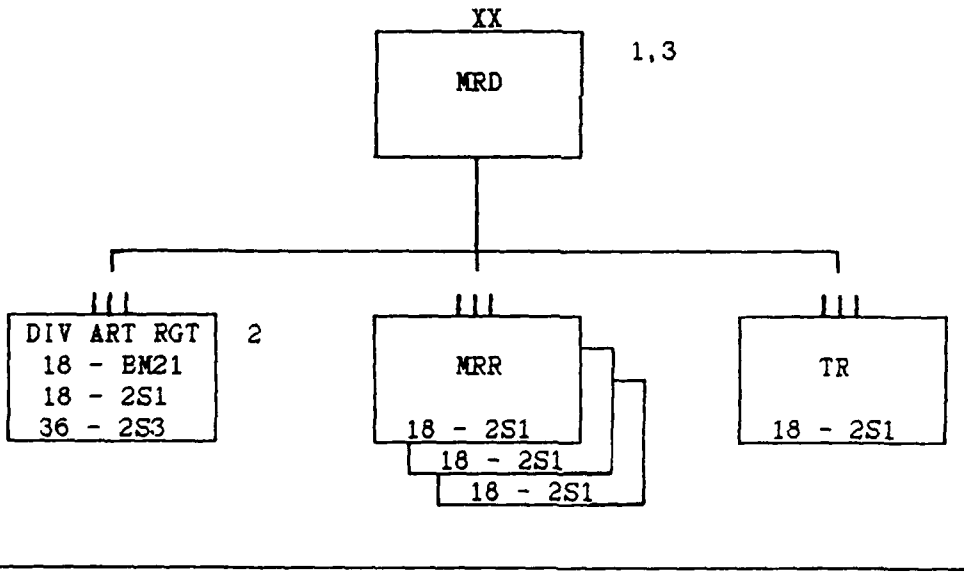
By the year 2000 the M109 will have basically the same profile, but inside it will be a completely revised weapon system. The M109-HIP will have an improved range depending on the cannon. One cannon, the same one that's on the M198 Towed Howitzer, will reach 30km firing rocket assisted projectiles. A new, "long tube" cannon will reach 40km when firing rocket assisted projectiles. [29] Other changes will include crew reductions, increased ammunition storage and improved survivability. Survivability improvements include an on-board navigation system and ballistic computer; NBC filtration system; Kevlar lined turret, roof and sides; and new generation radios. These modifications will allow a one kilometer or more displacement between guns, and enable each howitzer to function semi-independently. The Army of Excellence (AOE)

organization calls for a battalion to field 24 howitzers (3X8). [30] However, until the M109-HIP is fielded, the capabilities of U.S. and Soviet howitzers appear to be very similar.

The M109A2/A3's counterparts at the Soviet regimental and divisional level are the 122mm and 152mm self-propelled howitzers. Introduced in the early 1970's the 2S1 (122mm) and the 2S3 (152mm) self-propelled howitzers fulfilled the Soviets' perceived need for highly mobile artillery to function in close proximity of forward units. The 2S1 fires a variety of munitions out to a maximum range of 15.3km, while it can fire its rocket assisted projectile 21.9km. The howitzer is fully tracked, lightly armored, amphibious, and fitted with an NBC overpressure and filtration system. [31] Closely resembling the M109, the 2S3 fires a variety of munitions very similar to the U.S.'s 155mm howitzer. The 2S3 is lightly armored and fully tracked. It is not amphibious, nor does it have an NBC overpressure system. It does have a power loading system. Ammunition is fed through two small ports at the rear of the howitzer onto a semi-automated conveyor-belt loading system. [32] The 2S3 fires traditional munitions a maximum range of 18.5km. It also fires an extended range high explosive projectile (24.8km) and a rocket assisted projectile (37km). [33] The table in Appendix C shows that the capabilities of U.S. and Soviet howitzers are about equal.

While the M109A3 is a good weapon, we will be forced to depend on the technological improvements of the M109-HIP to overcome the superior numbers of artillery organic to the Soviet division.

Figure 1 shows the organization and quantity of artillery organic to a Soviet motorized rifle division. Totals for the division are ninety 122mm howitzers, thirty-six 152mm howitzers, eighteen BM-21 multiple rocket launchers, and four SS-21 surface to surface missiles. The tank division is equipped the same minus one battalion of 2S1s or D-30s (eighteen 122mm howitzers), and the T-12 anti-tank battalion. In a purely quantitative comparison, a U.S. mechanized division has 72 howitzers and nine multiple rocket launchers, while a Soviet motorized division has 126 howitzers, eighteen multiple rocket launchers, and four surface-to-surface missiles.



Note 1: Figure does not include the division's SS-21 battalion.
Note 2: MRD also has a T-12 anti-tank battalion in the artillery regiment.
Note 3: Most divisions have converted from D-30s to 2S1s, however, some units still have D-30s.

Figure 1. Soviet Motorized Rifle Division's Artillery
Source: Bellamy, Chris. Red God of War.

Under the AOE configuration field artillery brigades from the corps artillery would boost the firepower of the division. Figure 2 shows the structure of a typical AOE corps artillery supporting three divisions. Each supported division would be allocated a cannon brigade from corps. [34] This additional brigade would boost the division's total cannon artillery support to 144 howitzers. However, U.S. corps artillery cannot begin quantitatively to match the howitzers, guns, large caliber mortars, multiple rocket launchers, and surface-to-surface missiles found at the Soviet army and front level.

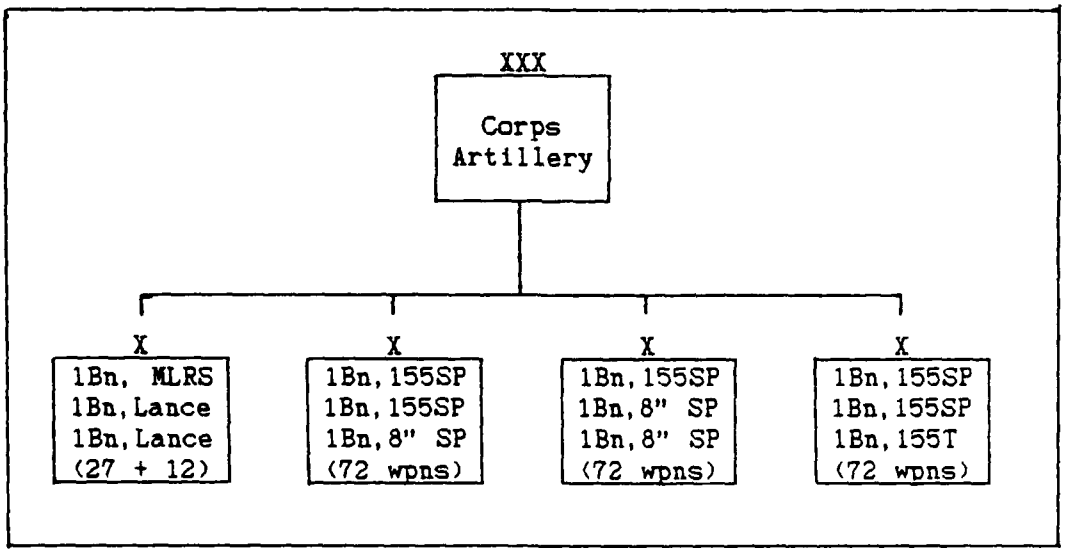


Figure 2. Typical Army of Excellence Corps Artillery
Source: Riley, Robert S., "AOE - What Is It?," Field Artillery Journal, Sep-Oct 85, p. 49.

To offset some of the quantitative difference between U.S. and Soviet artillery, division and corps commander's have the newest, most devastating, non-nuclear, field artillery system in the U.S. arsenal--the Multiple Launch Rocket System (MLRS). This system can send a dozen 227mm, 13-foot rockets down range after a priority

target in less than a minute, or rockets can be fired individually against 12 different targets. Currently, the MLRS warhead carries 644 dual-purpose improved conventional munitions capable of penetrating 2.5-4.0 inches of armor plate and an anti-personnel kill radius of three meters. Scatterable mines, anti-armor terminally guided warheads, sense and destroy armor munitions, and binary chemical warheads are in various stages of development. [35] Identified as a high priority Soviet target, MLRS was designed for survival on the battlefield. Utilizing "shoot and scoot" tactics, MLRS launchers routinely operate independently:

> "Using an on-board fire control system, each launcher crew has the ability to receive a digital fire mission while positioned in a hide area, move to a launch area, compute the technical firing data, orient on the target, fire its 12 rockets, and leave the launch area -- all within 3 minutes." [36]

Under the AOE table of organization, the nine launcher, MLRS battery replaces the 8-inch battalion at the division level. At corps, one artillery brigade will receive a MLRS battalion with 27 launchers. With a range of just over 30 kilometers, the MLRS provides a tremendous boost to field artillery firepower.

However, in the realm of rocket artillery, we remain the students, while the Soviets are the teachers. As shown earlier, the Soviets deployed massive numbers of rocket launchers during the "Great Patriotic War" and their love for them has never diminished. Introduced in 1964 the BM-21, a 40 barrelled, 122mm, truck mounted rocket launcher is the most widely employed rocket launcher in the world. With service in 30 countries, it remains the mainstay of the Soviet Army's rocket launcher force. [37] A battalion of BM-21s is

normally found in the tank and motorized rifle division's Artillery regiment. [38] At army and front, the new BM-27 boosts sixteen 220mm tubes with a range of 35-40km. Normally organized into brigades, a BM-27 brigade at army level could have 54 launchers (one truck with 16 tubes), while front level brigades may have up to 72 launchers. [39] While the MLRS may be technologically more sophisticated, once again, the Soviets have quantity.

Until the fielding of the Army Tactical Missile System (ATACMS), Lance remains the corps commander's only long range field artillery asset. Fielded in 1972, Lance was originally deployed as a nuclear only weapon system. [40] With a nonnuclear range of about 91km [41] and a M251A1 warhead (fragmentation and incendiary munitions) the Lance is well suited for attacking personnel and light equipment. [42] However, it is a resource to be used sparingly for Lance launchers are a nonreplenishable asset. Therefore, when used in a nonnuclear role, the corp's nuclear capability can be reduced if the firing unit is located and destroyed. [43] Currently, the Army has eight battalions and one independent battery of Lance. [44]

Scheduled for fielding in fiscal year 1991, ATACMS will give the corps commander additional organic capability to fight beyond the range of cannons and rockets. [45] With range in the vicinity of 150km, [46] ATACMS will fire a dual-purpose improved conventional munition warhead that is effective against both personnel and equipment. [47] Development of nuclear [48] and chemical [49] warheads are conceivable. ATACMS survivability

is enhanced by virtue of its similarity to MLRS. Using the same basic carrier, slightly modified ground support equipment, and the same "shoot and scoot" tactics, it is difficult to differentiate between the ATACMS and MLRS. To the untrained eye, the only noticeable difference is the replacement of the two 6-rocket pods for two large missiles. "Currently, there are no planned changes to the force structure to accommodate ATACMS."[50] ATACMS provides firepower, flexibility, and survivability with minimal resource investment.

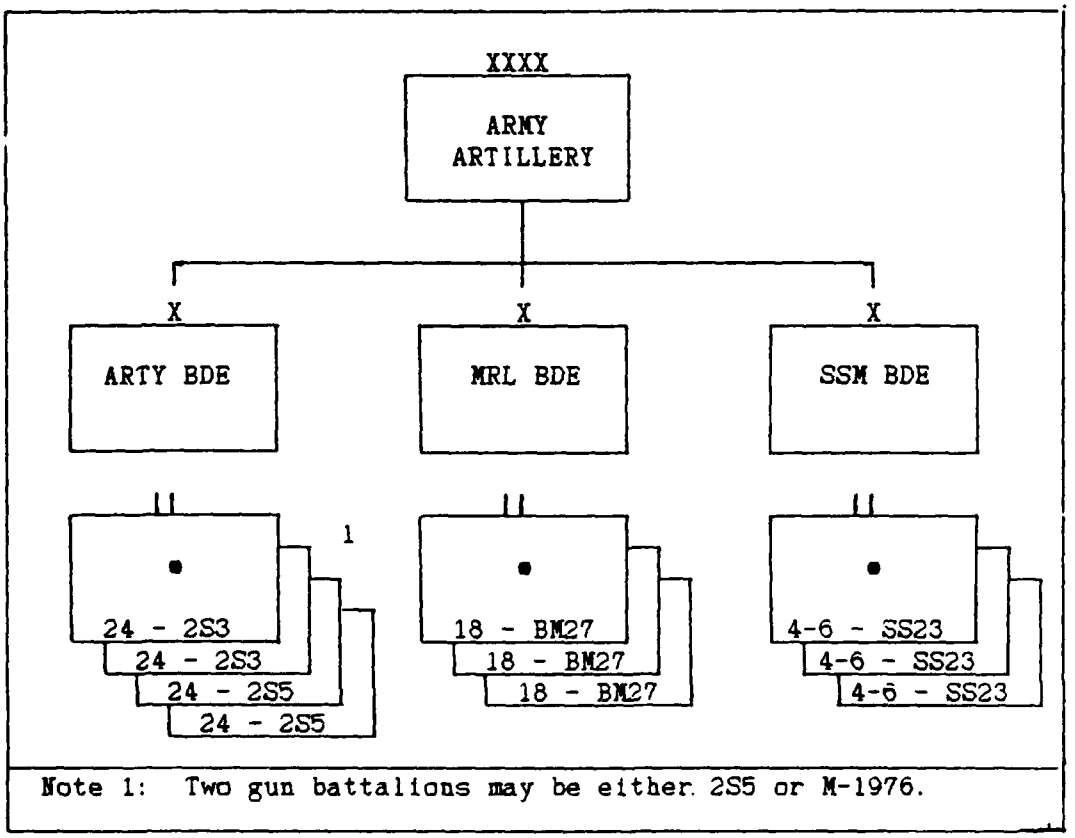
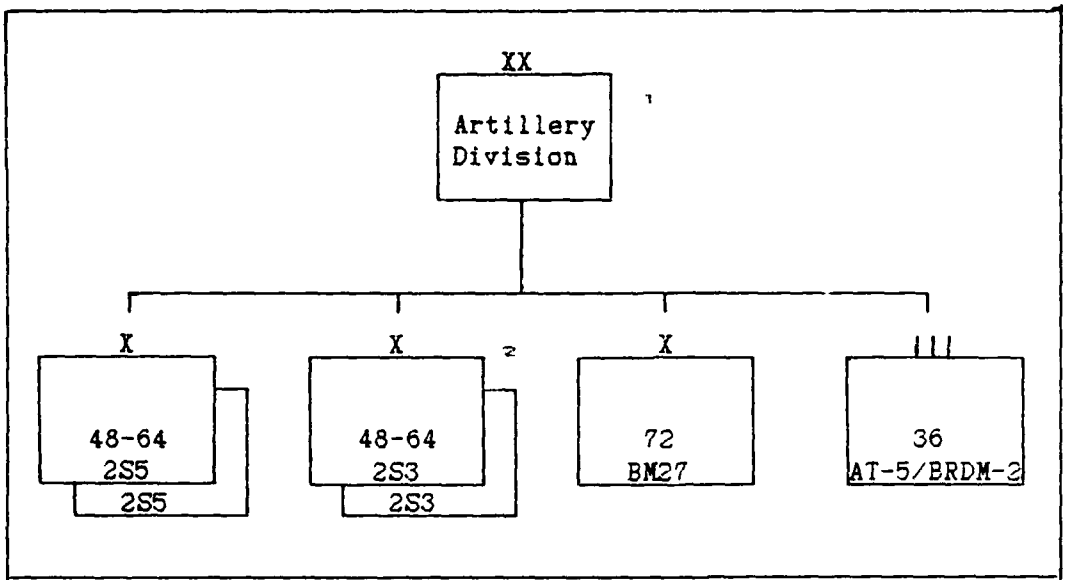


Figure 3. Soviet Army Artillery
Source: Bellamy, Chris. Red God of War, p. 194.

Even MLRS, ATACMS, and the new corps artillery configuration will not offset the massive numbers of Soviet artillery at army and above. Figures 3 and 4 show the organization of a Soviet army's artillery and a Front's artillery division. Soviet artillery assets not discussed in detail in this paper are the Theater of Military Operations' (TVD) heavy artillery brigade and intermediate range missiles. The heavy artillery brigade will normally consist of twenty-four, 203mm self-propelled guns and twenty-four, 240mm self-propelled mortars. [51] Intermediate range missiles (SS-4, SS-5, SS-12/22, SS-23, and SS-20) are not addressed due to their elimination as a result of the INF Treaty. [52] However, even without this heavy artillery and these surface-to-surface missiles, the Soviets have a formidable artillery force.



Note 1: Sources differ as to the structure of the artillery division. This depiction is a synthesis of three sources.
Note 2: These units may be equipped with either 2S3s or D-20s.

Figure 4. Soviet Artillery Division
Source: Bellamy, Chris. Red God of War, p. 195; Crutchly & Milam, "Warsaw Pact Modernization," Military Technology, 11/87, p. 52; Field Artillery Journal, Aug 88, p.45.

It is difficult to determine exactly how much artillery a U.S. division or corps would face in a specific operation for the Soviets task organize their artillery as necessary. Depending on the situation the higher level artillery commanders would allocate their artillery to subordinate commanders or retain centralized control of it. [53] Look at Chris Bellamy's example of a Soviet division advancing along an army's main axis:

> "The division has all the artillery of its subordinate regiments, its own artillery regiment, plus two battalions (that is, 48 in all), 2S5s or M-1976 152mm towed guns from Army, and from Front, three battalions of 2S3s making 72, 12 X 240mm self-propelled mortars, 12 X 203mm self-propelled guns and 18 BM-27 heavy rocket launchers...There would of course be the division's four FROGs or SS-21s, or any of the Army's 12 Scuds or SS-23s, or the Front's possible 24 Scuds or SS-23s, and 12 Scaleboards or SS-22s...This gives a total of 306 equipments, or 342 if the [divisions 120mm] mortars are included. If we take each barrel of the multiple rocket launcher separately, this gives 1278 barrels without the the 120mm mortars or 1314 with." [55]

Mr. Bellamy's figure of 1314 barrels does not include the SS-21s, FROGs, Scuds, SS-23s, Scaleboards, or SS-22s. A single volley from the massive artillery force depicted above, minus the surface-to-surface missiles is in excess of 56.2 tons of high explosives and steel. [55]

Up to this point I have not analyzed the lethality of the various delivery systems. Each delivery system has various types of ammunition designed for it. Table 1 shows the similarity of 122mm, 152mm, 155mm, and 8-inch munitions.

Table 1.
SELECTED U.S. AND SOVIET ARTILLERY COMPATIBILITY
(Current Capability)

	M109	M110	2S1	2S3	2S4	2S5	2S7	M1976	MLRS	BM-21	BM-27
High Expl Frag	X	X	X	X	X	X	X	X		X	X
HEAT			X	X		X					
ICM (Personnel)	X	X									
DP-ICM	X	X							X		X
Smoke	X		X	X						X	
Incendiary	X			X						X	
Illumination	X		X	X							
Concrete Pierce							X				
Armor Piercing				X							
Laser Guided	X										
Rocket Assist	X		X	X		X		X			
Nuclear	X	X		X	X	X	X	X			
Chemical	X	X	X	X		X		X		X	X
FASCAM	X										

Source: Data in this table is compilation of information extracted from the books and articles listed in the bibliography.

The trend is for Soviet heavy artillery to have less variety of ammunition. Multiple rocket launchers, saturation versus precision weapons, tend to have more variety than heavy artillery, but less that division level howitzers. While the U.S. has the edge in improved conventional munitions, the Soviets are developing this capability. One area in which the U.S. enjoys a monopoly is in the field of armor-seeking munitions. The first generation of this type munition is the laser guided "Copperhead." Although the U.S. may not enjoy much of a technological advantage in the more traditional munitions field, smart munitions appear to be the West's technological edge for the future.

Copperhead is the Army's first generation "smart" munition. Fired from any 155mm howitzer in the U.S. inventory, Copperhead is designed to destroy hard-point targets, stationary or moving, with a high probability of first-round kill. Effective to a maximum range of 16km, a "laser-guided Copperhead can literally fly down the hatch of a tank." [56] Currently the Army has approximately 12,000 Copperheads. Originally, the Army planned to purchase another 52,000 by 1991. However, due to rising procurement costs and budget cuts, procurement ends this year (1988) with the purchase of only 2,900 additional rounds. [57] While more rounds are desirable, 14,900 Copperheads are still a serious threat to a hostile armored force.

Whether its called SADARM (Search-and-Destroy Armor Weapon System) or APGM (Autonomous Precision Guided Munitions), the next generation of "smart", or perhaps "brilliant," munitions will have a dramatic effect on the battlefield. Designed to be fired from howitzers, rockets, or missiles, these munitions will find their own hard-point targets without the assistance of laser designation.

> "It is a low cost system which dispenses three sub-munitions from the rear of a conventional carrier projectile as it arrives over the target area. A decentralization mechanism slows and stabilizes each canister, a parachute deploys, power is activated and at a predetermined altitude a sensor begins to scan in an ever-decreasing circle. Any armored vehicle...within that circle will be detected and attacked at its center by a self-forging fragment warhead." [58]

Once perfected SADARM or APGM could have significant effects on both tank design and force structure. On design because the top is currently the most lightly armored part of the vehicle. On force

structure because a $20,000 artillery round which routinely destroys tanks, may generate a requirement for more artillery and fewer tanks. [59] As for tactics, massing of forces is risky under such a threat.

While the delivery sub-system is only one element of the field artillery system, it is certainly the most significant one. In this section, I have shown: First, that there is currently not much difference in quality and capabilities between U.S. and Soviet artillery. For examples, the M109 howitzer was mirrored against 2S1s and 2S3s, and the MLRS was looked at relative to the BM-21 and the BM-27. Second, in regards to survivability, it is clear technological improvements of the M109-HIP and new "shoot and scoot" tactics will help the M109-HIP and MLRS survive on the battlefield. Third, a notional Soviet division in the attack will have significantly more artillery firepower than the AOE can provide U.S. corps. Finally, there is not much difference between the Soviets and the U.S. in the traditional munitions area, but "smart" munitions may change the future battlefield significantly.

COMMAND, CONTROL, AND COMMUNICATIONS

The U.S. artillery support system is designed to support maneuver forces from the infantry platoon through the army level. Forward observers are allocated at each infantry platoon to provide platoon level fire support, while the company level fire support officer is the focal point of fire support for the maneuver company. Battalion and brigade fire support officers

integrate all fire support at the maneuver battalion and brigade levels. At division and corps, the fire support element is the organization charged with the planning, coordinating, and synchronizing of all fire support. The system is structured so that weapons from a multitude of units can be massed on the right target at the right time. In theory, a forward observer can "bring down the fires of an entire division or corps artillery" onto a single target. [60] The Soviets do not have an integrated fire support and maneuver system. Their system interfaces at the commander level. The ground force commander's approval of his allocated artillery's fire plan is Soviet fire support.

In a future high intensity battle against the Soviets, we must expect an artillery-on-artillery battle in addition to the traditional artillery support requirement. When fighting an enemy whose artillery force's declared aim is to smash an opponent with a crushing hail of high explosives and steel [61] -- and with a force structure that at least superficially has the capability to do so, -- we must win the artillery superiority fight. Near real time command and control is critical to our ability accomplish this mission; new technology is the way to get there.

Automated C^3 is a reality in the field artillery. The branch entered the computer age in 1963 with the fielding of the Field Artillery Digital Automatic Computer (FADAC). While archaic by today's standards, FADAC gave birth to the automated fire direction center and pushed the artillery into the twentieth century. Next came the tactical fire direction system (TACFIRE). Fielding started

n 1978 and continued into the mid-1980s. The TACFIRE system automated tactical fire control, target intelligence processing, unit status accounting, target analysis, fire support planning, and fire planning. TACFIRE tied corps artillery, division artillery, and artillery battalions into a computer loop. Fire support elements at each maneuver echelon above battalion are linked by the Variable Format Message Entry Device. Battery fire direction centers tie into the system with the Battery Computer System (BCS), a new generation technical fire direction computer. Forward observers entered the computer age via the Digital Message Device. [62] Obsolete by the time fielding was finished, TACFIRE will be replaced by the Advanced Field Artillery Tactical Data System (AFATDS). Hopefully, this system will be fielded by the mid-1990s.

Enhancing TACFIRE at the firing battery is the battery computer unit (BCU). Designed to provide technical fire control for missile, rocket, and cannon units this computer will be around through the 1990s. When configured with the gun display unit, the components form the BCS. System capabilities include the simultaneous control of up to 12 weapons, storage and application of ballistic data, processing of survey information, storage of fire plans and mission data. BCS not only links the battery fire direction center digitally to the battalion TACFIRE computer, it also automates the gun line fire control system. [63] Using current radios or wire in the digital mode, BCS processes calls for fire (received from the fire support team) and sends fire commands to the guns in near real time. BCS makes the whole artillery

sequence from "identifying the target" to "pulling the lanyard" quicker and more responsive.

AFATDS, as the replacement for TACFIRE, is the field artillery's link into the Army Tactical Command and Control System (ATCCS). In order to provide a near real time sharing of information on the future battlefield, the Army plans to link the five battlefield functions into a single computerized net. The fire support node will use AFATDS. The other sub-systems of the net will include the maneuver control system; the all source analysis system; the forward area air defense command, control and intelligence system; and the combat service support control system. [64] Using state of the art ATCCS compatible equipment, AFATDS will integrate target generation and processing, fire support control and coordination, field artillery tactical operations, field artillery technical fire direction, and field artillery support and sustainment. [64] Using the overall ATCCS architecture, AFATDS can support deep operations; conduct nuclear, nonnuclear, and chemical fire planning; and coordinate the employment of all U.S. and allied fire support assets to ensure that they support the senior commander's scheme of maneuver. AFATDS will implement detailed commander's guidance in the automation of operational planning, movement control, targeting, target value analysis and fire support planning and execution. [66] More than just another artillery computer, AFATDS will become a vital link in the artillery's ability to quickly detect, decide, and deliver fires in support of both the maneuver scheme and the

counterfire fight.

Despite past C^3 difficulties, this is still an area in which we are ahead of the Soviets, for the Warsaw Pact lags far behind the West in computerized command and control (C^2) systems and field artillery fire control. The West automatically labels this a plus for our side, however, that may not be true. When considering the vast difference between Western and Soviet automation capability, Bellamy comments:

> "But to what extent is it also a result of the West's need to extract the last drop of blood from its meager artillery assets, while the Soviets have enough artillery to avoid sharp conflicts between priorities and to give them redundancy that could be critical in continuous, intensely violent operations?" [67]

The Soviets have so much artillery that they may not need the sophisticated, automated system required by the West. Where the U.S. artillery uses the battery as a basic firing unit, and could conceivably use a platoon in the 3X8 battalion, the Soviets see the battalion firing at a single target. Their quantitative edge allows them to use an artillery battalion as the basic firing unit and expend massive quantities of ammunition merely neutralizing a small target. Their experience shows:

> "that 55-60 percent of all targets are destroyed by battalion fire, up to 25 percent are destroyed by the fire of an artillery group, and only 15-20 percent of the targets are destroyed by the fire of batteries and separate pieces. Thus a large share of fire missions in modern combat rest with the battalion...The battalion is the center for preparation of fire and fire control to the full extent...The factors examined above allow us to regard the battalion as the artillery's basic weapon and tactical subunit." [68]

Additionally, Soviet reference tables for the expenditure of artillery rounds show that they anticipate using one hundred 152mm

rounds or one hundred and forty 122mm rounds merely to neutralize a single ATGM, antitank gun or other individual target in the open. [69] What appears excessive to us is the norm for the Soviets. However, Bellamy's observation is probably not entirely correct. As part of the Soviet modernization effort, they have shown interest in new fire control computers and technological improvements to their command and control capabilities. [70] It appears they are interested in the best of both worlds: clear, quantitative advantage coupled with technological parity.

SUSTAINMENT & SUPPORT

In modern warfare, Class V -- ammunition -- has been considered the "achilles heel" of the field artillery. Along with the increased destructiveness of artillery in the 20th century, its appetite for ammunition has grown substantially. "The 19 day British bombardment at Third Ypres (1917) used 321 train loads of shells, a year's production of 55,000 war workers." [71] This event was not an anomaly. At Meuse-Argonne, September-November 1918, allied forces fired 4,214,000 rounds of artillery ammunition. During the four days of the Saint-Mihiel Offensive in September 1918, the American Expeditionary Force expended 1,093,000 rounds of artillery ammunition. [72] Jumping to the Korean War, artillery expenditures for the Battle of Soyang, 17 May - 7 June 1951 were 644,000 rounds or 18,000 tons. Two months later in the vicinity of Inje, artillery expenditures reached 1,087,000 rounds in eighteen days. [73] While it may appear that ammunition consumption was significantly less than World War I, numbers

alone are misleading. On 17 May 1951 one artillery battalion fired in excess of 11,981 rounds -- an average of almost one round per gun every two minutes for the whole twenty-four hour period. [74] Analysis of future battle indicates that the artillery's appetite for ammunition continues to grow.

Current Howitzer Ammunition Requirements[1]		Current ATP Sustained Output Capability[2]	Future Howitzer Ammunition Requirements per Level of Combat[3]	
Type of Operation (Heavy Commitment)	Rounds per Tube per Day (RTD)	350 Short Tons (STs) of all Ammunition Types; or 114-152 Rounds per Tube per Day	HIP Howitzer	AFAS-C Howitzer
			Committed	
Covering Force	274		201	473
			Surge	
Defense of Position	207		387	911
			Peak	
Attack of Position	153		599	1,409

1. FM 101-10-1/2, Oct 87, Page 2-138.
2. FM 9-6 rates output for an ATP at 350 STs per day. U.S. Army Field Artillery School (USAFAS) combat models show 60-80% of ATP ammo is for howitzers and project the percentage of each munition to be used. Taking the proportion of ammo used on a combat day and its weight (including packing materials), the supply system daily output of STs of artillery rounds was converted to single rounds.
3. USAFAS "Operational Mode Summary/Mission Profile for HIP," 23 Oct 86 & USAFAS "AFAS-C Use Study, "27 Jan 87.

Figure 5: Projected Howitzer Ammunition Use and Supply
Source: Kromer, Robert A., "Field Artillery Ammunition Resupply Solutions," Field Artillery Journal, Oct 1988, p. 17.

One prediction is that in a high intensity conflict on the European battlefield, a single direct support artillery battalion will require 600 short tons of ammunition per day. [75] Figure 5 reflects current and future howitzer requirements and current

ammunition transfer point capabilities. An examination of this table shows that there is a problem moving sufficient quantities of artillery ammunition through an ammunition transfer point (ATP). Current howitzer requirements will exceed ATP output capability by 45-60 percent for the covering force fight, 27-45 percent in the defense, and up to 25 percent in the attack. These shortfalls are even worse with the fielding of new generation howitzers. Figure 5 also indicates that each M109-HIP supporting a brigade during an "average" level of combat intensity (committed) would require 49-87 more rounds per day than the ATP could provide. If the howitzer fired its maximum quantity of rounds per day (peak), this shortfall could exceed 447 rounds per howitzer per day.

Solutions to the ammunition resupply problem are as numerous and varied as the number of people trying to solve it. There are several possible solutions. The "Bulk-Killer Forward" approach is a streamlined delivery of high usage projectiles such as high explosive and improved conventional munitions. These rounds are configured into complete round packages, delivered directly to artillery battalion trains, and established as push packages that are modified as the combat environment dictates. Ammunition such as illumination, smoke, etc. is drawn from the ATP as needed. [76] A variation of the "Bulk Killer Forward" concept is the use of combat-configured loads. These loads are push packages that are tailored to expected consumption. Another variation is to designate selected howitzers within the battery to fire only specific, not all, types of ammunition. This limits the variety of munitions on each weapon and individual howitzer

flexibility, but is usable for the bulk of the unit's anticipated fire missions. [77] Equipment recommendations include the use of a palletized load system (PLS) truck and trailer. With PLS, a crane would lift the entire flatbed off the truck or trailer to transload the ammunition. [78] These concepts indicate that while we still have a problem with getting enough ammunition forward to the guns, many possible solutions are being worked.

The fielding of two cargo vehicles is also helping to alleviate the ammunition resupply problem. The first is the Heavy Expanded Mobility Tactical Truck (HEMTT). It is an eight wheeled, 10 ton truck that is air transportable and capable of fording water up to four feet deep. The field artillery version of this vehicle comes with a light or medium crane, depending on the munitions to be lifted. With 64 of these per mechanized direct support battalion, ammunition transport is greatly enhanced. [79] The second vehicle, formerly called the FAASV, now referred to as the carrier ammunition track (CAT), is the newest tracked ammunition carrier in the Army inventory. The M992, 155mm version, carries 93 complete rounds plus a 10 percent overage of fuzes and propellants. The M1050, 8-inch version, carries 48 complete rounds plus an overage of 10 percent fuzes and propellants. Other features of the carrier are improved crew protection including a NBC protection system and protection against small arms fire and artillery shell fragmentation. Both carriers have a conveyor belt to move projectiles from the carrier into the supported howitzer. A future product improvement will enable rounds to be moved to the howitzer via the conveyor with the ammunition carrier's doors closed. Maintenance

is improved with automated engine analysis and 85 percent commonality with the M109 howitzer. [80]

A cursory look at the cargo carrying capability of a M109 artillery battalion in a mechanized infantry division indicates that it has sufficient ammunition transport capability. The approximate ammunition capability of the battalion's 64 HEMTTs and 24 CATs is 791 STONS. [81] FM 101-10-1/2 indicates that the maximum ammunition requirement for such a battalion would be 758.4 STONS. A quick analysis indicates that with these two new pieces of equipment, the artillery battalion has enough organic haul capacity to carry its anticipated ammunition load. If these computations are correct, this means the battalion could possibly use three or four of its HEMTTs to help alleviate the ATP ammunition problem. Solving the ammunition resupply issue is a complex problem given our current force structure. What's important to note is that ammunition resupply is a weak link in the artillery system.

Ammunition is the number one resupply priority for the Soviets, thus artillery unit commanders can expect maximum effort to keep them supplied. Transportation units may actually skip an echelon in the chain of command to ensure that units are resupplied with ammunition. It would not be unusual for a division transportation unit to resupply a battalion, while an army unit resupplies a regiment. Soviet commanders do not request ammunition resupply, their ammunition allocation is computed in accordance with their unit's fire plan and sufficient quantities of ammunition for that plan are pushed forward. To ensure that unit basic loads are full

at H-hour, it is not uncommon for ammunition to be placed on the ground prior to the start of an operation. This ammunition is usually fired during the preparation phase of the operation. Given the priority of ammunition resupply, it is not surprising to find that the Soviet artillery battalion has an adequate number of ammunition transport vehicles. [82]

Soviet artillery norms stress the organic haul capability of Soviet artillery battalions. The table in Appendix D shows the ammunition transport capabilities of a typical Soviet division. Here's an example to keep Soviet ammunition hauling capability in perspective. The ammunition summary from the "Excerpt from fire plan of Regimental Artillery Group 10 [122mm SP] in the attack," is as follows: [83]

> "AMMUNITION EXPENDITURE--2.45 units of fire, of which:
>
> For artillery preparation of attack--1.25 units of fire.
> For artillery support of attack--0.3 units of fire.
> For artillery accompaniment--0.9 units of fire."

From this extract one sees that the Soviet battalion commander plans to fire 2.45 units of fire (i.e. 2.45 units per weapon or 3528 rounds per battalion). The total hauling capability of his battalion is 2.83 units of fire (i.e. 4068 rounds). The ammunition difference of 540 rounds, will be used for unscheduled fires. Thus, his fire plan and ammunition resupply are synchronized.

Some sources indicate that the Soviets willingness to expend huge quantities of ammunition at small targets will stress their ammunition

resupply system. I believe the Soviet resupply system will adequately project the quantities of ammunition they need to support their fire plans and that they have the capability to haul that ammunition. Their ammunition "achilles heel" is not planning or haul capability, it is our ability to interdict their ammunition movement or force them to leave huge quantities of ammunition on the ground via counterbattery fires. This will disrupt their fire plan and their norms.

Another element of the sustainment system, critical to self-propelled artillery, is maintenance and maintenance turn around time. The 1973 Israeli War showed the need to repair combat vehicles in the forward area and to do it quickly. Of the 450 Israeli tanks available at the start of the conflict, 75 percent were lost during the first 18 hours of the war. Eighty percent of the damaged vehicles were returned to combat within 24 hours. Some tanks were repaired and returned to battle four or five times during the course of the war. [84] Without getting into a detailed analysis of the combat maintenance and support system, it is sufficient to state that the Army's initiatives in the improvement of tactical maintenance and sustainment are a step in the right direction.

Two elements of the artillery support system in which the U.S. is clearly superior to the Soviets are survey and meteorlogical data collection. In regards to survey, the AN/USQ-70 position and azimuth determining system (PADS) was fielded in the early 1980's and ended the use of traditional battalion survey teams. Mounted on the back of a M151 truck, a commercial utility cargo vehicle, or a HMMWV, its two-man crew gives the battalion quick and accurate survey. [85]

Accuracy of field artillery fire direction is enhanced by the meteorological data system (MDS). The first new meteorological system in decades, MDS is mobile and automated. It collects, processes, and transmits accurate meteorological data to artillery fire direction centers. It interfaces with TACFIRE, BCS, and AFATDS where its meteorlogical data is automatically applied to artillery trajectory corrections. MDS data can also be used to determine chemical effects, predict radiological fallout, and forecast weather. [86] On the other side, the Soviet Field Artillery Officer's Handbook indicates that the Russians use survey teams and the traditional survey methods. It discusses the application of meteorological corrections to firing data but does not address how that data is collected. An element of the artillery system that is easily overlooked, PADS and MDS are high technology systems which improve artillery responsiveness, accuracy, and survivability.

TARGET ACQUISITION

From the eyes of the forward observer to the Firefinder radar the field artillery has several high technology target acquisition systems. Without acquisition the field artillery's potential as the greatest killer on the battlefield is unreachable. While many non-artillery target acquisition assets help the artillery accomplish its fire support mission, this section will cover only field artillery target acquisition capabilities.

The first of these target acquisition systems is the forward observer. The second is the fire support team (FIST) headquarters using the M981 fire support vehicle. All company fire support

teams and each brigade combat observation lasing team found in armored and mechanized divisions have these vehicles. [87] This converted M113 personnel carrier mounts a ground/vehicular laser locater designator. The laser designator allows the fire support team to designate targets for destruction by "Copperhead" projectiles.

The third system is the Firefinder family of radars. Quite possibly, Firefinder is the best counterbattery radar system in the world. The Firefinder family consists of the AN/TPQ-37 and the AN/TPQ-36. Both radars are scheduled for total fielding by 1989. The AN/TPQ-37 has a range of up to 50km and is best suited for locating weapons firing low-angle trajectories. The AN/TPQ-36 has a maximum range of 24km and detects both high- and low- angle trajectory weapons. Both systems are capable of locating up to ten weapons firing simultaneously and are linked digitally to the TACFIRE system. [88] Under ideal conditions, Firefinder can detect an enemy weapon, pass target data to the supported artillery unit, and friendly fire can start before the first enemy round hits the ground. "In Lebanon in 1984, the Marines deployed six AN/TPQ-36 radars and by correlating data with satellite imagery, were able to pinpoint Syrian [firing] batteries within less than 10 meters." [89]

Finally, the OH-58D helicopter provides a fully-integrated aerial platform for target acquisition. A two man crew, the aerial fire support officer and the pilot, operates this sophisticated helicopter in day, night, or adverse weather. The OH-58D mission package includes an attitude heading and reference system; a laser range finder capable of calculating eight-digit grid coordinates and

designating targets for Copperhead, Hellfire, and other laser guided bombs; and an airborne target handover system that is digitally linked to tacfire and other digital message devices. The current fielding plan allocates six OH-58Ds for the ten active divisions. The XVIII Airborne Corps, VII Corps, and V Corps artillery brigades will receive additional aircraft. [90]

Soviet target acquisition is performed differently. Warsaw Pact artillery reconnaissance batteries in coordination with their division reconnaissance battalions provide the bulk of a division's artillery intelligence. The reconnaissance battery consists of several sections and platoons. [91]

Radar surveillance is conducted by three radar sections. One section conducts battlefield surveillance with a BMP-mounted SMALL FRED radar. The other battlefield surveillance section has a BIG FRED radar mounted on an armored multipurpose tracked vehicle. Also in the battery is another battlefield surveillance radar that remains unidentified. Finally, the countermortar/counterbattery radar section consists of two or three tracked vehicle mounted radars with a 20km range. The BIG FRED radar also has some limited countermortar/ counterbattery capability.

In addition to the radar sections, the battery has sound ranging, reconnaissance, communications, topographic survey, and meteorological survey platoons. The sound ranging platoon can operate a six-microphone base capable of locating targets up to 20km away in a 6-8km wide zone. The reconnaissance platoon can establish three visual observation posts capable of day or night operations. The

remaining platoons operate in support of the division's artillery.

The artillery battalion also establishes four command observation posts (COP) along with their auxiliary and alternate observation posts. In addition to observation responsibilities, the battalion COP controls the fires of the battalion, while the battery COPs serve as one of the fire direction elements for their batteries. [92] Target acquisition capability is one area in which the Soviets are focusing their technological efforts. [93] Although improving, Soviet artillery target acquisition means are of limited effectiveness beyond about 10km from the FLOT.

CONCLUSIONS

This comparative analysis of U.S. and Soviet artillery forces validates the Combat Power Model as a concept, identifies key differences between the two artillery systems, addresses perceived strengths and weaknesses of each system, and indicates U.S. actions to ensure that U.S. artillery rules the future battlefield.

First, the Combat Power Model is a useful concept for assessing the relative fighting capability of two forces. By modifying the model to meet my specific requirements (Appendix B), I was able to systematically dissect, compare, and evaluate each piece of the U.S. and Soviet artillery system. While all of these individual pieces are not specifically addressed in the paper, the impact of each piece was evaluated in respect to the whole system. By using my variation of the model, I was able to methodically evaluate the capabilities of U.S. and Soviet artillery.

In regards to doctrine, there is a dramatic difference between the U.S. and Soviet view of artillery employment. Even if U.S. forces were not limited by manpower and dollar constraints, the U.S. artillery force would not mirror the Soviets. The U.S. philosophy is one of harmony between maneuver and firepower, each gaining in importance temporarily, but usually remaining in relative balance. U.S. doctrine recognizes the historic destructiveness of artillery. We learned that lesson in World War I, World War II, and Korea. More current lessons from the Arab-Israeli and Iran-Iraq Wars validate the artillery's traditional role on the modern battlefield. However, in today's army, we normally envisage the artillery facilitating an attack by softening targets, delaying and disrupting follow-on echelon forces, or suppressing enemy air defenses. Rarely do we think of artillery destruction missions. Accordingly, our force structure supports our artillery philosophy.

In striking contrast to our artillery doctrine, the Soviets expect their artillery to play a major role in the destruction of enemy ground forces. As previously discussed, Soviet "fire destruction" necessitates the use of artillery groups at the regimental and divisional level, high power artillery brigades, heavy artillery brigades, multiple rocket launcher brigades, and artillery divisions. Their mission is to pulverize enemy positions to facilitate maneuver, and in conjunction with Soviet air forces, to deliver powerful, paralysing blows of artillery cannon and rockets as a substitute for nuclear fires. [94] To accomplish this mission, the Soviets have built an enormous artillery force.

To contend with Soviet quantity, the U.S. demands efficiency and flexibility from the artillery. While we have developed quality weapon systems, both howitzer and rocket, force structure causes us to field them sparingly. The M109 howitzer and the MLRS are extremely capable weapons. Likewise, the M109-HIP and ATACMS will become valued artillery assets. As for command and control, we have a highly sophisticated, computerized system which ensures artillery fires are responsive to a rapidly changing battlefield and to the counterbattery fight. ATCCS will make C^3 even more sophisticated as we move into the 1990s. ATCCS integration of C^3 will allow us to quickly detect, decide, mass, and destroy high value targets. Survey and target acquisition systems are also a real U.S. advantage. The newest survey and target acquisition equipment save manpower, improve survivability, and allow our artillery to shoot accurately at correctly located targets.

Accordingly, American artillery tactics capitalize on perceived U.S. strengths. While cannon units use natural concealment and maximum feasible displacement between guns to enhance survivability, automated technical fire direction accommodates this dispersion. BCS computes firing data for individual howitzers, ensuring maximum effects on target, in seconds. PADS provides quick and accurate survey which facilitates rapid gun emplacement. CATs with the same cross-country mobility as self-propelled howitzers ensure ammunition is always present. Cannon units, while not using "shoot and scoot" tactics, don't stay in one position long, but "shoot and move" after a few fire missions. MLRS, as will ATACMS, uses "shoot and scoot" tactics making acquisition and destruction by counterbattery fires extremely difficult. Six-rocket pods and an on-board reloading

capability keep MLRS launchers armed and ready. M109-HIP deployment will expand "scoot and scoot" tactics to cannon units, once again adapting our tactics to our technological strengths.

To improve the quality of their huge artillery force, Soviet modernization has focused primarily on development and fielding of high quality weapons. Their currently fielded 152mm SP howitzer has an automatic loading system, while our 155mm SP howitzer doesn't. Their BM-27 has four more rockets per launcher than our MLRS. Even the munitions are similar. The saying that "quantity has a quality of its own," [95] becomes even more ominous because now the Soviets have both. However, their support systems have not kept pace with their delivery systems. Command and control has virtually no automation, survey is conducted using traditional methods, and their artillery reconnaissance units are equipped like our target acquisition batteries of a decade ago. But given the size and organization of Soviet artillery, a lack of automation doesn't mean it is deficient. The size of Warsaw Pact artillery force and their dual artillery system may "make-up" for any lack of sophistication.

Simplicity permeates Soviet artillery tactics. Changes have occured infrequently since World War II. The most recent changes came in the late 1970s with the move away from the traditional deployment of artillery battalions into line or triangle formations, and the establishment of the battalion as the basic firing unit. [96] Soviet artillery units now make use of terrain and have abandoned regular intervals between delivery systems. Spacing between guns and howtizers is normally 20-60 meters, while spacing between rocket launchers is

15-50 meters. [97] The battalion and battery commanders' COPs remain critical command and control, technical fire direction, and target acquisition elements. The battalion commander's COP controls the fires of the battalion. Soviet artillerymen consider "the most 'complex and creative' element of artillery tactics to be the determination of how many rounds are to be fired at each target. To determine this they have developed a series of projectile expenditure rates..." [98]

To dominate the future battlefield, U.S. ground and air fires must capitalize on Soviet weaknesses. First, Soviet norms require the expenditure of large quantities of ammunition. While they have the transport capacity, their ammunition trucks must travel across a crowded battlefield on long supply lines for replenishment. Given limited off-road capability on restrictive European terrain this resupply system is very vulnerable to attack and disruption. [99] Second, large quantities of ammunition is normally placed on the ground at the firing unit until used. U.S. counterbattery fires can force units to displace leaving this ammunition behind, thus disrupting ammunition expenditure norms. Third, unless scheduled in a fire plan, the Soviets lack the ability to mass fires above the battalion level. While this may not be critical given the duality of Soviet artillery, even this limited massing of fires capability can be eliminated by disrupting their fire plan with counterbattery fires. Fourth, simply eliminating or isolating battalion and battery COPs disrupt target acquisition, command and control, technical fire direction, and observation of fires. Finally, since Soviet support of maneuver is hinged at the commander level, disruption of the maneuver force's plans or elimination of commanders seriously hinders artillery

support. While the "Red God of War" is powerful, he is not invulnerable.

Analysis of the U.S. artillery system indicates that it supports U.S. Army doctrine, adapts its tactics to technological advances, and strives to be the worlds best equipped force. However, there are weaknesses. First, the movement of sufficient quantities of ammunition through the ATP to the gun line must be assured. The ultimate solution to this problem is a combination of automated lift capability, new ammunition packaging, more trucks, and more drivers. Second, the increasing U.S. reliance on computers is a concern of many artillerymen. Computer failures on the battlefield could significantly degrade U.S. ability to mass fires, maximize the use of delivery systems, conduct effective counterbattery fires, develop timely fire plans, and conduct adequate command and control. While the solution to this problem is not simple, it hinges on improved and hardened computers, manual back-up procedures, and training. Related to the realm of C^{3} and firepower is the artillery's most perplexing problem. How does the artillery accomplish its growing number of tasks?

On the future battlefield the artillery will face a numerically superior foe whose weapons are as good as ours. While we may not need to match the Soviets weapon for weapon, there must be enough artillery to win the artillery-on-artillery battle, a significant undertaking; support the maneuver force with planned and on-call fires; and delay, disrupt, and destroy second echelon forces before they get into the fight. Additionally, the artillery will be called upon to lay artillery delivered minefields, fight enemy armor with laser guided or

"smart" munitions, and provide artillery fires as part of the Joint Air Attack Team and in the suppression of enemy air defenses. As the artillery's battlefield requirements have increased, it appears that we've relied on our acquisition capability, C^3, and innovativeness to get the maximum from our delivery systems.

During World War II when the artillery was regarded as a strength of the American Army, it possessed good communications, the ability to mass fires, and a quantity advantage. Today, the artillery has an effective C^3 system that will get better as the army becomes more computer literate and it has certainly not lost its ability to mass. However, in a war with the Soviets we will not have a numerical advantage. I believe we have reached the point where we don't have enough delivery systems for the artillery to accomplish all of its tasks. Furthermore, given the Soviet capability to acquire and destroy our artillery delivery systems and C^3, we've reached the point where we need more artillery in our force structure. GEN (Ret.) Merritt, former U.S. Representative to the Nato Military Committee, is on the right track when he said, "If I were 'King,'...I would continue to aggressively field the MLRS. I'd also add more tube artillery in Europe." [100] Additionally, we need to relook the missions of our divisional and corps artillery assets to determine which units or systems should fight the artillery-on-artillery duel, provide maneuver support, and accomplish those other tasks addressed above. Quite possibly we may want to adapt a variation of the Soviets' dual artillery force structure. In any event, for the "King of Battle" to reign on the future battlefield, we need more artillery.

Appendix A: The Combat Power Model

COMBAT POWER IS A FUNCTION OF:

1. FIREPOWER EFFECT:

VOLUME OF FIRE:
- Number of Delivery Means
- Supply capability
- Rate of fire of weapons systems

LETHALITY OF MUNITIONS:
- Design characteristics
- Explosive energy

ACCURACY OF FIRES:
- Weapon and munition design characteristics
- Crew proficiency
- Terrain effects
- Visibility

TARGET ACQUISITION:
- Intelligence and intelligence analysis
- Location and functioning of observers and sensors
- Transmission of target data

FLEXIBILTY OF EMPLOYMENT:
- Weapons ranges
- Mobility
- Signature effects
- Fire control systems
- Tactical employment doctrine

2. MANEUVER EFFECT:

UNIT MOBILITY:
- Physical fitness and health of individuals
- Unit teamwork and esprit
- Unit equipment capabilities
- Unit equipment maintenance
- Unit mobility skills

TACTICAL ANALYSIS:
- Intelligence and knowledge of enemy tactics
- Understanding of terrain effects
- Understanding of own unit capabilities

MANAGEMENT OF RESOURCES:
- Equipment utilization
- Supplies utilization
- Personnel utilization
- Time utilization
- Utilization of energies of subordinates

COMMAND, CONTROL, AND COMMUNITCATIONS:
- Span of control
- SOPs and doctrine
- Staff efficiency
- Communications efficiency

3. PROTECTION EFFECT:

CONCEALMENT
- Camouflage
- Stealth
- Equipment design
- Counter enemy intelligence acquisition means

EXPOSURE LIMITATION:
- Minimize potential target size
- Minimize potential target exposure time
- Complicate potential target tracking

DAMAGE LIMITATION:
- Individual protective equipment design and use
- Use of natural cover
- Use of artificial cover (incl field fortifications)
- Combat vehicle design
- Medical treatment and evacuation system
- Combat equipment canibalization and repair
- Alternate command and control arrangements
- Providing personnel and material replacements
- Misc. efforts to maintain continued combat effectiveness of units

4. LEADERSHIP EFFECTS:

TECHNICAL PROFICIENCY:
- Training
- Experience

UNDERSTANDING OF UNIT CAPABILITIES:
- Training
- Experience

ANALYTICAL SKILLS:
- Selection
- Training
- Experience

COMMUNICATION SKILLS:
- Selection
- Training

DEDICATION, COMMITTMENT, AND MORAL FORCE:
- Selection
- Motivation
- Training

UNDERSTANDING OF BATTLEFIELD EFFECTS:
- Combat experience
- Training

Appendix B: The Combat Power Model Variation

1. FIREPOWER/WEAPON SYSTEM EFFECT:

WEAPON SYSTEM TYPE:
- Cannon
- Rocket
- Missile

VOLUME OF FIRE:
- Number of Delivery Means
- Supply capability
- Rate of fire of weapons systems

LETHALITY OF MUNITIONS:
- Design characteristics
- Variety of types

ACCURACY OF FIRES:
- Weapon and munition design characteristics
- Fire control systems
- Observed fire
- Survey
- Exterior Ballistic Corrections (weather and muzzle velocity)

TACTICAL EMPLOYMENT DOCTRINE:
- Doctrine
- Weapons ranges
- Mobility
- Signature effects

SURVIVABILITY:
- Camouflage
- Stealth
- Equipment design
- Minimize potential target size
- Minimize potential target exposure time
- Individual protective equipment design and use
- Use of natural cover
- Use of artificial cover
- Combat vehicle design
- Support vehicle design
- Alternate command and control arrangements

2. COMMAND, CONTROL, AND COMMUNICATIONS

ORGANIZATION FOR COMBAT:
- Understanding of own unit (weapons, radars, etc.) capabilities
- Assignment of artillery missions

COMMAND:
- Doctrine
- Continued unit effectiveness
- Staff
- Location on battlefield

CONTROL:
- Tactical and technical fire control
- Span of control
- SOPs and doctrine
- Automation/Manual
- Linkage to battlefield functions

COMMUNICATIONS:
- Digital
- Wire
- Voice
- Alternatives
- Hardware

SURVIVABILITY:
- Camouflage
- Stealth
- Equipment design
- Minimize potential target size
- Minimize potential target exposure time
- Individual protective equipment design and use
- Use of natural cover
- Use of artificial cover
- Combat vehicle design
- Support vehicle design
- Signature

EFFECTIVE USE WEAPON SYSTEMS
- Precision versus saturation
- Integration of air, ground, naval

3. SUPPORT AND SUSTAINMENT

AMMUNITION RESUPPLY
- Requirement
- Transport
- Innovation

MAINTENANCE
- Repair time
- Location on battlefield
- Innovation

SURVEY AND METEOROLOGICAL
- Speed
- Accuracy
- Data transfer
- Doctrine
- Hardware

SURVIVABILITY
- Camouflage
- Stealth
- Equipment design
- Minimize potential target size
- Minimize potential target exposure time
- Individual protective equipment design and use
- Use of natural cover
- Use of artificial cover
- Combat vehicle design

4. TARGET ACQUISITION:

DOCTRINE
- Force structure
- Systems (manual/automated)

TARGET ANALYSIS
- Priorities
- Target lists

LOCATION OF OBSERVERS AND RADARS

COMMUNICATIONS LINKS

SURVIVABILITY
- Camouflage
- Stealth
- Equipment design
- Minimize potential target size
- Minimize potential target exposure time
- Individual protective equipment design and use
- Use of natural cover
- Use of artificial cover
- Combat vehicle design

5. HUMAN FACTORS/LEADERSHIP

TECHNICAL PROFICIENCY:
- Training
- Experience

UNDERSTANDING OF UNIT CAPABILITIES:
- Training
- Experience

ANALYTICAL SKILLS:
- Selection
- Training
- Experience

COMMUNICATION SKILLS:
- Selection
- Training

DEDICATION, COMMITMENT, AND MORAL FORCE:
- Selection
- Motivation
- Training

UNDERSTANDING OF BATTLEFIELD EFFECTS:
- Combat experience
- Training

Appendix C: Characteristics of Selected U.S. and Soviet Artillery Weapons[1]

	M109A2/3	2S1	2S3	MLRS	BM-21	BM-27
CALIBER	155mm	122mm	152mm	227mm	122mm	220mm
NO. OF ROCKETS	NA	NA	NA	12	40	16
TYPE	How	How	How	MRL	MRL	MRL
SELF-PROPELLED /TRUCK	SP	SP	SP	SP	Truck	Truck
MAX RANGE	18.1km	15.3km	18.5km	30.okm	20.5km	35-40km
Ext Rg HE[2]	none	none	24.8km	NA	NA	NA
RAP[3]	23.5km	21.9km	37.0km	NA	NA	NA
CREW	6	4	4	3	6	6
TIME: (min)						
Emplacement	1	2	5	1.5[4]	2.5	3-5
Displacement	1	2	5	1.5[4]	.5	1-3
Reload	NA	NA	NA	<10	10.0	15-20
RATE OF FIRE max rds per:						
1 min	4	6	4	12	12	16
3 min	12	16	12	--	40	--
60 min	69	100	90	--	--	--
after 1st hr	20	50	45	--	--	--
CRUISING RANGE	367km	500km	500km	483km	750km	500km
MAX SPEED	59km/hr	60km/hr	50km/hr	64km/hr	75km/hr	65km/hr

NOTES:

1. Sources vary significantly in most areas. It is also difficult to determine how data was computed. For example, the sources do not indicate whether MAX SPEED is cross-country or on improved roads.
2. The Soviets have an extended range high explosive projectile.
3. RAP = rocket assisted projectile.
4. MLRS can arrive at the launch area, compute technical firing data, orient on the target, fire its 12 rockets, and displace within 3 min.

SOURCE: This table is a synthesis of information found in Weapons and Tactics of the Soviet Army; the "1988-89 Gre_nbook," Army; FC-20-20, Fire Support Handbook; Jane's Armour and Artillery 1988-89; and The Artillery Battalion in Combat.

Appendix D: Soviet Division Ammunition Hauling Capability

VEH TYPE/CAPACITY	D30BN	2S1 BN	2S3 BN	BM21 BN	ARTY REGT TRANS CO	1 AMMO CO OF DIV TRANS
GAZ 66 2 MT	12	7	7	6	0	0
ZIL/Ural 3.5 MT	34	0	20	0	36	0
Ural 375 4.5 MT	0	20	0	36	0	60
TRLR ZIL-2.5 MT Ural-3.0 MT	11	10	10	36	30	60
Capacity of trucks (trk/trlr qty x capacity MT)	170.5	134	109	282	201	450
Gun on board capacity MT	0	28.8	45	72	0	0
Total unit capacity MT	170.5	162.8	154	354	201	450
No. of units of fire carried	2.96	2.83	2.28	1.64	NA	NA

NOTES:

1. MT = metric tons

2. A unit of fire is computed per howitzer.
   122mm How Unit of Fire = 80 rds = 3.2MT (per wpn)
   152mm How Unit of Fire = 60 rds = 3.75MT (per wpn)
   122mm MRL Unit of Fire = 120 rds = 12.0MT (per wpn)

3. This chart assumes the total capacity of each truck is carrying ammunition. The result is an overstatement of capacity, since personnel and section/unit equipment must also be carried on the vehicles. The cross country capacity is used above for the trucks instead of the improved road capacity.

SOURCE: Antis, Robert M., Soviet Artillery Handbook. Training and Training Developments Division, Threats Directorate, Combined Arms Center, Fort Leavenworth, KS, 1987, p. 13.

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64 HEMTTs = 640 STONS
24 CATs = 151 STONS *
791 STONS

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758.4 STONS/11,178 rds x 93 rds/CAT x 24 CATS/Bn

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