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This thesis assesses the effectiveness of the current and alternative organizational structures for the employment of the TOW (ATGM). Four alternatives are considered in comparison to the current organization which was assessed as a base case. The alternatives are divisional TOW battalions, mechanized battalion TOW companies, TOW companies in both the mechanized infantry and tank battalions, and TOW platoons in both the mechanized infantry and tank battalions. Analysis drew on historical data and the results of related work in a subjective asssessment of the alternatives based on concentration, command and control, balance, supportability, training, and cost. The scope of the thesis was limited to consider the time frame from the present until the mid-1980s and an assumption constrained the alternatives to adhere approximately to the current divisional end strength in equipment and people.

Overall, virtually all of the alternatives except the TOW company in the mechanized battalion were found to be better than the current organization. Optimum TOW potential, however, is achieved when TOWs are organized into companies organic to both the mechanized infantry and tank battalions.

The Heavy Antitank Company

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Final Report 8 June 1979

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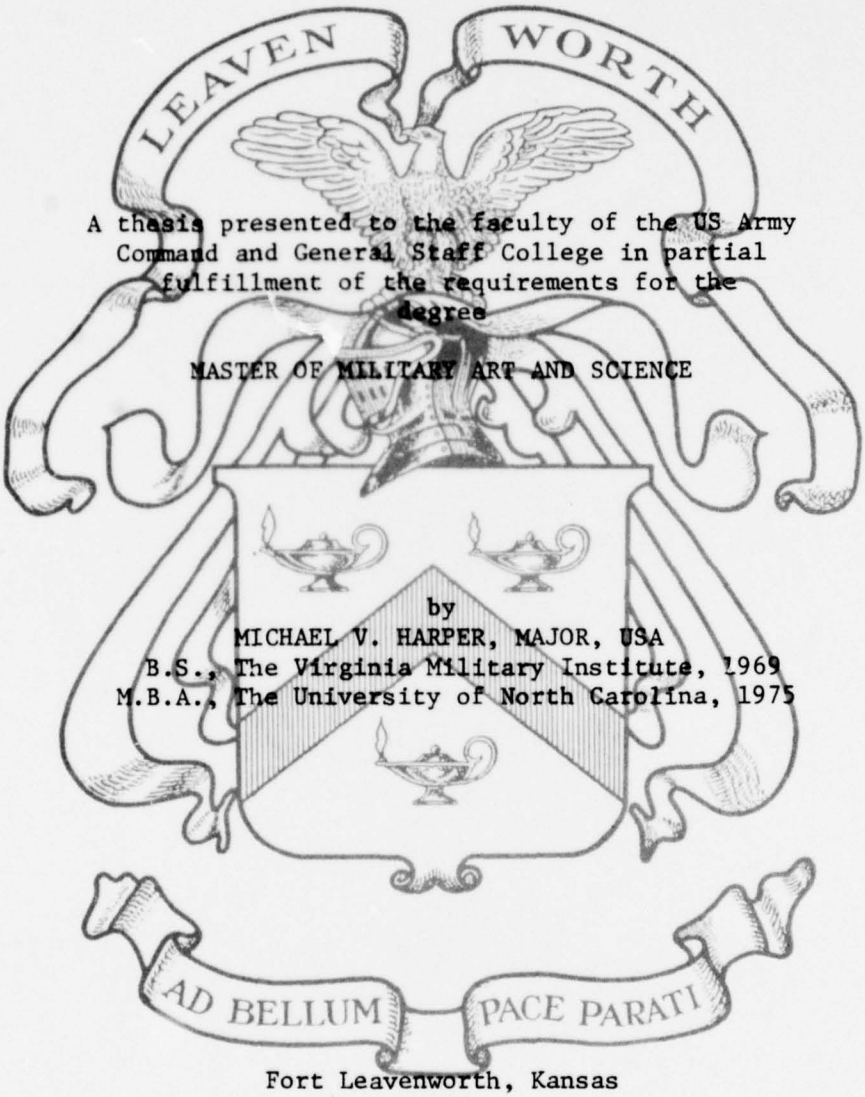
A Master of Military Art and Science thesis presented to the faculty of the U. S. Army Command and General Staff College, Fort Leavenworth, Kansas 66027

THE HEAVY ANTITANK COMPANY



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MASTER OF MILITARY ART AND SCIENCE

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Overall, virtually all of the alternatives except the TOW company in the mechanized battalion only were found to be better than the current organization. Optimum TOW potential, however, is achieved when TOWs are organized into companies organic to both the mechanized and tank battalions.

Modern all-arms combat is unthinkable without provisions for struggle against the enemy's armoured weapons. Second only to the combatting of nuclear weapons, antitank warfare has become the key element in any combat operation, and a vital part of all-arms combat.[1]

MG G. Biryukov, USSR

COL G. Melnikov, USSR

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CHAPTER 1

INTRODUCTION

In the sixty-odd years since armored vehicles appeared on the World War I battlefield, major armies have grown increasingly mechanized. The focus in warfare has evolved from slow moving infantry formations to rapidly deploying armored formations. Within those units the focus has drifted from masses of individual riflemen to relatively few highly technical weapon systems served by crews of men and backed up by vast combat service support infrastructures. To win in such an environment requires an orientation toward destroying those weapon systems. However, modernization has meant much more than the proliferation of armored vehicles; it has meant the increasing sophistication of the full range of offensive and defensive capabilities. In the US Army alone it is estimated that more than one hundred major new combat systems will be introduced in the decade of the 1980s.[2]

In response to this technical evolution, the US Army has experienced a revolution in tactical thinking that is perhaps unparalleled in its history. Changes in tactics, equipment, and the perception of the Threat have, however, been accompanied by very little organizational change. In particular, the current heavy antitank weapon (HAW), the tube launched, optically tracked, wire command link (TOW) antitank guided missile (ATGM), was fitted into an organization designed for its predecessor, the 106mm recoilless rifle, with very little change to that basic structure. Yet the capabilities of the TOW are vastly greater and are

essential to changes that have been made to basic tactical doctrine. Little thought seems to have been given to the effects of organizational structure on the full realization of those capabilities.

PURPOSE

The purpose of this thesis is to assess the effectiveness of the current and alternative organizational structures for the employment of the TOW ATGM in order to select the best organizational structure.

BACKGROUND

In the latter half of World War I, the Allies succeeded in restoring a degree of tactical mobility to the battlefield by introducing the tank. Early tanks were slow, only lightly armored, and very unreliable, but against inept antitank defenses they provided a means to break the stalemate of the trenches. Very early tanks were vulnerable to machinegun fire and hastily conceived antitank rifles. However, the only really successful antitank weapons in that war were field artillery pieces firing direct fire. The war ended without the infantry having been provided with a satisfactory means to defeat tanks.

In the decades between the wars, the infantry gradually acquired both light and heavy antitank weapons. The former consisted of a variety of hand and rifle grenades, mortars, and rifles while the latter consisted of direct fire artillery pieces. This was, however, a relatively minor effort in most armies owing to fiscal constraints; the very limited production of the new tanks that were developed; and, particularly in the United States, the notion that the best tank defense is provided by other tanks.

The United States, when it entered World War II, created organizations based on European experience and trends, but was unable, initially, to provide the infantry division with a satisfactory heavy antitank defense. However, the technological race to develop better tank and antitank weapons eventually resulted in the fielding of improved antitank weapons and improved munitions. Infantry units acquired weapons with increased capabilities and tanks became less free to roam the battlefield. While it is completely unrealistic to focus on the antitank dimension alone in considering the reduced freedom of armored formations, it is not unreasonable to conclude that, by the end of the war, the feasibility of an infantry-centered defense against tanks had been well established.

In the decades since the war, technology has continued in the measure-countermeasure growth pattern of the World War II period. The main battle tanks of the 1950s were far superior to those of the previous decade, but antitank weapons technology advanced accordingly. Additionally, organizational changes reflected decentralization, increased mobility, and increased numbers of heavy antitank systems. During World War II, HAWs (tank destroyers) were pooled in non-divisional battalions. During the post war decades, this structure gave way to regimental, then battle group, then battalion ownership of the heaviest antitank systems. Four types of interrelated changes occurred during this period: equipment (both tanks and HAWs) improved, tactics changed to reflect increased mobility and weapon systems capabilities, the perception of the Threat changed, and organizations changed.

In the mid-1950s the French introduced the first antitank guided missile, the SS-10. Within ten years, ATGMs had also been developed by

the Soviet Union (USSR), Germany, Italy, Sweden, Japan, and the United Kingdom.[3] In the early 1970s the United States fielded the TOW, a missile that compares favorably to any other ATGM in the world today.[4] The TOW and comparable systems provide the infantryman with, for the first time, a qualitative advantage over the tank. Under ideal conditions of range and visibility, he can engage and expect to kill the tank before the tank can engage and expect to kill him.

It is this qualitative advantage that prompts the question central to this thesis: is the current organization, developed for a more static, structured battlefield and less capable antitank weapons, optimized or can the capabilities of the TOW be more effectively exploited by some other organizational structure?

HYPOTHESIS

Optimum TOW potential is achieved when TOWs are organized into companies organic to both the tank and mechanized battalions.

SCOPE

The thesis was limited to consideration of TOW employment in heavy ground maneuver battalions employed in high intensity conventional warfare. This limitation was established in consideration of the central theme of the Army's capstone field manual on tactical doctrine, FM 100-5, Operations, that the "Battle in Central Europe against forces of the Warsaw Pact is the most demanding mission the US Army could be assigned."[5] It is, moreover, primarily a mission for armored/mechanized divisions.

The study was also limited to the mid-range time period to

consider only weapon systems currently in or on their way to the field. Looking into the future, one can see continued developments in the measure-counter measure pattern. For example, the possible wholesale proliferation of armored vehicles employing spaced armor may substantially reduce the present advantages of ATGMs, all of which rely on the shaped charge for their effectiveness. The author believes that by 1984 the environment may be sufficiently changed to require a new assessment.

METHODOLOGY

The effectiveness of each of five alternative organizations was subjectively assessed on the basis of a set of factors for comparison developed by the author. The current organization was used as the base case; the other four alternatives were to consolidate TOWs in divisional antitank battalions, to consolidate TOWs in separate companies in mechanized battalions, to consolidate TOWs in separate companies in both mechanized and tank battalions, and to consolidate TOWs in antitank platoons in the combat support companies of both the mechanized infantry and tank battalions. The alternatives are independent and, in a gross sense, they collectively encompass all feasible alternatives. The analysis consisted of determining the most effective alternative in terms of six factors for comparison: (1) concentration, (2) command and control, (3) balance, (4) combat service supportability, (5) training, and (6) cost.

The author did not attempt to duplicate the considerable efforts of the combat developments community in pursuing similar questions. Research incorporated a review of those efforts and brought together their unclassified results. For example, tests and studies of the TOW

Light Antitank Battalion (TLAT) and the Division Restructuring Study (DRS) Evaluation provided insights in the analysis of the antitank battalion and the antitank company respectively even though they were not directly applicable because the scope of those studies differed from that of this research. Reference to related results such as these did not change the basic subjective character of the analysis. The analysis was inherently subjective because of the intangible nature of the factors for comparison (especially command and control and training) and the consequent difficulty in measuring them directly. Similarly, it was felt that gaming was inappropriate because it would have required subjective assessments of organizational effects on simulation parameters that would have made game effects, in the author's opinion, no less subjective than assessments derived without recourse to gaming.

ASSUMPTIONS

Weapon System Capabilities

Assumption. Relative tank/antitank weapon system capabilities in both the US and Warsaw Pact Armies will remain approximately constant.

Rationale. This assumption permits the assessment of current conditions as being fixed. It is permitted by the mid-range time frame of the scope of the thesis and is based on the belief that it is neither feasible nor in keeping with past practices to develop and field weapon systems sufficiently innovative to change the complexion of an entire army in less than five years.

Tactics

Assumption. Neither US nor Soviet tactical doctrine will undergo major revision.

Rationale. In the case of US doctrine, this assumption took cognizance of the fact that the DRS addressed this same problem (in a much broader context) and offered a solution. The DRS solution, however, proposed tactical doctrine that differs from current doctrine significantly in the manner in which the combined arms are integrated. This study was constrained by this assumption to find a solution in the general context of current doctrine. In the case of Soviet doctrine this assumption established fixed conditions for the comparison of organizational alternatives.

End Strength

Assumption. Organizational changes recommended as a result of this research must be constrained to keep approximately the same divisional end strength for personnel and major weapon systems.

Rationale. This assumption recognized the requirement to structure the force within budgetary constraints. This creates a true optimization problem and precludes a solution based largely on adding equipment and/or people to the current division.

Combat Service Support

Assumption. Combat service support (CSS) assets in the current organization can be reorganized to adequately support approximately the same number of TOWs, however they may be reorganized.

Rationale. The CSS assets in the current organization were made a part of that organization on the basis of weapon system and personnel densities. Given that CSS assets are now adequate, this assumption permits the marginal analysis of strength differences among the alternative organizations to be made on the basis of TOW crewmen and command and staff increments only.

CHAPTER 2

BACKGROUND

This chapter establishes the background for this research by reviewing the historical perspective (including the current environment), related research, and systems other than the heavy ATGM currently in being to defeat armored vehicles. The historical perspective describes briefly the evolution of current armored formations and antitank equipment, tactics, and techniques, and incorporates a review of TOW system capabilities and the Threat.

HISTORICAL PERSPECTIVE

Antitank Warfare

Tanks were developed to break the stalemate of trench warfare in World War I. The machinegun and modern artillery weapons, munitions, and fire direction techniques had evolved to such a state that a massive imbalance existed between the offense and the defense. The infantry divisions were unable to mass sufficient combat power to achieve decisive results. The tank was developed by the Allies in an effort to restore mobility to the battlefield. The very first tanks were slow and very unreliable; no doctrine existed for their employment and no mechanisms existed to closely coordinate their efforts with those of the infantry. Nevertheless, they were successful enough to receive the support of the Allied command, and large quantities were ultimately procured.

In the absence of doctrine, their employment varied greatly.

The first significant successful employment of tanks was at Cambrai in November 1917. Nearly five hundred tanks, over a thousand guns, and aircraft for strafing and bombing supported six infantry divisions massed to break through on an eight kilometer front (an impressive density even by today's standards). A horse cavalry corps was to have conducted the exploitation. The assault was successful except in the area of Flesquières where the tanks met stubborn resistance, but command and control problems prevented an effective exploitation.[6]

Two things contributed to the failure at Flesquières: successful use of field artillery firing direct fire against tanks, and the failure of the infantry to coordinate their maneuver with the tanks. The artillery piece was the single most effective antitank weapon in that war. The standard German piece was the 77mm 1896, described as an "ideal antitank gun."[7] It was, first, larger than the tank guns (77mm versus 37-57mm or, in some cases, machineguns only[8]). Second, when properly emplaced its vulnerability was not much greater than that of the lightly armored tank (the thickest armor of that period was 22mm, on the French Renault, but most was half that[9]). In mobility, of course, the tank held an upper hand, although mechanical unreliability and slow speed put them on a much more nearly equal footing than their present day counterparts. Other weapons developed to defeat tanks were antitank rifles and grenades. The rifles were developed as an inexpensive, quickly available solution, but remained in use until the early days of World War II. They were unpopular because of their weight and limited effectiveness.

Thus an interesting equipment parity existed in tank versus gun, but the doctrine to exploit it was lacking. In fact, doctrine was

lacking on both sides, and the controversy over the use and role of armor raged throughout the last days of the war. Battles in 1918 were fought like Cambrai, but the problems of integrating the arms and of maintaining the tank fleets remained largely unsolved.

The great tank battles of the 1920s and 1930s were fought in the staff colleges and journals. It was a time when fiscal constraints and branch parochialism blinded all but the most visionary tacticians to the full implications of armored warfare. In Europe, theoriticians like MG J. F. C. Fuller were describing future warfare in terms of great sweeping scenarios much like those currently in vogue in the US Army. Yet, in virtually all armies except the German, armored/mechanized forces were neglected in favor of less controversial, less expensive, more traditional formations.

In the US Army, the National Defense Act of 1920 placed the tank corps equipment in the infantry[10] and thus tended to institutionalize the doctrine that tanks are basically infantry support weapons. Very little work was done to develop an antitank weapon. Initially it was believed that the World War I .50 caliber machinegun would suffice. However, lack of funds, failure to perceive the imperatives of modern warfare, or lack of interest (or all three) stifled armor and antiarmor developments in this country. An experimental mechanized force was organized in 1928 at Camp Meade, Maryland. Later moved to Camp Knox, Kentucky, it evolved into the 7th Cavalry Brigade (Mechanized)[11] and constituted the total US combined arms armored force as late as 1939.[12] Inadequate as that may seem, dedicated antitank capabilities were even more inadequate. Professor Weigley in his omnibus History of the United States Army credits the infantry with a total of one 37mm antitank gun

as late as February of that year.

In The area of doctrine, the Command and General Staff School (CGSS) published several editions of an Antitank Defense pamphlet in the late 1930s. It is perhaps indicative of the lack of consensus within the Army that it was labeled "tentative," but it is nevertheless a useful record of the then-current thinking. It states that "the primary positive methods of defense which seek to destroy or disable hostile tanks consist of the employment of antitank guns, tank mines, tanks, and aviation."[13] The guns were organized in regimental companies and divisional battalions; both had only .50 caliber machineguns because that was the best weapon available in the field at that time.[14] Both units were intended to be centrally controlled, the company at regimental level and the battalion at divisional level. The requirement for this central control was engendered by the perception that it was necessary to mass antitank weapons against determined armor attacks, and that it was necessary to provide antitank protection in depth in all types of operations. In retrospect, the organization and doctrine seem to have been far superior to the equipment of the era.

The Germans fully understood the implications of the revolution in mobility and firepower and successfully applied the new tactical imperatives in Poland in 1939 and in France in 1940. In France they faced a numerically superior enemy force in the French and British Armies: approximately 2,800 German tanks versus 4,000 in the Allied forces [15] with over 6,500 antitank guns in the French sector alone.[16] The numbers, of course, fail to adequately depict qualitative differences. For, example, the British Matilda tank was superior to the German Mark III which was itself superior to the British

Vickers-Armstrong Type B. Some French units had the relatively new 25mm antitank gun which was effective against 40mm of armor at 800 meters. However, the much older 37mm guns that predominated in the sector of the German breakthrough were much less effective. The point is that massive material imbalances did not exist. The organization and doctrine developed for the position defense left the French weak everywhere. Without a clearly superior weapon, a capability of massing, and a degree of flexibility, they were incapable of dealing with the German offense.

The United States went to war with an organization very much like that alluded to in the 1936 CGSS tretise: regimental antitank companies and antitank battalions. Formally, the antitank battalions were organized as non-divisional tank destroyer battalions, having been taken out of the division in the 1941 reorganization. In practice, a tank destroyer battalion normally accompanied a committed division. Additionally, an infantry battalion antitank platoon emerged, and a weapons platoon that ultimately included three rocket launchers was formed in the rifle company.

General Leslie McNair, Commander of Army Ground Forces (AGF), was largely responsible for making the tank destroyers non-divisional units. His redesign of the division was driven by the complementary concepts of streamlining and pooling. ("The division should include only those elements it would normally need to advance against average resistance."[17]) McNair was, however, an advocate of heavy antitank weapons and made one of the first assessments of their value based on cost. As early as July 1941 he stated, "it is poor economy to use a $35,000 tank to destroy another tank when the job can be done by a gun

costing a fraction as much."[18] Tank destroyer battalions were organized both with self-propelled guns and with towed guns. Guns used included 3 inch, 76mm, and 90mm cannons; in all cases a bigger gun than that provided the regimental antitank companies. Their role was an offensive role "even when supporting large-scale defensive operations....to seek out and destroy the tanks themselves."[19]

In principal, placing antitank weapons throughout the organization appealed to economy while satisfying tactical requirements. In practice, the theoretical organization was subverted because the 37mm gun in the infantry regiment was inadequate. (By the time it was replaced by the 57mm, that too was inadequate.) AGF reports indicate that some infantry regiments went so far as to disband the regimental companies.[20] The really successful US innovation was the 2.36 inch rocket launcher, the bazooka. Its rocket propelled warhead was effective against tanks, although its effective range was only 275 meters. Thus, the notion of light, medium, and heavy antitank weapons was well embedded in the organization by the end of the war. What is more significant, however, is that when the medium antitank weapons (ie. the regimental 37mm and 57mm guns) were perceived as inadequate the general solution was to fragment the tank destroyer battalions under the operational control of the regiments and battalions.[21] This suggests that in the heat of battle it was perceived as more important to push the heavy weapons down rather than hold them under centralized control to be employed in mass.

Perhaps the most famous antitank gun of World War II was the German 88mm, a multipurpose cannon intended primarily as an antiaircraft gun. This high velocity gun had an almost unparalleled capability to

to defeat armor and was effective at long ranges (3,000m). In ideal terrain it could, therefore, achieve a significant range advantage over the tank. After action reports and personal accounts relate numerous instances of a single gun blocking a constricted avenue of approach from a position safely beyond the effective range of the assaulting tanks. On the other hand, these same data indicate numerous instances where terrain precluded the realization of that potential advantage.

World War II was an infantry war. Only about 20 percent of US and German divisions and less than 10 percent of Soviet divisions were armored (or mechanized, or motorized, in a gross sense the distinction is moot).[22] Antitank guns in the infantry forces were capable of providing a defense against armored vehicles when force ratios were not badly skewed. US combat results have not yet been declassified but British data show that approximately 40 percent of tank losses were due to antitank guns. Even in the tank dominated North African campaigns, Axis antitank guns edged tanks slightly in numbers of British tanks destroyed; in Northwest Europe (1944-45), that ratio was three-to-one.[23]

In the post war demobilization, non-divisional tank destroyer battalions were eliminated. On paper, a tank battalion had been added to the division, representing the institutionalization of the idea that the best defense against a tank is another tank. The lessons of World War II seemed clear, the regimental antitank efforts had been inadequate and a tank was inherently more flexible than a tank destroyer (which, in its self-propelled version was viewed by many as merely a light tank). That decision was also influenced by the fact that thousands of tanks left over from the war were available to fill those battalions.

At the same time, however, recoilless weapons technology continued to advance. The 2.36 inch rocket launcher of World War II was replaced by the 3.5 inch rocket launcher during the Korean War, and 57mm and 75mm recoilless rifles were introduced.

The next big change for the Army came in late 1950s when the pentomic infantry division was created. 90mm recoilless rifles replaced earlier models and the 106mm was introduced. Tanks also continued to improve. This was a period when both tank and antitank capabilities got bigger and better without a radical departure from past trends. Tanks got heavier and faster, guns got bigger, and fire controls got better. Similarly, antitank weapons got bigger and more accurate at longer ranges but a sort of dynamic status quo seemed to have been reached. The first significant innovation was the French success in the development of the SS-10 ATGM in the mid-1950s. A variant of the follow-on SS-11 was exported as the Entac and used in the US pentomic division. These early missiles provided the infantry with a longer effective range than the tank. However, these were first generation missiles: the operator had to fly them to the target by remote control. As a consequence they tended to be inaccurate and were not well accepted. For these and other reasons they were phased out in preference to the proliferation of the 106mm recoilless rifle and the then under development TOW missile.

In 1961 the US Army reorganized again along the lines of the flexible World War II armored division. That organization is essentially the organization currently employed. Divisions were organized with the 106mm recoilless rifle originally but have since been reequipped with the TOW. Before discussing that organization, however, it is

appropriate to focus on the weapon itself.

TOW Heavy Antitank Weapon

The TOW. The current standard heavy antitank weapon in use by US forces is the TOW ATGM. The TOW is a second generation ATGM employing a shaped charge warhead capable of defeating any known homogeneous armor.[24] The weapon system consists of a launcher assembly and the missile. The launcher assembly is configured in a variety of vehicular mounts and a ground mount. Its key components are the missile guidance set and the day sight tracker. The missile comes to the gunner encased, and is placed in the laucher without being removed from the sealed case.

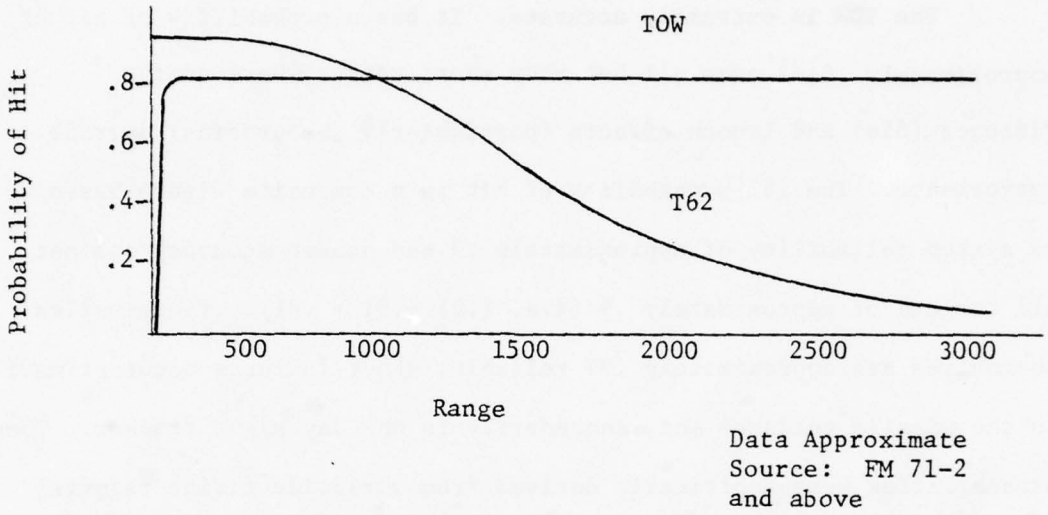
The missile has a two stage rocket motor: a launch motor which burns totally before the missile leaves the launch tube and a sustaining or flight motor which ignites when the missile is approximately twelve meters down range and boosts the missile to its peak velocity very quickly. The missile coasts throughout most of its flight and slows down from the time the flight motor ceases to burn until the end of the flight. There is some variation in speed over time; however, its flight can be estimated at approximately 200 meters per second with sufficient accuracy for most work.

The TOW is used with both ground and aerial launchers. In the ground mode, with which we are concerned here, it has a range of 3000 meters which is constrained by the optical tracking system. The TOW has an infared flare which burns in the aft end of the missile. This flare is visible to the infared tracker mounted parallel to the day sight. The gunner merely tracks the target using the standard cross hair reticle in the day sight/night sight. The missile guidance set

determines the difference between the point of aim (from the sight) and the location of the missile (from the tracker), computes corrections, and sends them to the missile (via the wire command link). The missile corrects its flight using airfoil control surfaces. It is this automatic correction mechanism that makes the TOW a second generation missile.

The TOW is extremely accurate. It has a probability of hit of approximately .81[25] over all but very short ranges where arming distance (65m) and launch effects (particularly obscuration) degrade performance. The .81 probability of hit is a composite figure based on system reliability of approximately .9 and gunner accuracy against all targets of approximately .9 (i.e. (.9) (.9) = .81). The missiles themselves are approximately .97 reliable; other failures occur primarily in the missile guidance set, secondarily in the day sight tracker. These probabilities were empirically derived from worldwide firing reports collected by the TOW-Dragon project manager (PM TOW) since the TOW was first fielded in the early 1970s. They have been criticized because raw data from which they were derived include multiple firings by experienced gunners, demonstrations, and stationary target engagements. The Training Effectiveness Analysis (TEA)-TOW conducted at Fort Hood in March-May 1978 generally corroborated those figures for 228 novice gunners engaging a tank moving 20-25 kilometers per hour at a range of 2,900 meters (+/-),[26] and they will be used here without further question. These probabilities are, however, based on training range conditions and should be degraded for suppression and other battlefield conditions. The extent to which the theoretical weapon effectiveness is degraded is highly controversial and may, directly or indirectly

be linked to organization. Regardless of the exact probabilities involved, the unquestionable fact remains that the TOW can outshoot the Soviet T62 main battle tank at ranges in excess of about 1,000 meters (Figure 1).



Data Approximate
Source: FM 71-2
and above

Figure 1

TOW, T62 First Round Hit Probabilities

The TOW kills by means of an eight pound shaped charge warhead that can burn through thirty inches of conventional armor. Most hits are catastrophic with almost all resulting in major damage rendering the tank unable to move or fire.[27] Innovations in armor technology will inevitably reduce the effectiveness of shaped charge munitions. The majority of the armored fighting vehicles in first line divisions will, however, have conventional armor well beyond the mid-range time period because, in the author's opinion, it is neither feasible nor in keeping with past practice to develop and field weapon systems sufficiently innovative to change the complexion of an entire army in less than

five years.

A final consideration of capabilities cogent to this discussion is the supply of missiles themselves. Each encased missile weighs 83 pounds including packing materials but, more importantly, takes up 4.14 cubic feet. The M113A1 armored personnel carrier (APC) can carry ten missiles on board. Others may be carried in the task force trains but there also the capability is constrained and hence the total number of missiles available may be severely limited.

Training. The TEA-TOW found that the individual skills required by the gunner are much easier to teach than had been previously believed. In that test, seventy-three out of eighty-five novice gunners (86 percent) hit the moving tank target after having received only eight hours of training that included only eleven tracking exercises and did not use conventional TOW training equipment (i.e. the M70 TOW Trainer). Subsequent testing involved two groups of gunners who trained for twenty hours. One group used the M70 TOW Trainer and the other group did not. There were no statistically significant differences between the groups by all measures used: percent hits, radial distance of the point of impact (or the point at which the missile entered the plane of the target) from the center of mass of the target, and tracking steadiness. The overwhelming conclusions are that sophisticated equipment, including highly engineered range facilities, and large blocks of time are not needed to teach gunnery skills.

Vulnerabilities. Several TOW vulnerabilities and limitations have been alluded to but are worth recapitulating for emphasis. The most significant vulnerability is the lack of crew protection afforded

by the M113A1 APC. To fire the TOW, the vehicle must be stationary throughout launch and tracking and the cargo hatch must be open. At least one crew member, the gunner, must expose the upper half of his body throughout the entire engagement. Even when/if buttoned up, however, the M113A1 affords only the most limited armor protection, and can be destroyed by heavy machine gun fire and virtually all gun, rocket, and missile systems. The US Army is designing an improved TOW vehicle (ITV) based on an M113A1 that will enable the crew to launch and track missiles buttoned up but it is an expedient solution that fails to address the fundamental inadequacies of the M113A1.

The vulnerability of the system tends to off-set some of the superiority implied in the probability of hit comparison made in Figure 1. At shorter ranges the tank generally enjoys significant advantages; at middle ranges the advantages and disadvantages tend to be off-setting; and at long ranges the TOW enjoys the advantage.

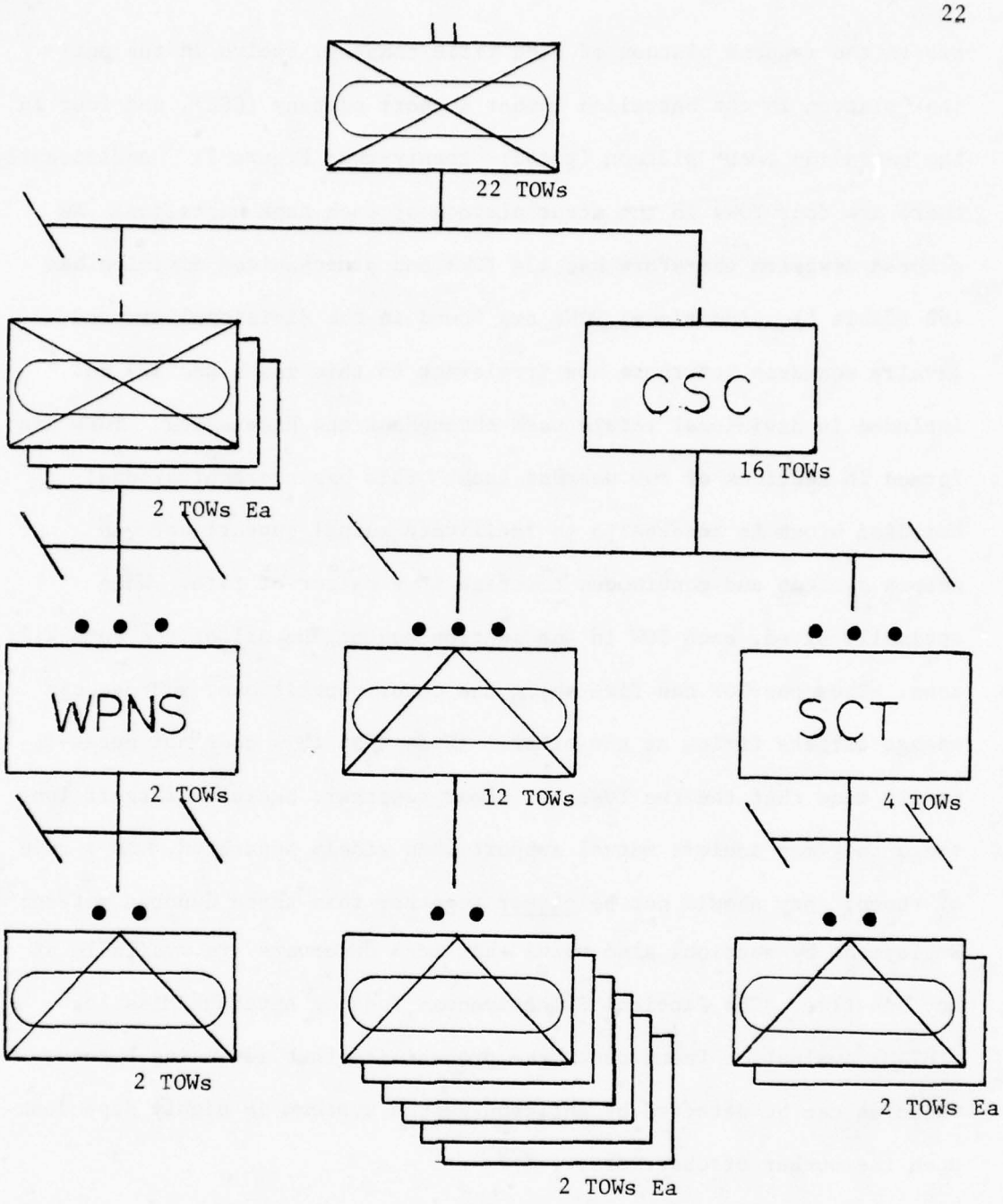
The most significant limitation of the system is the slow rate of fire combined with a paucity of ammunition. A TOW can expend its on-board ammunition very quickly; thus resupply is a critical problem. The slow rate of fire compared to a main battle tank or a Soviet BMP cannon combines with the ammunition limitation to make the TOW a very poor weapon for close fighting; once located at close range it will be easy to suppress and kill.

Current Organization

The organization used as the current organization for the purposes of this thesis will be that prescribed by the modified table of organization and equipment (MTOE) employed by the US Army, Europe. TOWs are heavily concentrated in the mechanized infantry battalion with

two in the weapons platoon of each rifle company, twelve in the antitank platoon in the battalion combat support company (CSC), and four in the battalion scout platoon (total: twenty-two; Figure 2). Additionally, there are four TOWs in the scout platoon of each tank battalion. An armored division therefore has 134 TOWs and a mechanized division has 152 (Table 1). Additional TOWs are found in the divisional armored cavalry squadron but those are irrelevant to this issue and are not included in divisional totals used throughout the discussion. TOWs are formed in sections of two weapons each. This basic organizational building block is adhered to to facilitate mutual support between weapon systems and continuous coverage of a sector of fire. When optimally sited, each TOW in the section can engage all of the same kill zone. Thus one TOW can fire while the other repositions, and one can engage targets firing at the other. (Note that this does not necessarily mean that the two TOWs are close together; because of their long range they may achieve mutual support when widely separated. As a rule of thumb, they should not be <u>closer</u> together than three hundred meters.[28]) Employment by sections also means that more observers are available at any one time. The Tactical Effectiveness Testing Antitank Missiles (TETAM) evaluation found that "the probability that advancing threat vehicles can be detected by antitank weapon systems is highly dependent upon the number of observers...."[29]

In organizing for combat, TOW sections organic to rifle companies and the scout platoon are seldom taken from those units. TOWs from the antitank platoon are normally attached directly to company teams including companies cross-attached to tank battalions. In some cases all or part of the antitank platoon is retained under task force control.[30]



(1) NOTE: The Tank Bn included only these two TOW sections.

Figure 2

Current Organization

Table 1

TOW Density in Current Divisions

Type Division	Mechanized Battalions		Tank Battalions		Total
	No. of Bns	TOWs per Bn	No. of Bns	TOWs per Bn	TOWs
Mechanized	6	22	5	4	152
Armored	5	22	6	4	134

The Threat

Forces. "The principal challenge to the security of the United States and its Allies is the military power of the Soviet Union."[31] In terms of the battle in Central Europe, that military power takes the shape of Soviet tank and motorized divisions garrisoned in East Germany and Czechoslovakia. Their offensive doctrine is generally characterized by the concentration of combat power on a very narrow front to achieve a breakthrough of the enemy main defenses.[32] Writing in 1972, Biryukov and Melnikov state that up to fifty armored vehicles must be concentrated per kilometer of front line. This corresponds to massing the first echelon battalions of an attacking division on a 6-10 kilometer front. Concentrations of weapon systems that dense were achieved in both World Wars. The difference today is the tremendously increased lethality of modern weapon systems. This concentration creates for the defender the critical problem of concentrating his own forces in order to meet strength with strength. Soviet doctrine calls for a minimum of 3 to 1 in tanks and 4 to 1 in infantry at points of desired penetration.[33] Some sources indicate that the desired ratios run twice that high. Once concentrated, the defender then faces the problems of

target selection (engaging the most appropriate target with a given weapon system) and target servicing (killing all the targets quickly).

To further enhance the value of concentration, Soviet tacticians seek to achieve and maintain a very high tempo in combat operations. This is facilitated by the high degree of mechanization achieved by Soviet and Warsaw Pact forces over the last two decades and by the Soviet doctrine of continuous combat. In a tactical sense this is achieved by attacking in echelons. At all levels, second echelon forces follow the lead elements and are ready to assume their mission or reinforce their success. Generally each organization above battalion will be echeloned with up to half of its combat strength in the second echelon. Thus the defender knows that he must end each engagement quickly and in his favor to be able to turn his attention to new battalions and regiments coming into the fight.

The Soviets envision supporting this attack with large amounts of artillery and generally preplanned tactical air support (including attack helicopters). Up to one hundred tubes of artillery per kilometer of front in a deliberate, main attack are envisioned. This is a particularly significant factor for TOW employment because the M113A1 TOW carriers are so vulnerable to artillery fire. It also means that sufficient artillery will be available to fire smoke on suspected or likely TOW positions and/or to screen the flanks of attacking columns. The tremendous suppression capability could seriously degrade TOW effectiveness both by limiting engagement opportunities and by damaging equipment and injuring crew members. Moreover, the replacement of towed artillery with self-propelled artillery in first line Soviet divisions is making artillery support more and more responsive in the

offense in both direct and indirect fire roles. In the latter role, Soviet artillery can be expected to maneuver very far forward and represents a greatly increased threat to the TOW when employed to provide immediate suppression.

Additionally, the Soviets envision extensive use of offensive electronic warfare in support of their main effort. This will potentially disrupt command and control communications and severely hamper such routine and essential details as target hand-off, movement to alternate positions, and movement from a battle position.

In the defense, Soviet forces will array themselves in echeloned belts not unlike the echelons of the offense. The defense is organized around heavily defended strong points tied together laterally in an elaborate position defense. Counterattack forces and antitank reserves are maintained at all levels. Positions are improved continually once occupied to include digging in armored vehicles.

Terrain and Weather. The advantage offered by the TOW is its very high kill probability at very long range. Under ideal conditions, that long range provides a standoff capability that makes the TOW relatively immune to direct fire. In an MMAS thesis that considered the availability of ideal terrain in Central Europe, however, LTC John R. Angolia concluded that "the effective engagement range will fall between 1500 and 2000 meters."[34] To the extent that this is true, TOWs in any organizational structure would be seriously degraded. Among his data, Angolia notes the results of a "US/GE Antiarmor Concept Paper" published by the German Army Staff on 15 November 1976 which concluded that "lead tanks conducting the attack would be first observed beyond 2000 meters only 20-30 percent of the time"[35] (Table 2).

A similar study published by Durre Wilcken in Germany in 1972 indicated that the average frequency of fighting distances in excess of 2,000 meters for grounded weapon systems with a firing height of 1 meter is only 15 percent[36] (Table 3).

Table 2

Observation Ranges: Central Europe (from Angolia)

Range	Frequency (%)
Less than 2000m	70-80
2000-3000m	10-20
more than 3000m	5-15

Table 3

Observation Ranges: Central Europe (from Wilcken)

Range	Frequency (%)
0-500m	40
500-1000m	20
1000-2000m	25
over 2000m	15

Both authors also note the requirement for an intervisibility segment or window within which the enemy is observed so that he remains engagable throughout acquisition, launch, and tracking. To the extent that studies of this nature include terrain unsuitable for enemy

armored formations (e.g. urban terrain), the implications are less severe. The TETAM looked at specific sites in Germany in the North German Plain and the Fulda Gap and concluded that the "ATGM can be effectively used on the terrain sites examined in an ideal environment."[37] More detailed findings indicated that 3,000 meter shots were generally available in the Fulda Gap but were generally not available in the North German Plain.[38] Additionally, it must be recognized that TOWs are limited by reduced visibility during the hours of darkness, by adverse weather, and by smoke. These factors further limit the theoretical availability of maximum range engagements.

Taken together, all of these results do not mean that the range advantage of the TOW cannot be achieved; they emphasize that realization of that advantage is highly dependent upon site selection and that frequently it will not be possible to achieve the ideal standoff.

1973 Middle East War

The 1973 Middle East War is important to consider because it is the only time that modern, totally mechanized armies have met on the battlefield. One can argue that it is unrepresentative because many weapon systems used were a generation or more behind the state of the art, because it was fought in the desert, or because of the Israeli reliance on the tank-air team to the relative exclusion of mechanized infantry. While all of those criticisms are meaningful, they only obscure the central point, this is the most recent full scale armor battle that we have to study.

Descriptive statistics that express the general parameters of the conflict are somewhat questionable. Because of the confusion of modern battle; because of the unparalleled Israeli capability to repair

damaged tanks rapidly; because of an admitted Israeli psychological and organizational bias toward the tank; and because Arab data, especially Syrian, are generally unavailable in the West, studies that offer specific data tend to vary one from another. Data which are useful for discussion and which are probably as accurate as any other were offered by the International Institute for Strategic Studies (IISS) in its 1973 Strategic Survey. This shows that in the seventeen days from 6-22 October Israel lost one-half of its tank fleet and the Arabs lost over one-third. A total of about 2,200 tanks were destroyed, roughly the equivalent of all of the tanks in seven US heavy divisions (Tables 4 and 5).

Table 4

1973 Middle EAst War, Forces (Initial)

Country	Divisions	Total Manpower	Medium Tanks	Combat Aircraft	SAMs
Israel	11	290 000	1700	500	60
Egypt	12	283 000	2000	600(1)	650
Syria	7	130 000	1600	300(1)	200
Iraq	3	31 000	400	60	-

Note: (1) many in storage

Table 5

1973 Middle East War, Estimated Losses

Country	Killed	Wounded	MIA/POW	Tanks Dest.	Fighters Dest
Israel	2812	7500	531	840	120
Egypt	15000	45000	8500	650	182
Syria	7000	21000	NA	600	165
Iraq (in Syria)	125	260	18	80	21

Those casualties, more than anything else, led the IISS to conclude in a study two years later that "On the ground and in the air, therefore, the advent of the missile suggests that the day of the main battle tank and warplane may be ending. The superiority of the offensive may be declining in favor of the defensive."[39]

While this is by no means a universally accepted point of view, a senior Israeli viewpoint on the changing role of the tank is interesting, especially because it represents somewhat of a departure from the Israeli tradition:

> No other weapons system contains such a potential for movement and firepower as the tank, and it is almost certain that within the near future the tank will remain the chief weapons system for desert warfare....The tank was created, and exists, as an attack weapon, in particular for assault campaigns, and as such there is still no alternative to it....We must get used to the fact that the security and status of the tank on the battlefield has changed in several ways; the extent of the tank's vulnerability and the risks involved in employing it in battle have increased considerably; the tank has lost its superiority as an antitank weapon to the long-range missile and in the future will also lose it to antitank artillery; against new weapons systems the tank has lost its capacity to fight alone and is, to an increasing extent, dependent on other systems; the tank has lost a large part of its freedom of movement throughout the fighting arena.[40]

The 1973 War established several things. First, conventional war has become totally mechanized and very complex. Associated with that idea is the tremendous lethality of the modern battlefield. Second, the war clearly demonstrated the viability of the ATGM and its value. Third, it demonstrated still again the absolute necessity for the integration of all arms, air and ground.

RELATED STUDIES

TOW Light Antitank Battalion

The TLAT was conceived as an inexpensive means to dramatically increase the ground TOW capability of the light infantry divisions. It was designed with five companies of twelve TOWs each (Figure 3) and would supplement (not replace) TOWs already in maneuver battalions. Conceptually, one TLAT would support one light division, along the lines of the tank destroyer doctrine. The maneuver commander could employ TLAT as a battalion, by companies, or by platoons. A scaled down organization of three companies of twelve TOWs each was organized in the 101st Airborne Division (Air Assault) and deployed in the REFORGER 76 exercise. The reduced size was appropriate to the size of other deploying divisional elements. Gunners were credited with being able to achieve substantial standoff and the battalion achieved an impressive kill ratio. However, upon completion of the exercise it was decided not to retain the organization.[41]

Division Restructuring Study

Throughout 1976 the Training and Doctrine Command (TRADOC) conducted Phase I, DRS "to develop organizations for test which best

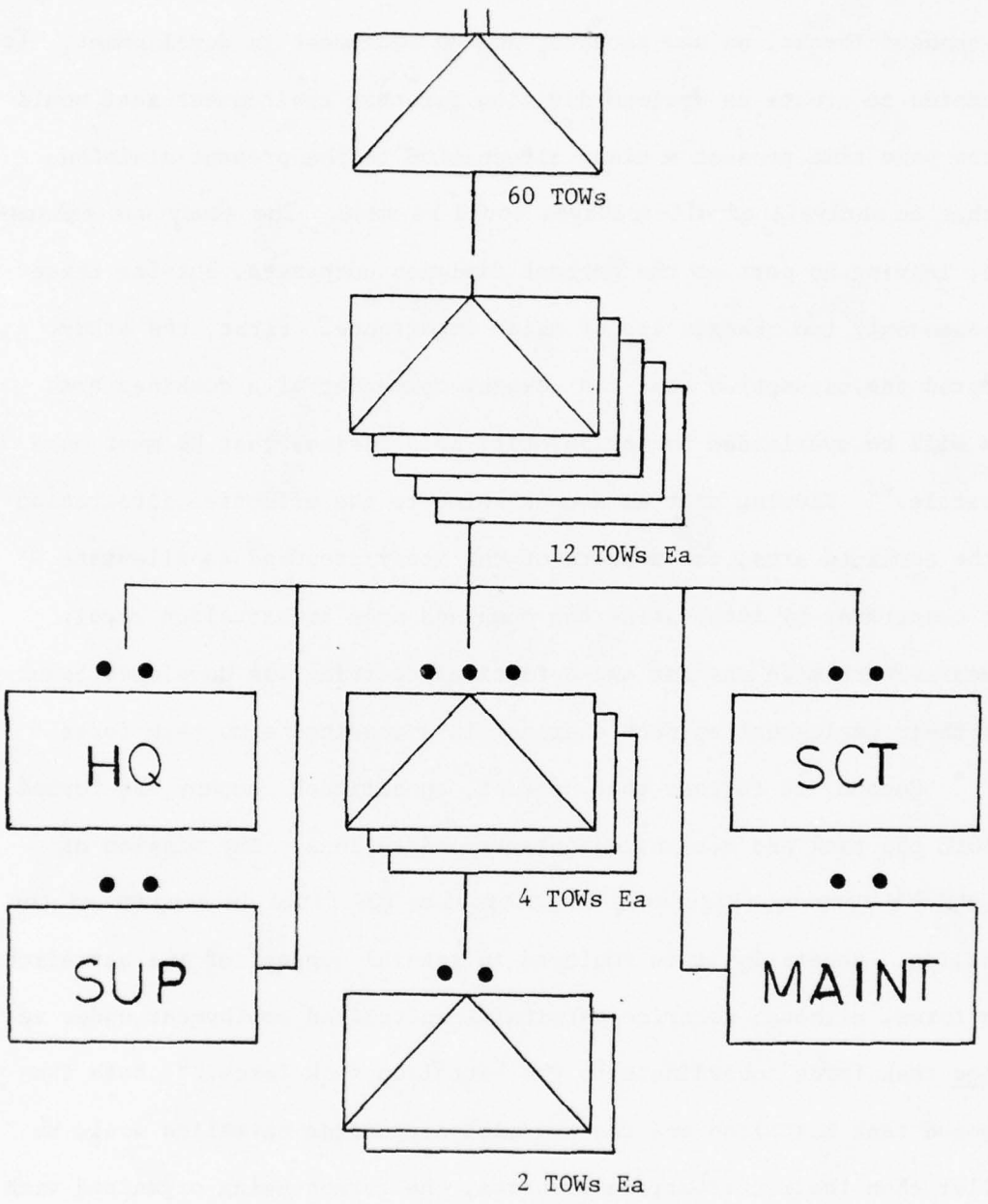


Figure 3

TOW Light Antitank Battalion (TLAT)

prepare the US Army to integrate into the force and optimize the employment of the new weapon systems of the 1980s.[42] The study focused on the changed Threat, on new tactics, and on equipment in development. It attempted to create an optimum division for that environment that would at the same time present a clear alternative to the present division so that an analysis of alternatives could be made. The study was exhaustive, leaving no part of the current division unchanged, but for these purposes only two changes are of major importance. First, the study accepted the assumption that the company commander of a combined arms team will be overloaded by the quantity of decisions that he must make in battle.[43] Viewing that as a constraint to the effective integration of the combined arms, the authors of the study proposed to alleviate that constraint by integrating the combined arms at battalion level. Companies were made smaller and a tactical doctrine was developed based upon their employment as pure elements in a combined arms task force.

Second, to further that concept, an antitank company was formed in both the tank and mechanized infantry battalions. The mission of the DRS TOW Company (Figure 4) is to provide TOW fires in support of the battalion. Generally it is employed in general support of the battalion task force, although doctrine permits decentralized employment under an ad hoc task force subordinate to the battalion task force.[44] Both the proposed tank battalion and the proposed mechanized battalion would be smaller than their current counterparts, the former being organized with three tanks per platoon.

DRS, in essence, solved the problem posed by this thesis. The primary difference between this effort and that study, aside from breadth, is that the present author seeks a solution in the context of current

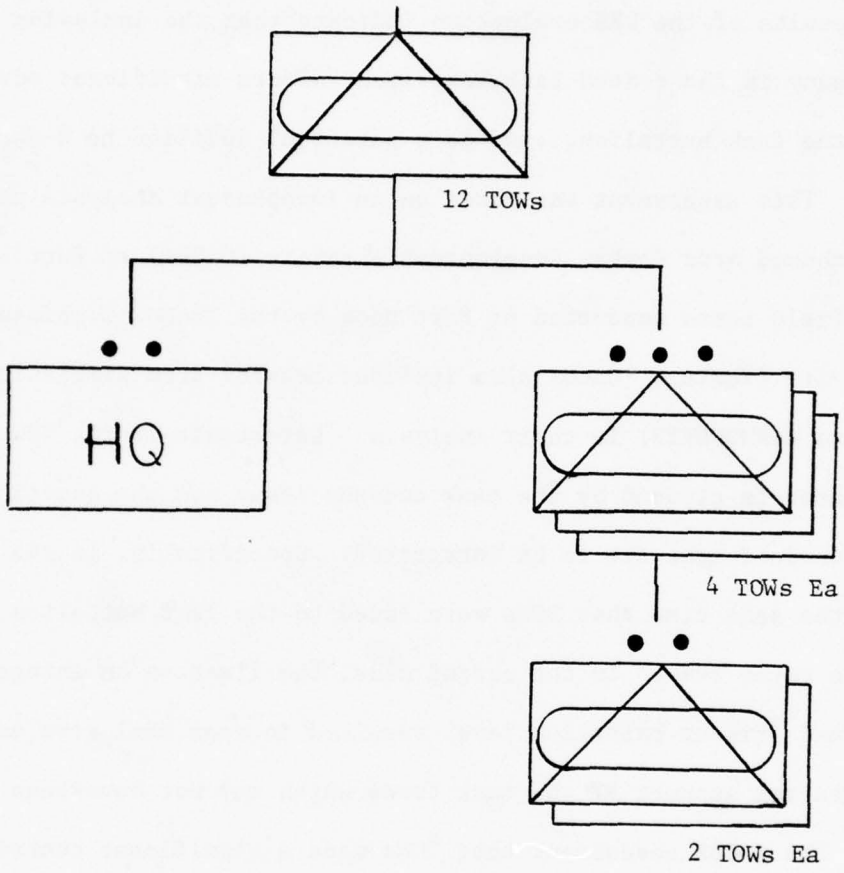


Figure 4

Proposed DRS TOW Company

tactical doctrine that the tank-infantry team is generally formed at company level. This is primarily because the author does not accept the assumption that integrating the combined arms at battalion level enhances command and control to more effectively fight the battle.

Results of the DRS evaluation indicate that the inclusion of a TOW company in the tested tank battalion "offers significant advantages to the tank battalion...and is a potential addition to H-series units."[45] This assessment was based on an independent analysis performed by the Combined Arms Combat Development Activity (CACDA) at Fort Leavenworth of field tests conducted at Fort Hood by the TRADOC Combined Arms Test Activity (TCATA). CACDA also included results from simulations (BATTLE and CARMONETTE) in their analysis. Unfortunately the TOW company issue is clouded by the tank company issue and the question of how the combined arms are to be integrated. Specifically, in the first case, at the same time that TOWs were added to the test battalion, tanks were taken away. In the second case, the fixation on integrating the combined arms at battalion level resulted in near exclusive use of TOWs in general support of the task force which may not have been optimal. The CACDA assessment that TOWs made a significant contribution to organizational effectiveness in terms of loss exchange ratios is, however, supported by the data.

In the mechanized battalion the assessment was inconclusive[46] noting the fact that the loss of TOWs (eighteen in the current, H-series organization versus twelve in the test organization, exclusive of scouts) causes the question of effectivenss, measured by loss exchange ratios, to be clouded. The difficulty with this view is that it fails to make an assessment at a sufficiently high organizational level to account for

the shift in resources from the mechanized to the tank battalion. Additionally, the evaluation noted that command and control in the mechanized battalion is enhanced and it questioned the effectiveness of using the TOWs primarily in general support.[47]

In terms of training, the TOW company was favored because of the concentration of expertise, singleness of mission, and increased officer density.[48]

A follow-on test, the Modified Tank Battalion Evaluation was conducted by TCATA to assess the effectiveness of two tank battalion organizations, both of which were based on the four tank platoon. Both variants were organized with a TOW company. A user assessment methodology was employed in this test and users overwhelmingly concluded that the TOW company was an effective, worthwhile addition to the organization. Unfortunately, no comparison testing or field testing was done.[49]

USMC Organizational Study

In 1975 the United States Marine Corps (USMC) undertook a study of the optimum organization of the tank battalion, Fleet Marine Force (FMF). This study was undertaken because the phasing out of the Ontos antitank recoilless rifle system and the consequent deletion of the USMC antitank battalion left the division seriously weakened in antitank capability at a time when potential adversaries were acquiring more and more tanks and other armored vehicles. The study concluded that the battalion should consist of a TOW company and three tank companies (Figure 5). In the particular environment that the USMC envisions, however, the tank battalion exists primarily as a combat support element. "The elements of the battalion will normally be attached to, or in

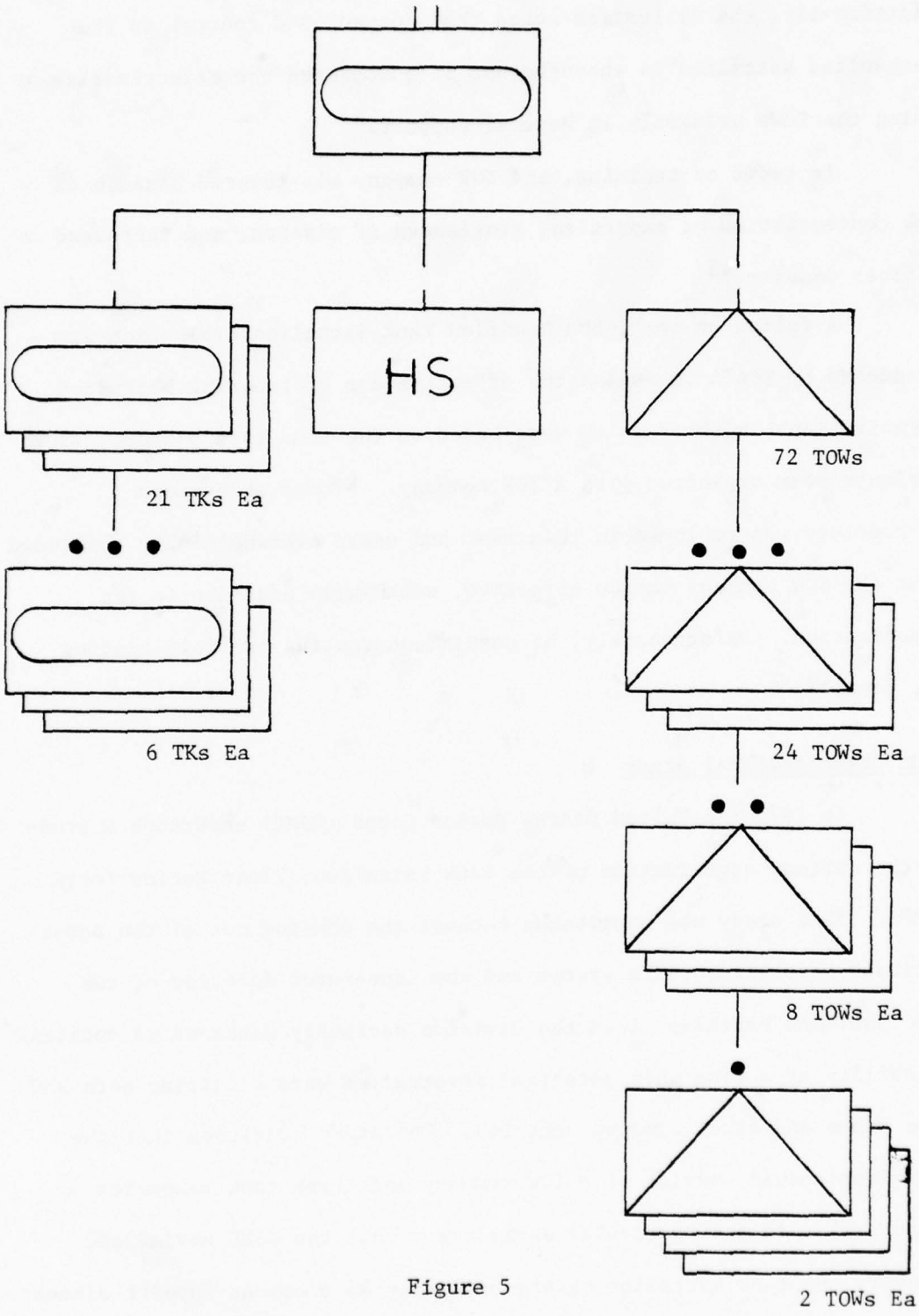


Figure 5

USMC Tank Battalion, FMF (1975 Study)

direct support of, infantry units."[50] Of particular interest is the TOW section which is composed of four squads of two TOWs each. This was felt to be the "minimum number of launchers necessary to support a Marine Infantry Battalion opposed by an armor-heavy enemy."[51] The triangular organization provides one such section for each infantry battalion in the Marine division; although, at least theoretically, a force could be tailored with more than one section supporting or attached to a battalion. The section can be broken down into squads to provide two TOWs per infantry rifle company or employed in whole or in part from battalion level. The Marine infantry battalion itself has no organic TOWs.

Student Work

An antitank battalion for Central Europe was proposed by several Command and General Staff College (CGSC) students in a paper written in 1976. The analysis presented consisted of an exhaustive review of the threat which the authors concluded made the thickening of US antitank defenses desirable. Unfortunately their work failed to demonstrate the unique values of their alternative. Their work is of interest primarily because of the nature of their alternative, a battalion that includes not only TOWs but also Dragons and mortars (Figure 6). The mortars are an especially interesting innovation owing to their capability for suppression and illumination.

AntiArmor Systems Study

The AntiArmor Systems Study (A^2S^2) was an exhaustive TRADOC study of the US Army's overall antitank posture. It included consideration of all antitank systems and offered a net assessment of the

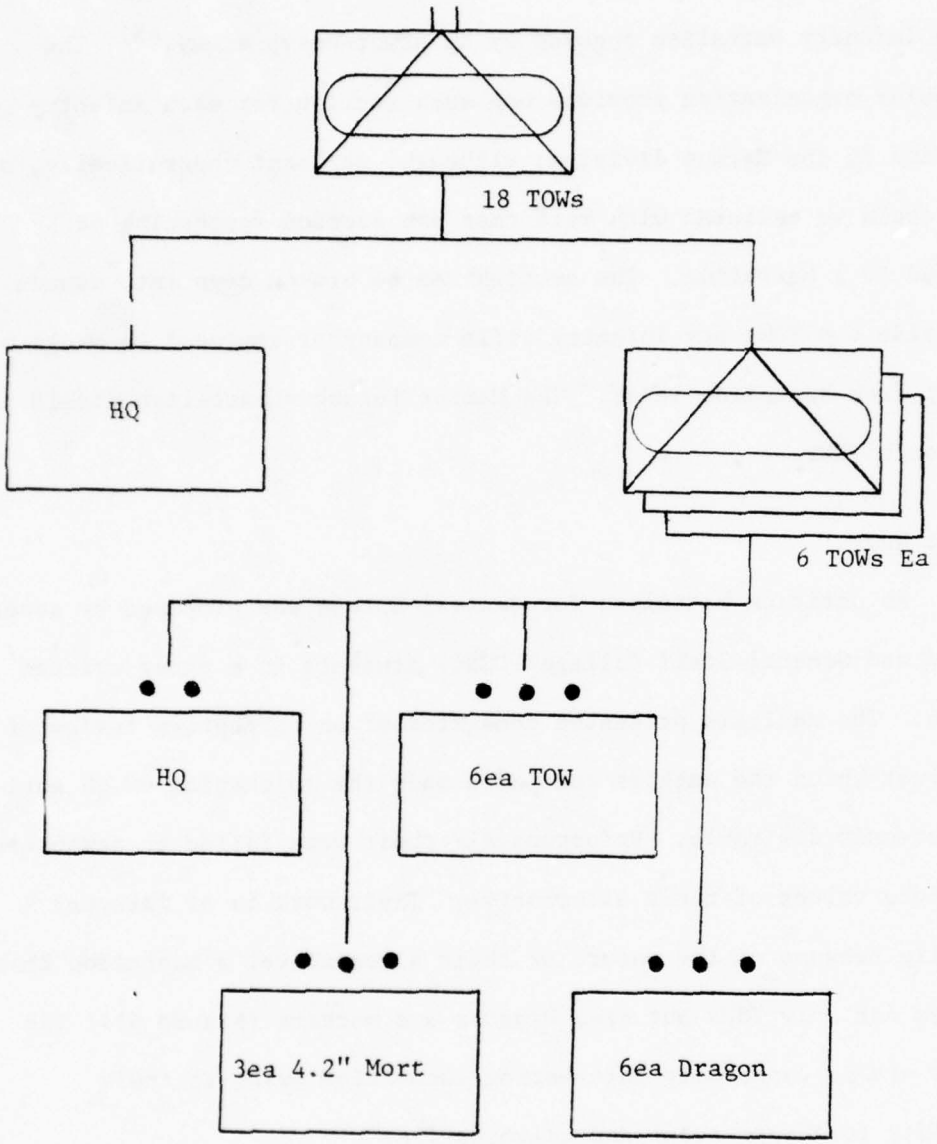


Figure 6

Conceptual Antitank Battalion (CGSC Students)

then (1976) current situation in the field. Of particular interest to this thesis are the TOW training deficiencies reported. Two of the six deficiencies reported concern use of the M70 TOW Trainer which the TEA-TOW showed to be unneeded for gunner training. A third deficiency concerned the TOW training development program and that too was addressed by TEA-TOW. The remaining points can be assumed to remain deficiencies: (1) 67 percent of TOW crews seldom train at night, (2) 61 percent seldom train as a combined arms team, and (3) 40 percent of TOW crewmen cannot identify USSR tanks.

RELATED SYSTEMS

TOW is part of a family of infantry antitank weapons. Other members of the family are the Light Antitank Weapon (LAW) and the Dragon medium antitank weapon (MAW). Additionally, these infantry systems share the antiarmor role with several other systems on the battlefield. The purpose of this portion of the narrative is merely to acknowledge these other systems and provide a very brief description of their use and capabilities.

LAW

LAW is a shoulder fired 66mm high explosive, antitank (HEAT) rocket fired from a disposable launcher. It supplements other antitank weapons and is widely employed by combat support and combat service support units for close in antiarmor protection. It is a short range weapon (250 meters against point type targets) with a low probability of kill becuase of its small size and inaccuracy.[53] A replacement light antitank weapon, the Viper,will complement the LAW in the field and gradually replace it. Although superior to the LAW, the Viper retains

the same relative disadvantages of range and accuracy compared to ATGMs.

Dragon

Dragon is a second generation ATGM fielded on the basis of four per infantry platoon or scout platoon (four per infantry battalion and four per tank battalion). Compared to the TOW, it has both a short range (1,000 meters) and a slower time of flight (12 seconds per 1,000 meters). The large warhead is effective in defeating armor but the system probability of kill is lower than that of the TOW because the position of the launch tube on the gunner's shoulder makes tracking more difficult.[54]

Airborne TOW

Attack Helicopter companies and air cavalry troops equipped with the AH-1S attack helicopter are being organized in divisions, in separate brigades and regiments, and in non-divisional aviation battalions and air cavalry combat brigades. The heliborne TOW system differs from the ground system only in the range of the missile, 3,700 meters versus 3,000 meters in the ground mode. This difference is caused by the ability of the tracker to detect the infared flare clearly at extended ranges, however, and not by the missile itself. Generally speaking, attack helicopter companies are employed from division level although they may be placed under the operational control (OPCON) of a brigade or battalion for a specific operation or they may reinforce a ground maneuver unit by fire.[55]

Mines

Presently conventional mines are available to defeat armor. Mine capabilities are being greatly enhanced, however, by the fielding

of the family of scatterable mines (FASCAM). These are self-destructing antitank (and antipersonnel) mines delivered by a variety of means. They provide a dynamic capability to reinforce terrain. In terms of the scope of this thesis, FASCAM is an "on the way to the field" system although it may not be fully fielded by the mid-1980s. Already in the field is the M56 helicopter dispersed mine system and soon to be fielded is the artillery delivered antitank mine (ADATM), a 155mm artillery round. Also nearing the end of the development cycle are the Ground Emplaced Mine Scattering System (GEMSS), and the Surface Launched Mine Rocket System (SLUMINE), and the Modular Mine Packed System (MOPMS).[56]

Cannon Launched Guided Projectile

The Cannon Launched Guided Projectile (CLGP or Gopperhead) is in an even earlier state of development than FASCAM; hence it is not perceived by the author as having an effect on the tactical balance to the mid-1980s.

Air Support

Fighter aircraft provide still another tank killing capability utilizing both gun and missile systems delivered by a variety of aircraft in both close air support and battlefield interdiction roles. They provide depth to the battle by attacking echelons not yet in contact. Like attack helicopters, air support will generally be controlled from a fairly high level and allocated to specific battalions and brigades as needed.

Tanks

The tank remains a primary antiarmor system. It defeats armor

targets using kinetic energy rounds and chemical energy rounds. The principal US kinetic energy round is armor piercing, discarding sabot (APDS); its Soviet analogue is called high velocity, armor piercing, fin stabalized, discarding sabot (HVAPFSDS or just APFSDS). Because both are "hyper-velocity" rounds their trajectories are very flat and the rounds are extremely accurate. Chemical energy rounds used in an antiarmor role are the HEAT and high explosive plastic (HEP) round. While all three are effective against armor targets, kinetic energy rounds are preferred against tanks, HEAT against APD's, and HEP against bunker type targets. The principal advantages of the tank in its antiarmor role are its armor protection, its rapid rate of fire when compared to ATGM systems, and its relatively large basic load of ammunition.[57]

SUMMARY

A new balance has been achieved. The ATGM possesses a distinct accuracy advantage over the tank at long range. It is extremely vulnerable and its vulnerability increases as range decreases. It is wholly unsuited to be an assault weapon, although it can support an assault including a hasty attack. It is severely degraded by terrain and reduced visibility. Yet, in spite of its limitations, the ATGM brings a new symmetry to the battlefield. At issue, then, is how to best exploit its advantages and minimize its disadvantages. The disadvantages of the tank, particularly in the offense, are substantial but talking about which system is "preeminent" or which is "offensive" or "defensive" is disfunctional. The lessons of Cambrai are the same as lessons of the 1973 War: modern battle is a combined arms undertaking

requiring the integration of a vast range of technologies. The optimization problem transcends branch and service lines and requires a conceptualization of the environment well into the future. This thesis addresses only a very small part of that optimization problem and addresses it only in the present: given an organization that owes its structure to a different environment, is it optimized in light of the new battlefield symmetries and tactical imperatives?

CHAPTER 3

METHODOLOGY

The hypothesis suggests that the current organization is not optimized for the battlefield described in Chapter 2. To test that hypothesis, the effectiveness of each of four alternative organizations was subjectively compared to the current organization on the basis of a set of factors for comparison developed by the author.

ALTERNATIVE ORGANIZATIONS

Four notional organizations were developed to provide simple, clear alternatives to the present organization. Together with the current organization they provided five alternatives for analysis: the Current Organization, the divisional TOW Battalion, the TOW Company (Mechanized Battalion), the TOW Company (Mechanized and Tank Battalion), and the Antitank Platoon (Mechanized and Tank Battalion).

Current Organization

The current organization, described in Chapter 2, was assessed as the base case.

TOW Battalion

The notional TOW Battalion (TOW Bn) consists of four companies with thirty-six TOWs each plus required CSS (Figure 7). The companies

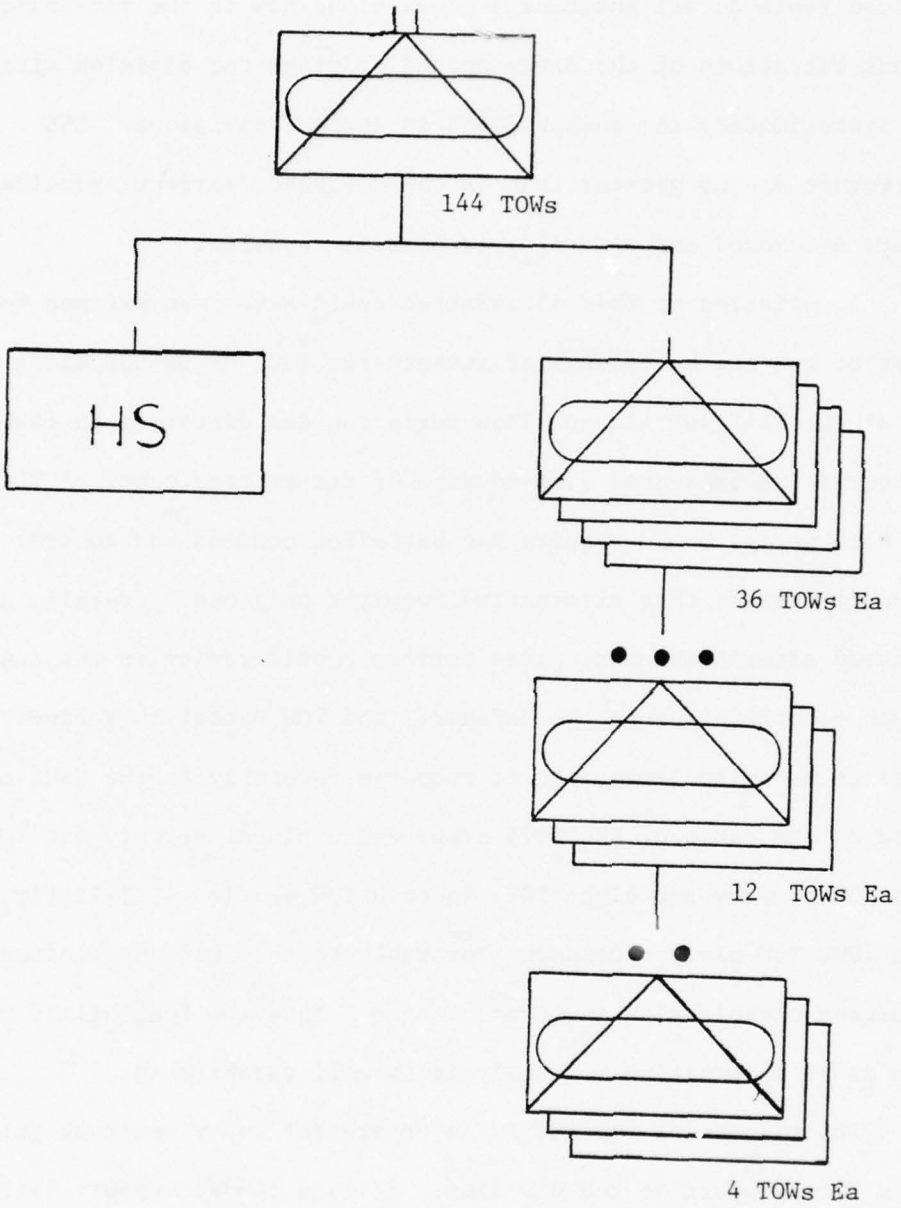


Figure 7

TOW Battalion

have three platoons, each structured like the current antitank platoon. The battalion also includes a headquarters and service company. One battalion replaces all antitank organizations now in the mechanized and tank battalions of the division and provides the division with 144 TOWs, approximately the number found in current divisions. CSS requirements are no greater than in the diffused, current organization; however, a command and control increment is required.

A variation of this alternative could have been defined to consist of two TOW battalions of seventy-two TOWs organized along the lines of the TLAT battalion. This variation was discarded in favor of the alternative presented here because of its extreme cost. A TLAT-based alternative would require two battalion command and control increments whereas this alternative requires only one. Overall, a TLAT-based alternative that gives serious consideration to the end strength constraint cannot be defined. The TOW Battalion defined here appears to be quite large, yet it compares favorably to the USMC model adopted on the basis of the 1975 study which places seventy-two TOWS in the TOW company and eight TOWs in each TOW section. Similarly, the twelve TOW, TOW platoon compares favorably to the antitank platoon in the current organization in terms of size. Thus the feasibility of the TOW Bn as an alternative for analysis is well established.

The mission of the TOW Bn is to provide heavy antitank guided missile fire support to the division. It is a combat support battalion and is employed by companies attached to, placed under the OPCON of, or placed in support of a major combined arms formation immediately subordinate to the division. Companies can be reinforced or reduced by one platoon prior to commitment. Consistent with the command/support

relationships established, companies, platoons, and/or sections can then be integrated into the maneuver units of the division as low as team level. The battalion headquarters may accompany a substantial portion of its companies (e.g., "TOW Bn(-) attached 3d Bde") but it does not perform as a command and control headquarters on which to tailor a maneuver force.

TOW Company (Mechanized Battalion)

The notional TOW Company (Mechanized Battalion) (TOW Co (Mech)) consists of twenty-four TOWs in four platoons of three sections each (Figure 8). As the name implies, the company is part of the mechanized infantry battalion and is separate from but does not replace the CSC. It does, however, replace the present antitank platoon of the CSC, the rifle company antitank sections, and the antitank sections in the scout platoons of both the mechanized and tank battalions. Assignment of one company per mechanized battalion provides the mechanized division with 144 TOWs and the armored division with 120, approximately the current quantities. CSS requirements are no greater than in the current organization; however, a command and control increment is added.

The mission of the TOW Co (Mech) is to provide heavy antitank guided missile fire support to the ground maneuver task force. It is employed by platoons and/or sections attached to, placed under the OPCON of, or placed in support of company teams and/or retained directly under the control of the task force commander. Normally, some portion of the company accompanies each mechanized infantry company attached to a tank battalion from the TOW Co (Mech)'s parent battalion. The company headquarters normally remains with the parent battalion to directly control and support its elements as required.

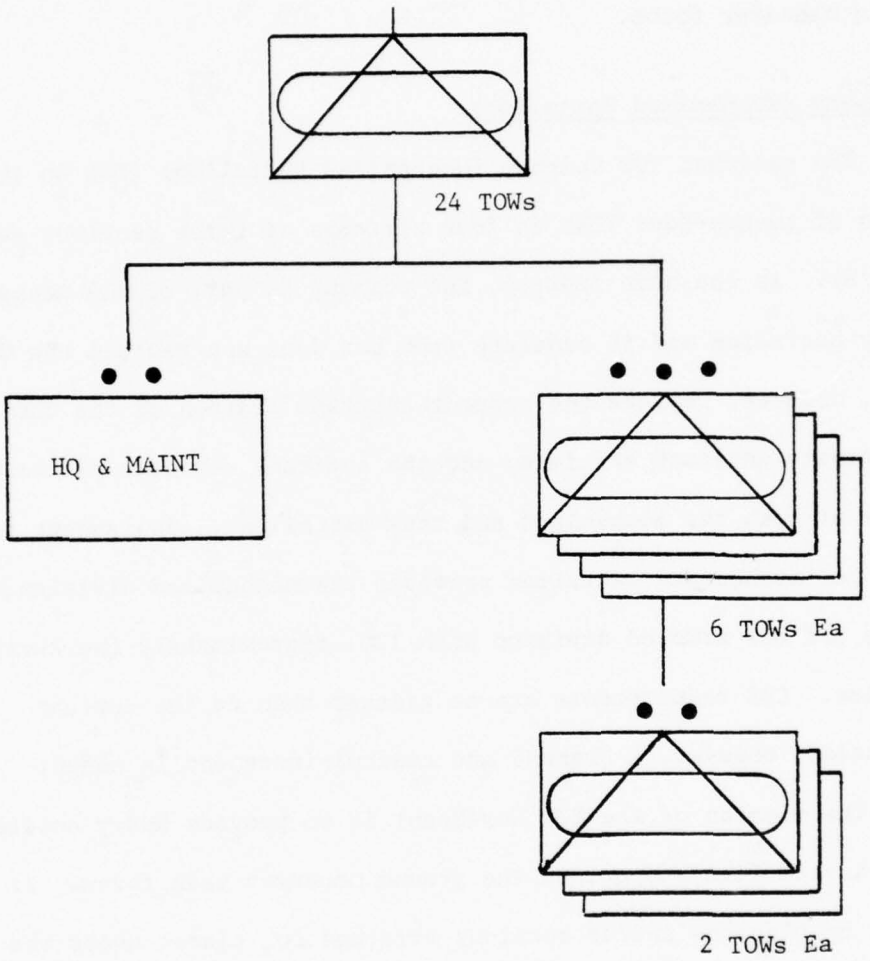


Figure 8

TOW Company (Mechanized Battalion)

TOW Company (Mechanized and Tank Battalions)

The notional TOW Company (Mechanized and Tank Battalions) (TOW Co) consists of twelve TOWs in three platoons of two sections each (Figure 9). The company is part of both the tank and mechanized battalion and thus provides both the armored and mechanized division with 132 TOWs. As with the TOW Co (Mech) and TOW Bn, this results in the elimination of the current mechanized battalion antitank platoon, the rifle company antitank sections, and the antitank sections in both the tank and mechanized battalion scout platoons. In this case also, CSS requirements are no greater than in the present organization; however, the high officer density resulting from the DRS-type organization results in a substantial command and control increment.

The mission of the TOW Co is to provide heavy antitank guided missile fire in support of ground maneuver task forces. It is employed by platoons and/or sections attached to, placed under the OPCON of, or placed in support of company teams and/or retained directly under the control of the task force commander. The company headquarters can control all, some, or none of its elements.

Antitank Platoon (Mechanized and Tank Battalion)

The notional Antitank Platoon (Mechanized and Tank Battalion) (AT Plat) consists of twelve TOWs in six sections (Figure 10). The platoon is part of both the tank and mechanized battalion as part of the CSC and thus provides both the armored and mechanized division with 132 TOWs. This results in the elimination of the current rifle company antitank sections and the scout platoon antitank sections in both the tank and mechanized battalions. In this case also, CSS requirements are no greater than in the present organization.

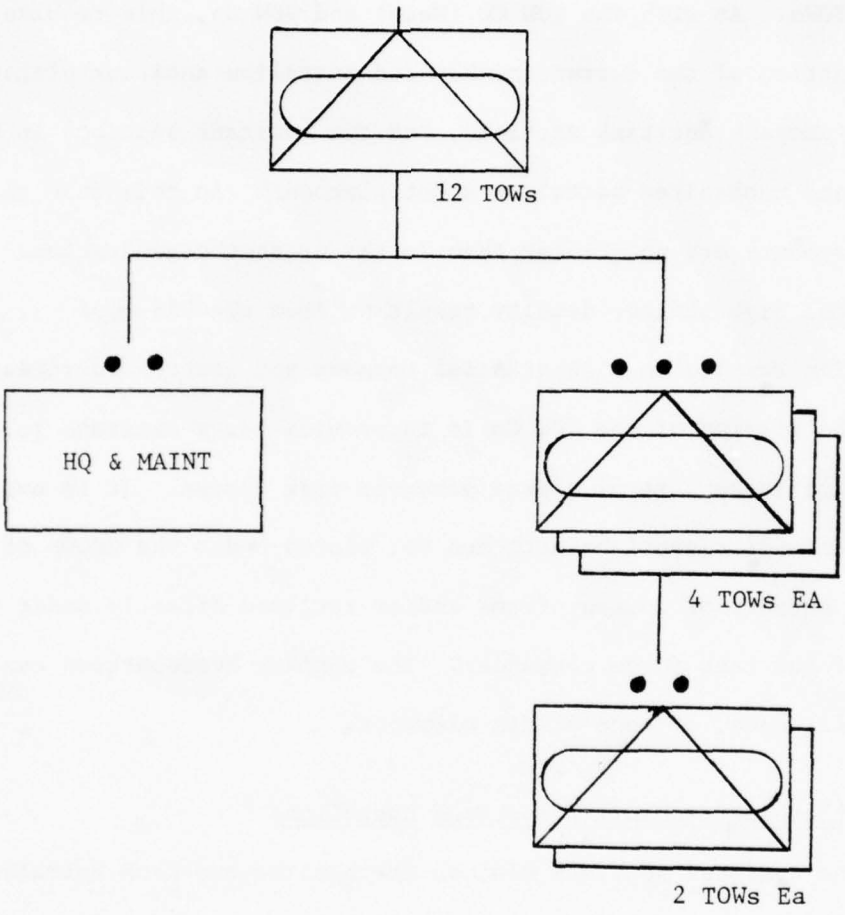


Figure 9

TOW Company (Mechanized and Tank Battalion)

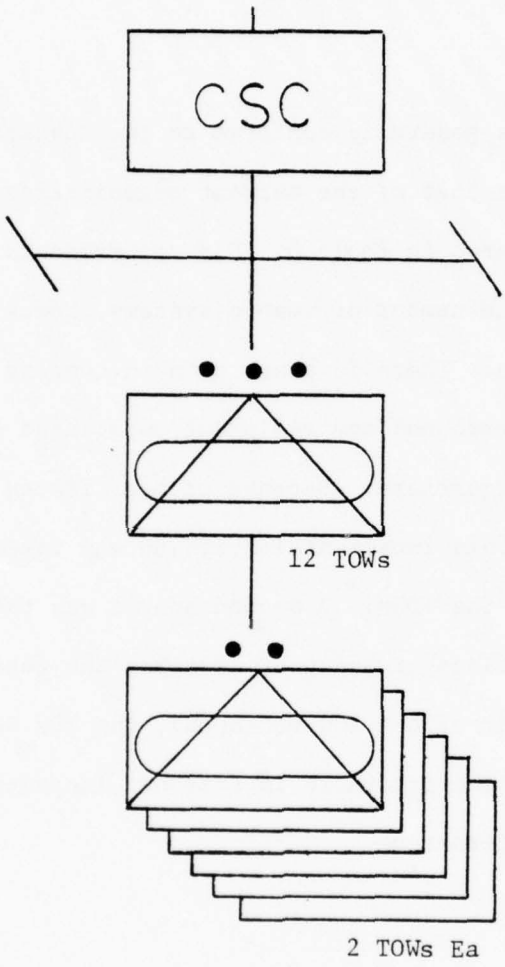


Figure 10

Antitank Platoon (Mechanized and Tank Battalion)

The mission of the AT Plat is to provide heavy antitank guided missile fire support to ground maneuver task forces. It is employed by sections attached to, placed under the OPCON of, or placed in support of company teams and/or retained directly under the control of the task force commander. The platoon headquarters can control all, some or none of its elements.

End Strength

Each alternative generally conforms to the requirement that end strength approximate that of the current organization. Numbers of TOW systems are compared in Table 6. CSS requirements were assumed to be proportional to the number of weapon systems, hence there is no net gain in that area. There is a net gain in command and control increments: overhead personnel and equipment associated with the increased number of headquarters. Because of the effects of consolidation, some of this incremental overhead was taken from the companies that now have the TOWs. A second source was the equipment and personnel authorizations given up by reducing the total number of TOWs, a characteristic of the TOW Co (Mech), the TOW Co, and the AT Plat. Overall, however, there is some net increment associated with each alternative.

Table 6

Comparison of Equipment Density by Alternative

Alternative	Type Division	Number of TOWs
Current Organization	Mechanized	152
	Armored	134
TOW Battalion	Both	144
TOW Company (Mech)	Mechanized	144
	Armored	120
TOW Company	Both	132
AT Platoon	Both	132

FACTORS FOR COMPARISON

The alternatives were compared on the basis of six factors for comparison: Concentration, Command and Control, Balance, Supportability, Training, and Cost.

Concentration

"Adequate forces and weapons must be concentrated at the critical times and places. The combination is combat power" (FM 100-5).[58]

The quotation is a new one (FM 100-5 was published less than three years ago) but the concept that it conveys is as old as warfare. Winning in the defense requires that strength be met with strength; winning in the offense requires massing strength against weakness. For

this analysis, the term concentration was applied narrowly to mean the ability of the commander to mass TOWs--to tailor formations with a quantity of TOWs appropriate to the mission, enemy, terrain, and troops available. It is a significant issue at division, brigade, and task force level, and it takes on different dimensions in covering force operations, in the defense of the main battle area, and in offensive operations in general. It was considered not only in terms of establishing an appropriate initial task organization but also in terms of the flexibility of the organization in response to a developing situation.

Command and Control

"The battle must be controlled and directed so that the maximum effect of fire and maneuver is concentrated at decisive locations" (FM100-5).[59]

The command and control subsystem of the organization is the subsystem that coordinates and directs the output of all other systems. For each alternative, the analysis considered the facility with which TOW fires can be integrated into the battle to exploit their capabilities and reduce the effects of their vulnerabilities. The key parameters of this factor are the extent of cross-attachment required, span of control, the potential for habitual association, and the utility of various command relationships.

Balance

"The battle must be fought using cover, concealment, suppression, and combined arms teamwork to maximize the effectiveness of our weapons and to minimize the effectiveness of enemy weapons" (FM 100-5).[60]

Balance, as a factor for comparison, focuses on the "combined arms teamwork" emphasized in the quotation, above. The analysis surveyed all the tank killing capabilities of the organization by level of command and drew on historical data as well as tactical doctrine to assess how effectively each alternative provided for balance, both in the nominal organization and in the organization for combat. This was not intended to overlap with concentration and command and control but to focus more specifically on the integration of all resources available for the antitank battle as influenced by each of the alternatives.

Supportability

"Concentration of force--or combat power--includes provision of logistic support for maneuver elements (ammunition, POL, and forward maintenance)" (FM 100-5).[61]

The most significant limitation of the TOW is its small, ten missile, on-board load. That shortcoming results from the small interior dimensions of the M113A1 APC and the bulky size of the encased missiles. Consequently, after firing ten missiles, the TOW system cannot fight until it is resupplied. This single issue, ammunition, dominated the analysis of this factor, although some consideration was also given to the entire spectrum of organizational level combat service support. Above organizational level, the combat service support structure is left unchanged by all alternatives and is required to support the same number of weapon systems similarly dispersed; hence support above organizational level is the same for all alternatives.

Training

"Our teams and crews must be trained to use the maximum capabilities of their weapons" (FM 100-5).[62]

The extent to which the organization does or does not facilitate appropriate training is critical. If an organization facilitates concentration, for example, but not training, the net gain may well be zero. That is, ten good crews may be just as effective as twenty crews that are only fair. TOW training deficiencies identified by A^2S^2 that were not invalidated by the TEA-TOW were used as the primary basis for this analysis.

Cost

Cost was assessed in terms of the extent to which each organization violated the third assumption, that end strength be held constant. Simplifying assumptions were made to provide a reasonable qualitative assessment without attempting to estimate costs down to the last screw driver.

ASSESSING EFFECTIVENESS

Subjective assessments of the effectiveness of each alternative were made for each factor as indicated above. The current organization was used as a base case (0) and the alternatives were assessed to be much better than (++), moderately better than (+), about the same as (0),

case facilitated the subjective combination of interim conclusions by providing a fixed reference against which to make comparisons.

To reach the overall conclusion, the by-factor assessments of each alternative were combined subjectively by the author. In making that subjective combination, concentration and command and control were weighted the most heavily. This is consistent with the scope of the thesis which focuses it on the defense of Central Europe. Concentration, at all levels, is the essence of that defense. The command and control function was emphasized because it is the subsystem which gives meaning to the other subsystems by integrating them.

A careful decision was made to not wargame the alternatives. In as much as the effects of the organizational changes would have to be addressed by subjectively moderating one or more simulation parameters or by extrapolating from surrogate measures, it was felt that simulation results would be no less subjective than the analysis presented here.

CHAPTER 4

DISCUSSION

This chapter is devoted to an analysis of each alternative in accordance with the methodology outlined in Chapter 3. Interim conclusions are stated as each factor for comparison is discussed. These interim conclusions are summarized in Chapter 5 to support th overall conclusion presented in that chapter.

CONCENTRATION

"Adequate forces and weapons must be concentrated at the critical times and places. The combination is combat power" (FM 10

Concentration was considered in terms of allocating weapon systems, in consideration of the factors of mission, enemy, terrain and troops available. In the words of FM 100-5, this is both the responsibility of the generals, who concentrate the forces, and of colonels and lieutenant colonels who suballocate resources and cont and direct the battle. It is a significant part of the target serv problem as it applies at those levels--bringing to bear the most appropriate quantity and mix of weapons at the right place and the right time. The allocation process is generally performed as a marginal analysis; that is, decisions usually come down to determin the value to the organization as a whole of small shifts of resourc between suborganizations. (For example, the division commander may view a typical decision as "given that I'd like to have three more

tank battalions but I have only one more, is it better overall t
it in the 1st, 2d, or 3d Brigade?") Hence there evolve two key
in concentrating TOWs. The first is how well the nominal organi
inherently concentrates TOWs. The second is how easily resource
be shifted at the margin. Finally, a third consideration, flexi
was superimposed on top of the first two to consider how well th
organization facilitates changes to the initial task organizatio
response to changes in the battle.

Current Organization

From the division perspective, TOWs in the current organ
are automatically allocated by the allocation of maneuver battal
For example, looking at the defense, assume that the division is
a combined arms army that can enter its sector on three primary
avenues of approach. Avenue A is a regimental size avenue and i
constrained by forests and hilly terrain; Avenue B is open, gent
rolling, and wide enough for two regiments to operate abreast; a
Avenue C is like Avenue A. All else equal, this terrain analysi
very likely lead to a decision to concentrate tank battalions al
Avenue B ("tanks are most effective where they can move rapidly
fields of fire are relatively long")[63] and to conduct infantry h
economy of force operations on Avenues A and C ("Infantry operat
times and places where fields of fire are relatively short").[64]
concept articulating such a decision in an armored division migh
be: "1st Brigade defends battle area (Avenue A) with one tank a
two mechanized battalions; 2d Brigade defends battle area (Avenu
with one mechanized battalion, one cavalry squadron, and three t
battalions; 3d Brigade defends battle area (Avenue C) with one t

and two mechanized battalions; and one tank battalion task force is in reserve, positioned on Avenue B." The problem should be obvious, the traditional matching of type units to terrain puts nearly eighty percent of the division's TOWs on secondary avenues of approach in terrain poorly suited for their use. In spite of the awkwardness of this allocation, there is very little capability in the current organization to do much else. In this specific example, the center brigade could have been organized with two mechanized battalions, but only with a decrease in the concentration of tanks.

Before leaving the division, mention should be made of the division controlled covering force where the problem is essentially the same. "The covering force is organized around cavalry and tank heavy battalion task forces in sufficient strength to fight a major battle in order to determine where and in what strength the enemy main effort will be made."[65] Allocating tank battalions to the covering force does not get sufficient TOWs into the covering force area where their potentially long range fires are essential to destroy enemy weapons, to overwatch maneuvering tank units, and to show a mix of weapons adequate to deceive the enemy as to the true location of the forward edge of the main battle area.

In the offense, the problem revolves around how to best use the TOW. Lacking the characteristics of an assault weapon, it can best be used in overwatch. Moreover, because of its small, on-board ammunition carrying capability it will generally be used only against well defined targets and not for indiscriminate suppression. A typical scheme of maneuver, from the division perspective, will employ one or more balanced or mechanized heavy brigades making the main effort on a

narrow front in terrain favorable to armored combat. The concentration problems imposed by the organization in those cases are not severe. In heavy brigades, the problems will be similar to those experienced in the defense except that the likely presence of follow and support forces including TOWs may lessen the effect of the problem. Overall, the current organization does not facilitate concentration primarily because of the problems of the defense and the covering force.

At brigade level the problem is very similar to the problem at division level. To create a task force that is heavy in both tanks and TOWs requires either making a tank heavy task force on a mechanized battalion base or directing the attachment of a substantial number of TOWs to a tank battalion. Theoretically, any number of TOWs can be attached to a tank battalion; however, beyond some point, concentration by "piling on" tends to denude the mechanized battalion while taxing the tank battalion base. Problems are essentially the same in the main battle area (MBA), covering force area (CFA), and in the offense.

Given an allocation of maneuver battalions, it is very difficult to allocate TOWs at the margin from division level. Because TOWs are diffused in the mechanized battalion they tend to go where the battalion goes and it would be uncharacteristic for the division to direct cross-attachment of specific TOW sections. Within brigades, the allocation problem is simpler, provided that there are sufficient TOWs there to begin with. Cross-attachment of a rifle company inherently cross-attaches two TOWs, and frequently brigade standard operating procedures (SOPs) or specific orders will direct additional cross-attachment. (FM 71-1 even goes so far as to state: "Companies being attached to tank battalions should receive additional HAWs from the battalion AT

platoon. Normally a mech infantry company should have at least one HAW section for each of its platoons. (Italics added.)[66]

At battalion level, the concentration problem overall and at the margin is simple. The task force commander builds teams from mechanized and tank platoons and TOW sections. The problem is defined in terms of what has been allocated to the battalion. However, looking at concentration in isolation, flexibility within the constraints of that allocation is substantial.

Finally, the current organization tends to be fairly inflexible once the initial task organization is established. The low leader (especially officer) density in the current organization makes reallocations between task forces especially difficult on the move. Employing TOWs in the covering force and then using them to thicken the MBA or shifting TOWs laterally between task forces would require the junior noncommissioned officer section leaders to employ liaison skills and to exercise responsibilities generally beyond their expertise.

TOW Battalion

From the division perspective, the TOW battalion provides significant flexibility in concentrating. The division allocates mechanized and tank battalions as before but then allocates TOWs by companies in a manner analogous to the allocation of combat engineer assets. Consequently the capability to concentrate TOWs is greatly increased compared to the current organization, for all types of operations. In the example given for the current organization, the TOW battalion structure permits massing two companies (seventy-two TOWs) on Avenue B while placing one each on Avenues A and C. At the margin, TOWs can be shifted in groups of twelve (a platoon) by

allocating in terms of reinforced companies and companies (minus). This flexible, direct allocation also facilitates organizing the division controlled covering force.

From the brigade perspective this alternative also facilitates concentration in that the brigade can deal with a fairly straight forward allocation problem addressing TOWs directly rather than indirectly. Note, however, that the triangular organization of the TOW companies and the relatively low leader density (twelve TOWs per one platoon leader) tends to limit flexibility at this level. Brigade allocates on the basis of reinforced platoons, platoons, and platoons (minus). This is some improvement over the current organizations, but at brigade level it is less of an improvement than it is at division level. At task force level this may even be less flexible than the current organization because the TOWs are organized in sections of four.

For making changes to the allocation in response to changes in the situation, the TOW Bn offers only minor advantages compared to the current organization primarily because there is very little change in leader density. Most task forces will be allocated a TOW platoon. That platoon will probably be suballocated (at least in part) and/or spread over a relatively large area. Hence assembling all or part of it to move to another task force will be difficult and will tend to denude the task force of TOWs. Shifting TOW sections (in this case four TOWS) is easier than in the current organization to the extent that the company headquarters can facilitate the move. It is easier, with this organization, to concentrate TOWs in covering force and then use them to thicken the MBA.

TOW Company (Mech)

From the division perspective, the TOW Co (Mech) poses the same disadvantages as the current organization. That is, the organization inherently tends to concentrate TOWs in sectors or battle areas organized primarily with mechanized battalions. In fact, removing the TOWs from the tank battalion scout platoon actually makes this organization slightly more difficult to concentrate than the current organization. This is true regardless of the tactical context, CFA, MBA, or offense.

At brigade level, however, given an allocation of maneuver battalions, the suballocation problem is slightly less difficult than in the current organization. Cross-attachment of the six TOW, TOW platoon can be directed by brigade in the manner that TOW sections are currently allocated. At the margin, TOWs can be allocated in sections by dealing with reinforced platoons, platoons, and platoons (minus).

Flexibility is enhanced slightly as it is more feasible to shift the smaller TOW platoons, both from CFA battalions to MBA battalions and between MBA battalions. As was the case with the TOW Bn, the presence of the company headquarters may facilitate such shifts.

TOW Company

The TOW Co automatically results in a TOW allocation proportional to the allocation of maneuver battalions, and therefore, concentrates TOWs automatically, although somewhat inflexibly. From the division perspective, it is not as flexible as the TOW battalion, and from a brigade perspective, it presents some problems because twelve TOWs tend to be an upper limit on TOWs in a task force. At the margin, it is possible to direct the cross-attachment of one additional

platoon (four TOWs) without excessive dislocation. This is especially useful when employing a brigade covering force. An MBA battalion can give up one TOW platoon to a battalion in the covering force and receive it back upon completion of the covering force operation. Such a scheme increases the concentration of TOWs in the CFA beyond that inherently achieved by this alternative without degrading the MBA battalions. The four TOW, TOW platoon is important in achieving this flexibility and also facilitates shifts within the MBA, both within and between task forces.

Antitank Platoon

The AT Plat also automatically results in a TOW allocation proportional to the allocation of maneuver battalions. This inherently concentrates TOWs from the division perspective but again is somewhat inflexible. Within the brigade, cross-attachment of TOW sections to further concentrate in one task force could be done and is, at the very least, no more difficult than in the current organization. The low leader density, however, tends to make that difficult. It is also difficult, for example, to shift TOWs between task forces in response to changes in the situation. Overall, then, this alternative greatly enhances concentration by facilitating the allocation of TOWs to the concentration sector. However, it retains the shortcomings of the current organization with regard to flexibility and allocation at the margin.

Summary

The current organization tends to inherently allocate TOWs away from the most likely armor avenues of approach. It also tends to be

somewhat inflexible and makes it difficult to allocate TOWs at the margin, especially above task force level. The TOW Bn is superior for concentrating TOWs in the initial organization and from the division and brigade perspective is slightly more flexible. From the task force perspective, allocation at the margin and flexibility are little different than in the current organization. The TOW Co (Mech) offers minor advantages from the viewpoint of flexibility and allocation at the margin but it retains the major deficiency of the current organization by tending to concentrate TOWs in brigades assigned either supporting roles or the least favorable terrain (or both). The TOW Co inherently allocates TOWs in proportion to the allocation of maneuver battalions. Primarily because of its small platoons it is easy to reallocate at the margin and is quite flexible. Its inherent flexibility facilitates shifting the concentration within the brigade or task force as the battle shifts. The AT Plat also inherently allocates TOWs in proportion to the allocation of maneuver battalions but it retains the relative inflexibility of the current organization both in reaction to changes and to allocate resources at the margin.

In terms of how well the nominal organization inherently concentrates TOWs, then, the TOW Bn is best but the TOW Co and AT Plat are also better than the current organization. The TOW Co (Mech) is no better. In terms of allocation at the margin, the TOW Bn offers significant advantages at division and brigade level, and the TOW Co and TOW Co (Mech) offer advantages at brigade and task force level. The TOW Co is the most flexible overall but the TOW Bn and TOW Co (Mech) also offer some advantages in flexibility. These results are summarized in Table 7 which also provides an overall assessment. This overall

assessment was arrived at by subjectively combining the subordinate assessments giving weight to inherent allocation.

Table 7

Summary Assessment of Concentration

Alternative	Inherent Allocation	Allocation at the Margin	Flexibility	Overall Assessment
Current Organization	0	0	0	0
TOW Battalion	++	+	+	++
TOW Company (Mech)	0	+	+	+
TOW Company	+	+	++	++
AT Platoon	+	0	0	+

COMMAND AND CONTROL

"The battle must be controlled and directed so that the maximum effect of fire and maneuver is concentrated at decisive locations" (FM 100-5).

Command and control was considered as a measure of the facility with which TOW fires can be integrated into the battle to exploit their capabilities and reduce the effects of their vulnerabilities. It is both the glue that holds the organization together and the central nervous system that coordinates its functions. Specific aspects of command and control that were considered were the extent of cross-attachment required, span of control, the potential for habitual association, and the utility of various command relationships.

Cross-attachment can create command and control problems.

Personalities differ, SOPs differ, and applications of tactical doctrine vary slightly from unit to unit. Hence, every time a unit goes from one battalion to another or from one company to another the potential for error or misunderstanding in battle is increased. This becomes especially critical in consideration of the electronic warfare threat and the general requirement to rapidly deploy and redeploy within and between battle positions. Commanders cannot wait until the first day of the war to find out how subordinates will react.

Span of control problems arise when a leader is responsible for more subunits than he can effectively control. In tactical operations, factors affecting span of control include dispersion as well as the absolute number of subordinates. Consideration of dispersion is perhaps the single most important point in considering span of control. A key implication of integrating the combined arms at team level in the general case is that TOW units will almost always be broken up. The ability of the TOW platoon leader to command TOWs retained under his control will be taxed only infrequently because generally very few TOWs will be retained under his control. The significant span of control problem will occur in the team where the team commander must control one, two, or three TOW sections that are frequently widely scattered and may be located 1,000 meters or more from his tank and mechanized platoons.

Habitual association refers to the constant pairing of the same units in the supporting-supported relationship. Its value lies in the fact that it breaks down the command and control problems caused by cross attachment. It gives people a chance to get to know each other, develop mutually acceptable SOPs, and reduce the chance

of misunderstanding.

To provide TOW fire support to teams, assigned (organic), OPCON, direct support (DS), and general support (GS) relationships are all viable options offering various advantages and disadvantages under given conditions. The nominal TOW organization should lend itself to the widest possible range of employment options.

Current Organization

There are three general problems cross-attaching TOWs in the current organization. The first is that TOWs must be shifted from mechanized battalions to tank battalions. The second is that a task force cannot easily be organized heavy in both tanks and TOWs. The third problem is coordinating the fires of the rifle company TOW sections and the other TOWs in the battalion.

Tank battalions in the current organization are organized with four TOWs in the scout platoon and they normally are left in that platoon. However, in the general case, teams are organized with tank platoons, mechanized platoons, and TOW sections. In fact, every example company team organization for combat illustrated in FM 71-1, The Tank and Mechanized Infantry Company Team, shows two TOW sections (noting "HAW sections added by task force as the situation dictates"[67]). The point is that, in the tank battalion task force, those TOWs are not there to begin with. They have to be cross-attached from a mechanized

cross-attached rifle company, then as many as twelve of the twenty-two TOWs in the mechanized battalion may be fighting in and/or in support of teams not with their parent battalion.

Following this cross-attachment problem a bit farther yields the conclusion that it is very difficult to organize a task force heavy in both tanks and TOWs. Yet, FM 71-2 states "He (task force commander) will often find that the majority of TOWs can best employ their long-range fire capability with the tank heavy or pure tank teams...."[68] This is the obverse of the concentration problem, even if you succeed in concentrating TOWs and tanks, you face command and control problems because one system or the other is operating away from its parent and familiar surroundings.

Finally, there is the matter of how the rifle company TOWs should be employed with the TOWs from the TOW platoon. It is a small problem, undoubtedly, but a problem nevertheless to the team commander who finds his TOW sections looking back to two different parent organizations. (The World War II tank destroyer experience suggests that this anamoly would disappear in combat. Either the reinforcing TOWs would be entirely absorbed or the rifle company TOWs would be pulled back into the antitank platoon.)

Span of control problems in the current organization generally arise because of distance factors. The range-vulnerability character-

force under the antitank platoon leader (an allowable option, see FM 71-2, App J). Unless a great many TOWs have been detached, that leaves the antitank platoon leader with a substantial span of control problem. The other option is to attach the TOWs to teams. That leaves the team commanders with the problem of fighting a tightly concentrated team plus one, two, or three TOW sections that are either 1,000 meters or so from his other positions or are not positioned (for whatever reason) to achieve a desirable standoff.

In economy of force sectors and task force battle areas, large areas of responsibility will probably lead to almost exclusive use of the second option discussed, TOWs attached to teams. The team commander's problems do not, however, go away. Consider the mechanized company attached to a tank battalion. It may well have two tank platoons (from two different companies), a rifle platoon, mortars, one organic TOW section, and one TOW section from his battalion's antitank platoon. The already significant span of control problems are increased when those TOWs are employed apart from the maneuver platoons to decrease their vulnerability.

This same concern is a major problem in the offense where the TOWs must be kept in overwatch, away from the bulk of the forward oriented team. This problem is not easily solved by putting TOWs in GS or DS however, because that tends to overload the antitank platoon leader, as pointed out above.

matter of SOP that 1st and 2d Antitank Sections be habitually assoc with A Company). The obstacles to habitual association with a tank battalion would also seem to be few; however, A^2S^2 indicated that there are serious combined arms training deficiencies in the field. Thus it appears that while habitual association could be achieved i the current organization, the organization itself does not facilita it because of the necessity to cross battalion lines.

The current organization is actually fairly inflexible in s as command relationships are concerned. This is particularly true the tank battalion where TOWs normally come in attached, where ther is no dedicated officer available to form an ad hoc TOW platoon for GS or DS employment, and where the trains are geared primarily to service tanks. In the mechanized battalion, GS employment is feasi subject to the span of control problems already discussed, and it m be desirable when all or most of the battalion is focused on a sing kill zone.

TOW Battalion

The TOW battalion alternative yields a nominal organization which the potential for cross-attachment problems is greatly increa Under this alternative, TOWs are attached to both the tank and mechanized battalions so that all the problems of personalities, SO drills, and doctrine have an opportunity to appear everywhere there a TOW.

Span of control problems are little different from those of current organization owing to the fact that the twelve TOW, TOW pla is retained. TOWs supporting a team will frequently be displaced f it without officer leadership and/or the antitank platoon leader wi

find himself taxed to control all or most of the platoon direct company headquarters may be available to provide some assistanc generally will not have any direct control over its elements.

The potential for habitual association is reduced. Pro such as matching four TOW companies to three brigades could be The big problem is the same problem presented by the current or tion: operating across battalion lines. Because this characte all combined arms training and not just that involving tanks an effectiveness in this area would decline.

This organization is better than the current organizati in facilitating a range of command relationships. It is import however, that TOW platoons (+/-) be attached to task forces to the task force maximum flexibility in establishing command relat ships within the task force. However, given an officer dedicate the tank battalion TOWs and given attachment as a standard pract TOWs can be used somewhat more flexibly than in the current orga tion.

TOW Company (Mech)

The TOW Co (Mech) has the same problems of cross-attachm and habitual association as the current organization with the ex that it avoids the problem of interfacing rifle company TOWs an antitank platoon TOWs. It provides advantages, however, in spar control and range of command relationships available because of flexibility its increased officer density provides in those area

It must be recognized that normally some of the three s TOW platoons would have to be broken up. If, for example, a tar battalion and mechanized battalion pair up to cross-attach, the

six teams and four TOW platoons. Unless wide use is made of GS relationships, one or more of the TOW platoons will have to be up. Nevertheless, the overall situation compares favorably to current situation in these respects.

TOW Company

The TOW Co does not create the cross-attachment problem the current organization because the nominal organization is ap mately congruent with the organization for combat, in so far as are concerned. Some cross-attachment between task forces may s required in specific situations but, overall, it will inevitabl less. For the same reason, the potential for habitual associat a much less pressing concern although it is important to note t some problem areas remain because the organization for combat c one or two companies in every task force. From the TOW perspec alone, however, this problem is greatly reduced.

In terms of span of control and the range of command an control options available, the increased officer density result substantial advantages. The four TOW platoon virtually elimina of control problems within the TOW platoons and companies. Mor importantly, it facilitates controlling TOWs attached to teams, when they are employed apart from the main body. Given that ma not most TOW engagements will be constrained by terrain and wea ranges less than 2,000 meters, this increase in command and con capability enhances survivability. The platoon leader can trul in the "follow me and do as I do" tradition and will presumably better employment decisions than the section leader loosely con by a team headquarters preoccupied with its maneuver platoons.

Antitank Platoon

The AT Plat reduces the cross-attachment problems of the current organization and solves the problems of habitual association in the same manner as does the TOW Co. It does not enjoy the TOW Co's advantages in span of control, however, because it does not have a significantly increased leader density. The range of command and control options available is increased, especially in the tank battalion where provision of an antitank platoon leader makes GS/DS missions much more feasible.

Summary

The current organization tends to require that a significant portion of the TOWs in any given mechanized battalion be cross-attached to tank battalions. Within task forces built on both tank and mechanized battalion bases, span of control problems are common and the range of effective command relationships available is limited. The TOW Bn is, at best, no better in that it offers even more severe cross-attachment and habitual association problems while providing relief only in the area of command relationships. The TOW Co (Mech) mirrors the problems of the current organization in cross-attachment and habitual association but offers some improvement in span of control and command relationships by virtue of an increased leader density. The TOW Co offers significant advantages in all areas by greatly reducing the need for cross-attachment and greatly increasing the officer density. The AT Plat also reduces the need for cross-attachment but achieves little or no advantage in other areas.

These results are summarized in Table 8 which also provides an overall assessment. This overall assessment was arrived at by

subjectively combining the subordinate assessments giving them equal weight.

Table 8

Summary Assessment of Command and Control

Alternative	Cross-Attachment	Span of Control	Habit. Assoc.	Cmd. r'ships.	Overall Assessment
Current Organization	0	0	0	0	0
TOW Battalion	-	0	-	+	0
TOW Company (Mech)	0	+	0	+	0
TOW Company	+	++	+	++	++
AT Platoon	+	0	+	+	+

BALANCE

"The battle must be fought using...combined arms teamwork to maximize the effectiveness of our weapons and to minimize the effectiveness of enemy weapons" (FM 100-5).

Numerous weapon systems are available to defeat tanks. Besides ground to ground ATGMs and tanks, the division can employ air to ground ATGMs from attack helicopters, TAC air, and mines. Mine technology is being rapidly advanced to include FASCAM, some portions of which are already being fielded. Each of these systems, and still others in various stages of development, offer unique capabilities that require their careful integration in mutual support. At issue is where best to employ all of this in the nominal organization of the division.

Current Organization

The current organization balances these capabilities well by level of command. Dragon, tanks, and TOWs are found at company level; TOWs are also found at battalion level. Artillery and engineers are found at divisional level, but normally are employed in direct support of brigades. Attack helicopters are also found at division level and may be placed under the OPCON of brigades or individual task forces and/or they may reinforce task forces or teams by fire. TAC air is allocated at every level of command but, for these purposes, it is not incorrect to assess it as a division level asset. Although the division does not have absolute control over TAC air, it does have control over that which is actually flown directly in support of the division. Thus at each level the commander must focus specific resources: HAWs at battalion level, engineers (mines) and artillery at brigade level, and attack helicopters and TAC air at division level (with some overlaps).

To the extend that the current organization has a shortcoming in this area it is the segregation of weapon systems at battalion level. The mechanized battalion has forty Dragons, twenty-two TOWs, and no tanks. The tank battalion has four Dragons, four TOWs, and fifty-four tanks. That difference is the root cause of the concentration problem and has been exhaustively discussed under that heading.

TOW Battalion

The TOW battalion takes the HAW from battalion level and puts it at division level. At that point, however, the organization for combat turns them around and pushes them back to the battalions. The

question is whether or not consolidation represents a real change in this respect.

The TOW battalion is similar in concept to the tank destroyer battalion of World War II. Although the tank destroyer battalions were corps battalions, they were generally habitually associated with a division and then pushed down into the regiments and battalions whose organic antitank guns were often inadequate. Reports and unit histories report that under these conditions the tank destroyer battalions virtually ceased to exist as coherent units. This suggests that the same thing would happen to the TOW battalions.

Given the above and given that the TOW battalion alternative provides twelve platoons to support eleven maneuver battalions, each maneuver battalion will, in general, have one platoon (+/-) attached or in support and once attached (or placed in support) it will tend to stay there. Every maneuver battalion will not necessarily have one and only one TOW platoon, but that will in fact be more common than not. That being the case, the TOW battalion alternative does not really alter the balance by level of command at division and brigade level. However, at battalion level this addresses the imbalance caused by concentrating TOWs in mechanized battalions in the current organization. In summary, the TOW battalion alternative imbalances the nominal organization but much of that ill effect is compensated for in the organization for combat, command and control problems not withstanding. Overall, then, it is really about the same as the current organization.

TOW Company (Mech)

With respect to balance, the same factors that were relevant to the current organization are relevant to the TOW Company (Mech).

In this respect the two organizations are almost exactly alike.

TOW Company

The TOW Co offers balance by level of command and by type of battalion, both in the nominal organization and in the organization for combat.

Antitank Platoon

The AT Plat also offers balance by level of command and by type of battalion in both the nominal organization and the organization for combat.

Summary

The current organization is well balanced by level of command but poorly balanced by type of battalion, especially in the nominal organization. The requirement to get TOWs down to where they can kill tanks tends to cause the TOW Bn to be well balanced in the organization for combat in spite of its apparent extreme centralization. The TOW Co (Mech) is almost exactly like the current organization in this respect; however both the TOW Co and the AT Plat improve balance somewhat by balancing the nominal organization by type battalion. These results are summarized in Table 9.

Table 9

Summary Assessment of Balance

Alternative	Assessment
Current Organization	0
TOW Battalion	0
TOW Company (Mech)	0
TOW Company	+
Antitank Platoon	+

SUPPORTABILITY

"Concentration of force--or combat power--includes provision of logistic support for maneuver elements (ammunition, POL, and forward maintenance)" (FM 100-5).

The limitation to TOW availability created by the small onboard supply of missiles raises the most ciritical supportability issue: to what extent does each alternative facilitate the resupply of missiles? Other supportability concerns are in part addressed by the assumption that CSS assets can be reorganized to adequately support any new organization.

Current Organization

In the current organization TOWs are normally attached to teams, thus organizational CSS is generally a team responsibility. If all or part of the antitank platoon is in a GS or DS role, then the antitank platoon leader and combat support company retain some

responsibility. As a matter of SOP, the combat support company commander, his executive officer, or the antitank platoon leader may exercise broad oversight within the task force, but, by and large, the responsibility devolves on the maneuver teams.

This is a particular problem in the tank battalion task force which is not accustomed to having more than four TOWs in its scout platoon. While the rifle company(s) attached to that battalion should be expected to arrive with their CSS "slice," any further tailoring within the task force creates severe cross loading problems in the Class V bulk load. Without dedicated support, TOW missiles may well enjoy a very low priority behind tank ammunition, especially in view of their bulk. Fuel and maintenance are of little concern under any circumstances, however, because the M113A1 is common to tank and mechanized battalions. Both battalion bases, therefore, are organized to deal with it.

TOW Battalion

The TOW battalion has dedicated TOW infrastructure to manage and provide organizational level CSS. The TOW companies and platoons would deploy with a "slice" of CSS assets so that there would be a "stovepipe" of dedicated TOW assets all the way back to the general support CSS echelon. Two potential problems lessen the impact of this arrangement. The first is that cross-loading of ammunition must continue to take place in the combat and field trains. This problem derives from integrating the combined arms at company level. As long as that is being done, mixed loads of ammunition, including small (less than truck full) loads of TOWs, must be positioned to back up those companies. This is a problem that characterizes all alternatives,

however.

The second potential problem is much more serious. When TOW companies and platoons are attached to brigades, the TOW battalion drops out of the supply chain and the units to whom the TOWs are ultimately attached assume the responsibility. This in fact occurred during World War II when tank destroyer battalions were in effect broken up and attached throughout the division.[69] While this problem can be avoided by putting the TOWs in DS or GS (like artillery or engineers), DS or GS is frequently an undesirable command relationship for direct fire heavy weapons.[70] The TOWs will generally be part of the teams. Operational control would be a viable option under those circumstances and may in fact be the only way to keep the "stovepipe" open. In any case, it must be noted that there may well be a conflict between appropriate CSS relationships and appropriate command relationships.

On the plus side, the creation of a dedicated TOW organization and infrastructure raises the level of concern about the management of resources dedicated to TOW. Greater expertise in planning and the functioning of TOW unit commanders as advisors (in the manner of the brigade engineer and the brigade fire support officer, for example) enhances the execution of resupply, prepositioning of supplies, data management, and cross-leveling.

TOW Company (Mech)

The TOW Co (Mech) enhances the organization in the mechanized battalion with little change in the tank battalion. Because battalion lines are crossed in the organization for combat, the same problems associated with command relationships that were discussed in

consideration of the TOW battalion occur here. The higher leader density makes it easier for TOWs to operate in the tank battalion but nothing as pervasive as the "stovepipe" created in the case of the TOW battalion exists. The six TOW, TOW platoon lacks the separate platoon sergeant found in the twelve TOW, TOW platoon (i.e. the platoon sergeant, like the tank platoon, platoon sergeant, is a crewmember). Thus the platoon leader lacks the flexibility afforded by having a mobile CSS coordinator although, admittedly, the smaller platoon presents less of a management problem in this regard.

TOW Company

This alternative offers two significant advantages. The first is that by being in the nominal organization of both the tank and mechanized battalions, command relationships do not blur CSS responsibilities at task force level. Responsibility (and resources) are clearly fixed on the task force. It is true that within the task force the cross loading problems within and between teams will continue to exist. What is significant is that those problems are bounded organizationally under one commander and his staff who are fairly close (both literally and figuratively) to the execution.

The second major advantage is the high leader density. In this case also the platoon lacks a separate platoon sergeant but the CSS requirement for the four TOW, TOW platoon is small indeed compared

an ATGM employment advisor all come together to greatly enhance the management of CSS assets.

Antitank Platoon

The AT Platoon exhibits the same advantages as the TOW Co in terms of command relationships and CSS responsibilities. In general, battalion lines need not be crossed; hence responsibility is fixed and SOPs can be exploited. On the other hand, it lacks the leader density of the TOW Co to provide substantial CSS management advantages.

Summary

The most significant problems in the current organization are the requirement to cross organizational lines and the lack of a dedecated TOW infrastructure, especially low level CSS managers and operators particularly in the tank battalion. The TOW Bn offers advantages in both areas but at the expense of some flexibility. The TOW Co (Mech) offers small advantages in terms of leader density but, on balance, is no better. The TOW Co and AT Plat eliminate the need to cross organizational lines in the general case, and the TOW Co enhances the TOW CSS infrastructure within (but not above) the task force. These assessments are illustrated in Table 10.

Table 10

Summary Assessment of Supportability

Alternative	Assessment
Current Organization	0
TOW Battalion	+
TOW Company (Mech)	0
TOW Company	+
Antitank Platoon	+

TRAINING

"Our teams and crews must be trained to use the maximum capabilities of their weapons" (FM 100-5).

Antitank units, however large or small they may be, must conduct both individual and collective training uniquely oriented to the proper employment of the TOW. For purposes of this discussion, it is useful to break down individual training into gunner training and other individual training and to break down collective training into crew and section training and combined arms training. Gunner training

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and training within the section such as achieving proper fire distribution, target hand-off, and continuous coverage during movement.

TEA-TOW demonstrated that the first subcategory, gunner training, is not as difficult as had been believed. Experience with first generation missiles, both in the US Army and in other armies, and with the Dragon system had convinced trainers that gunner training was difficult and that acquired skills deteriorate rapidly over time. TEA-TOW showed that novice gunners can track, launch, and hit with very little, unsophisticated training. This was attributed to the ease of employing second generation ATGMs, the superior performance characteristics of the TOW, and the highly stable launch platform of the TOW compared to that of the Dragon. Based on those results, it can be concluded that enhancements to gunner training due to organizational changes could only be inconsequential.

Current Organization

The problems identified by A^2S^2 and not discounted by TEA-TOW are problems of the current organization. They are insufficient night training, insufficient combined arms training, and inadequate vehicle recognition training. A major hinderence to training in the current organization is the diffusion of TOW sections throughout the battalion, one section in each of the three rifle companies, two sections in the scout platoon, and six in the antitank platoon. In keeping with current training management doctrine, training is frequently centralized in the antitank platoon. This is particularly true for gunner and crew and section training although in the former case, the rationale will lessen as the TEA-TOW results are disseminated. Combined arms training may be accomplished under the direction of the antitank platoon

Table 10

Summary Assessment of Supportability

Alternative	Assessment
Current Organization	0
TOW Battalion	+
TOW Company (Mech)	0
TOW Company	+
Antitank Platoon	+

TRAINING

"Our teams and crews must be trained to use the maximum capabilities of their weapons" (FM 100-5).

Antitank units, however large or small they may be, must conduct both individual and collective training uniquely oriented to the proper employment of the TOW. For purposes of this discussion, it is useful to break down individual training into gunner training and other individual training and to break down collective training into crew and section training and combined arms training. Gunner training is that individual training whose object is to teach gunners to acquire, track, launch, and hit the target. Other individual training concerns a wide range of skills such as vehicle identification, positioning, and range card preparation. Crew and section training is that collective training intended to teach the crew to work together as a team. It includes training within the crew such as crew drill

but generally it is accomplished by integrating TOWs into team and task force exercises. In all cases the responsibility is vague, resources are fragmented, coordination problems are extensive, and the antitank platoon leadership is severely taxed.

TOW Battalion

Individual training and crew and section level collective training are enhanced in the TOW battalion. When TOW companies were organized for the DRS evaluation, commanders and other unit leaders with experience in both the current organization and that test organization indicated a preference for the TOW Company (DRS) for training because of the concentration of expertise, increased leader density, singleness of mission, and unity of command.[71] These same advantages accrue to the TOW battalion for essentially the same reasons although to a lesser extent because of the great differences in leader density. The DRS TOW Company has one officer for each 2.4 TOWs whereas the TOW Co, TOW Bn has one officer for each 7.2 TOWs (offset to some extent by slightly more noncommissioned officers).

On the other hand, potential obstacles to combined arms training are created because the TOW companies are completely separated from the tank and mechanized battalions. In theory, this could be addressed by having the TOW companies train with the maneuver battalions, but potential differences in training cycles and command emphasis would create a worse problem than that which already exists. At the very least, the environment for combined arms training could be no better than it is in the current organization where combined arms training is a significant problem.

TOW Company (Mech)

The TOW Co (Mech) evidences the same general advantages as the DRS TOW Company although the leader density is not quite as high. In other areas, notably combined arms training, it is no worse than the current organization and may even fare better, given a company headquarters to help manage its training.

TOW Company

In the TOW Co the full advantages noted in the DRS Evaluation accrue. In the area of combined arms training a significant advantage accrues because of the TOW Co in the tank battalion, creating more opportunities for tanks and TOWs to train together. On the other hand, there was some indication in the DRS Evaluation that the TOW company in the tank battalion may enjoy a very low priority compared to the tank companies. This was undoubtedly exacerbated by the austere DRS tank battalion organization which is severely constrained in total manpower; however, the potential for an odd company to be treated poorly is substantial. Furthermore, placing TOWs in the tank battalion does not insure the integration of mechanized infantry in combined arms training. Hence, overall, the environment for combined arms training is enhanced, but all potential hinderances are not eliminated.

Antitank Platoon

The AT Plat has the same advantages of concentration of expertise, singleness of mission, and unity of command discussed in the other alternatives. It shares, however, the low leader density of the current organization. It achieves advantages in combined arms training, however, by having TOWs in the nominal tank battalion in the

same manner as the TOW Co.

Summary

Significant shortcomings in the current organization are caused by the fundamental nature of the organization, the low leader density, and the concentration of TOWs in the mechanized battalion. This impacts adversely on training in all areas. The TOW Bn and TOW Co (Mech) alternatives offer some advantages for individual and crew and section training but neither facilitates combined arms training. The TOW Co and AT Plat also facilitate individual and crew and section training. In addition they both offer advantages for combined arms training. Because of its greatly increased leader density, the TOW Co offers the greatest advantage in all areas. These results are summarized in Table 11.

Table 11

Summary Assessment of Training Implications

Alternative	Assessment			
	Other Indiv.	Crew Section	Comb Arms	Overall
Current Organization	0	0	0	0
TOW Battalion	+	+	0	+
TOW Company (Mech)	+	+	0	+
TOW Company	++	++	+	++
Antitank Platoon	+	+	+	+

COST

In defining the parameters of this study, it was assumed that organizational changes recommended as a result of this research must be constrained to keep approximately the same divisional end strength for personnel and major weapon systems. This portion of the analysis compares the marginal cost of each notional alternative, not in terms of dollars, but in terms of officer spaces, enlisted spaces, and TOW systems. In accordance with the fourth assumption, support personnel, including such personnel as organizational mechanics, were not considered in this part of the analysis. It was assumed that the current organization is adequate in this respect; therefore, since there is not a substantial change in the number of weapon systems, it was assumed that existing support personnel could be redistributed adequately. This is a very simplified approach to cost but it is quite adequate to show the general order of magnitude of the costs involved and to permit a meaningful comparison of the alternatives.

Current Organization

The marginal cost of the current organization is zero. All other costs will be computed as variations from that. Dedicated TOW officer and enlisted spaces and the number of TOW systems (exclusive of cavalry) for both the current armored and mechanized division are shown in Table 12. The average of the two divisions is computed to enable a single set of comparisons to be made. Note also that people indirectly or partially dedicated to TOW (e.g. rifle company weapons platoon leaders) are not included in these totals.

Table 12

Current Organization (Base) Costs

Cost Element	Mechanized Division	Armored Division	Average (1)
Officer Spaces	6	5	6
Enlisted Spaces	626	551	589
TOW System	152	134	143

NOTE: (1) Rounded up.

TOW Battalion

The TOW battalion alternative requires one battalion headquarters, four company headquarters, and twelve platoon leaders. The command and control increment (battalion headquarters) was estimated to be twelve officers and fifty-six enlisted men (Table 13). This rough estimate was based on the totals in the command increment of the tank battalion and those headquarters company elements that would have to be added to support the headquarters. The tank battalion was used as a model because it is smaller than the mechanized battalion and therefore more like the TOW battalion in size.

The TOW Company, TOW Battalion command and control increment was estimated to be the same as the command and control element in the DRS TOW Company with two additional people. The DRS TOW Company was an appropriate model because all combat service support was taken out of the DRS TOW Company; therefore what was left was purely for command and control. Two additions were, however, made. In the DRS Evaluation

the need for a TOW Company executive officer was stressed, so one was added with a driver. Thus each TOW Company command and control increment is two officers and five enlisted men. TOW platoons were structured using the current antitank platoon as a model: a platoon leader, platoon sergeant, one driver in the platoon headquarters, and forty-eight TOW crewmen. Table 14 summarizes the incremental cost of this alternative.

Table 13

TOW Battalion Command and Control Increment (Estimated)

Element	Officers	Enlisted Men
Battalion Headquarters	8	1
HHC Headquarters	2	6
HHC Maintenance Section	0	11
Battalion HQ Section	2	24
Battalion Comm Platoon	0	10
Company Mess Team	0	4
TOTALS	12	56

Table 14

Incremental Cost of the TOW Battalion

Cost Element	Current Division (Average)	Division with TOW Bn	Incremental Cost
Officer Spaces	6	32	+ 26
Bn HQ		12	
Co HQ (x 4)		2 (4)	
Plat HQ (x 12)		1 (12)	
Enlisted Spaces	589	676	+ 87
Bn HQ		56	
Co HQ (x 4)		5 (20)	
Plat HQ (x 12)		2 (24)	
Crews (x 144)		4 (576)	
TOWs	143	144	+ 1

TOW Company (Mech)

The DRS model used for the TOW Co, TOW Bn was also used for the command and control increment of the TOW Co (Mech) with the same changes. Hence two officers and five enlisted men are required for each. This alternative also requires officer platoon leaders, but here they displace noncommissioned officer crewmen in the manner of tank platoon leaders who are also tank commanders for one of the five tanks of the platoon. Totals for this alternative vary with 144 TOWs in the six mechanized battalions of the mechanized division and 120 TOWs in the five mechanized battalions of the armored division. Hence an average

was used to compare this to the base case. Table 15 summarizes the incremental cost of this alternative.

Table 15

Incremental Cost of the TOW Company (Mech)

Cost Element	Current Division	Mech Div with TOW Co (Mech)	Armored Div with TOW Co (Mech)	Average with TOW Co (Mech)	Incremental Cost
Officer Spaces	6	36	30	33	+ 27
Co HQ (x 6/5)		2 (12)	2 (10)		
Plat HQ (x 24/20)		1 (24)	1 (20)		
Enlisted Spaces	589	582	533	558	- 31
Co HQ (x 6/5)		5 (30)	5 (24)		
Plat HQ (x 24/20)		0	0		
Crew (x 144/132)		4* (552)	4* (508)		
TOWs	143	144	132	138	- 5

NOTE: *one crew in six includes only three enlisted crewmen plus the platoon leader.

TOW Company

The DRS model used for the TOW Co, TOW Bn and TOW Co (Mech) was used here also. The command and control increment is therefore estimated to be two officers and five enlisted men for each of the eleven TOW Cos. Here again also the officer platoon leader replaces a noncommissioned officer crewman and the separate platoon sergeant has been eliminated. Table 16 summarizes the incremental cost of

this alternative.

Table 16

Incremental Cost of the TOW Company

Cost Element	Current Division (Average)	Division with TOW Co	Incremental Cost
Officer Spaces	6	55	+ 49
Co HQ (x 11)		2 (22)	
Plat HQ (x 33)		1 (33)	
Enlisted Spaces	589	550	- 39
Co HQ (x 5)		5 (55)	
Plat HQ (x 33)		0	
Crews (x 132)		4* (495)	
TOWs	143	132	- 11

NOTE: * one crew in four includes only three enlisted crewmen plus the platoon leader.

Antitank Platoon

The AT Plat was modeled on the current mechanized battalion antitank platoon. Hence each of the eleven platoons requires one platoon leader, one platoon sergeant, one driver, and forty-eight enlisted crewmen. Table 17 summarizes the incremental cost of this alternative.

Table 17

Incremental Cost of the Antitank Platoon

Cost Element	Current Division (Average)	Division with AT Plat	Incremental Cost
Officer Spaces	6	11	+ 5
Plat HQ (x 11)		1 (11)	
Enlisted Spaces	589	550	- 39
Plat HQ (x 11)		2 (22)	
Crews (x 132)		4 (528)	
TOWs	143	132	- 11

Summary

Incremental costs for each alternative are compared in Table 18. With a net increase of 113 spaces, the TOW Bn is clearly the most expensive however, the AT Plat is the only alternative which is less expensive than the current organization and that is almost entirely due to the fact that it deletes TOW systems. The TOW Co (Mech) and TOW Co show little net cost increase; however, the shift from non-commissioned officer spaces to officer spaces in the TOW Co results in an increase of forty-nine company grade officers in the division, a substantial expense. A qualitative assessment of these cost comparisons is given in Table 19.

Table 18

Incremental Costs Comparison

Alternative	Officer Spaces	Enlisted Spaces	TOWs
Current Organization	0	0	0
TOW Battalion	+ 26	+ 87	+ 1
TOW Company (Mech)	+ 27	- 31	- 5
TOW Company	+ 49	- 39	- 11
Antitank Platoon	+ 5	- 39	- 11

Table 19

Incremental Costs Assessment (Qualitative)

Alternative	Assessment
Current Organization	0
TOW Battalion	-
TOW Company (Mech)	0
TOW Company	-
Antitank Platoon	+

CHAPTER 5

SUMMARY AND CONCLUSIONS

THE PROBLEM

The capabilities of second generation ATGMs have created new parameters on the potential battlefield. The tank is no longer, if indeed it ever was, the best defense against another tank. Under ideal conditions of range and visibility, the TOW can engage and expect to kill the tank before the tank can engage and expect to kill the TOW. The TOW, on the other hand, has peculiar vulnerabilities and limitations that cause its qualitative advantage to decrease as range decreases. The organization within which we find the TOW is one designed for the 106mm recoilless rifle, a weapon system that did not enjoy a range advantage over the tank and that was even more vulnerable than the TOW. The problem is to ascertain whether or not that organizational structure is the best way to maximize the effectiveness of the TOW and, if not, to find a more desirable alternative.

Scope

The discussion was limited to consideration of TOW employment in heavy, ground maneuver battalions employed in high intensity, conventional warfare. The study was further limited to the mid-range time period for which it could be reasonably assumed that tactics and equipment would remain relatively constant.

METHODOLOGY

Alternative Organizations

The effectiveness of each of five alternative organizations was subjectively assessed on the basis of a set of factors for comparison developed by the author. Four notional alternatives were defined to provide simple, clear alternatives to the current organization which was used as a base case. Together with the current organization, these made up the five alternatives.

Current Organization. The organization used as the current organization is that prescribed by the MTOE employed by the US Army, Europe. TOWs are heavily concentrated in the mechanized infantry battalion with two in the weapons platoon of each rifle company, twelve in the battalion antitank platoon, and four in the battalion scout platoon (total: twenty-two). Additionally there are four TOWs in the scout platoon of each tank battalion. An armored division therefore has 134 TOWs and a mechanized division has 152. Additional TOWs are found in the divisional armored cavalry squadron but those were not considered here. In organizing for combat, TOW sections organic to rifle companies and the scout platoons are seldom taken from those units. TOWs from the antitank platoon are normally attached directly to company teams including companies cross-attached to tank battalions. In some cases, all or part of the antitank platoon is retained under task force control.

TOW Battalion. The notional TOW Bn consists of four TOW companies with thirty-six TOWs each plus required CSS and includes a

headquarters and service company. One battalion replaces all antitank organizations now in the maneuver battalions of the division. The mission of the TOW Bn is to provide heavy antitank guided missile fire support to the division. It is a combat support battalion and is employed by companies attached to, placed under the operational control of, or placed in support of a major combined arms formation immediately subordinate to the division. Companies can be reinforced or reduced by one platoon prior to commitment. Consistent with the command/support relationships established, companies, platoons, and/or sections can then be integrated into the maneuver units of the division as low as team level.

TOW Company (Mechanized Battalion). The notional TOW Co (Mech) consists of twenty-four TOWs in four platoons of three sections each. The company is part of the mechanized battalion separate from the CSC. It replaces the present antitank platoon of the CSC, the rifle company antitank sections, and the antitank sections in the scout platoons of both mechanized and tank battalions. The mission of the TOW Co (Mech) is to provide heavy antitank guided missile fire support to the ground maneuver task force. It is employed by platoons and/or sections attached to, placed under the operational control of, or placed in support of company teams and/or retained directly under the control of the task force commander. Normally some portion of the company accompanies each mechanized company attached to a tank battalion from the TOW Co (Mech)'s parent battalion.

TOW Company (Mechanized and Tank Battalion). The notional TOW Co consists of twelve TOWs in three platoons of two sections each. The

company is assigned to both tank and mechanized battalions and replaces all existing TOW sections and platoons in the current organization. Its mission is to provide heavy antitank guided missile fire support to the ground maneuver task force. It is employed by platoons and/or sections attached to, placed under the operational control of, or placed in support of company teams and/or retained directly under the control of the task force commander.

Antitank Platoon. The notional AT Plat consists of twelve TOWs in six sections of two TOWs each, like the current antitank platoon found in the mechanized battalion. It is assigned to the combat support company of both the tank and mechanized battalions, replacing both rifle company TOW sections and scout platoon TOW sections. Its mission is to provide heavy antitank guided missile fire support to the ground maneuver task force. It is employed by sections attached to, placed under the operational control of, or placed in support of company teams and/or retained directly under the control of the task force commander.

Factors for Comparison

Concentration. The term concentration was applied narrowly to mean the ability of the commander to mass TOWs--to tailor formations with a quantity of TOWs appropriate to the mission, enemy, terrain, and troops available. It is a significant issue at all levels of command and takes on different dimensions in covering force operations, in the defense of the main battle area, and for offensive operations. It was considered not only in terms of establishing an appropriate initial task organization but also in terms of adjusting that task organization in response to a developing situation.

Command and Control. For each alternative, the analysis considered the facility with which TOW fires can be integrated into the battle to exploit their capabilities and reduce the effects of their vulnerabilities. The key parameters of this factor are the extent of cross-attachment required, span of control, the potential for habitual association, and the utility of different command relationships.

Balance. Balance focused on the positioning of all tank killing capabilities in the organization, by level and by type unit, and drew on historical data and current doctrine to assess that positioning as it contributed to combined arms teamwork. The assessment considered how effectively each alternative provided for balance, both in the nominal organization and in a typical organization for combat.

Supportability. Supportability focused on the capability of the organization to support itself and emphasized ammunition resupply. Combat service support considerations beyond organizational level were not considered.

Training. Training focused on the extent to which each alternative facilitates training. Special attention was given to training deficiencies described by the AntiArmor Systems Study and the extent to which alternatives do or do not lend themselves to correcting those deficiencies.

Cost. Cost was assessed in terms of the extent to which each organization violated the assumed constraint that end strength be held constant. Simplifying assumptions were made to provide a reasonable qualitative assessment.

FINDINGS

Concentration

The current organization tends to inherently allocate TOWs away from the most likely armor avenues of approach. It also tends to be somewhat inflexible and makes it difficult to allocate TOWs at the margin, especially above task force level.

The TOW Bn is superior for concentrating TOWs in the initial organization for combat, and from the division and brigade perspective is slightly more flexible.

The TOW Co (Mech) offers minor advantages from the viewpoint of flexibility and allocation at the margin but it retains the major deficiency of the current organization by tending to concentrate TOWs in brigades assigned either supporting roles or the least favorable terrain (or both).

The TOW Co inherently allocates TOWs in proportion to the allocation of maneuver battalions. Primarily because of its small platoons it is easy to reallocate at the margin and is quite flexible. Its inherent flexibility facilitates shifting the concentration within the brigade or task force as the battle shifts.

The AT Plat also inherently allocates TOWs in proportion to the allocation of maneuver battalions, but it retains the relative inflexibility of the current organization both in reaction to changes and in the allocation of resources at the margin.

Command and Control

The current organization tends to require that a significant portion of the TOWs in any given mechanized battalion be cross-attached

to tank battalions. Within task forces built on both tank and mechanized battalion bases, span of control problems are common and the range of effective command relationships available is limited.

The TOW Bn is, at best, no better in that it offers even more severe cross-attachment and habitual association problems while providing relief only in the area of command relationships.

The TOW Co (Mech) mirrors the problems of the current organization in cross-attachment and habitual association but offers some improvement in span of control and command relationships by virtue of an increased leader density.

The TOW Co offers significant advantages in all areas by greatly reducing the need for cross-attachment and greatly increasing officer density.

The AT Plat reduces the need for cross-attachment in a manner similar to the TOW Co but achieves little or no advantage in other areas.

Balance

The current organization is well balanced by level of command but poorly balanced by type battalion, especially in the nominal organization.

The requirement to get TOWs down to where they can kill tanks tends to cause the TOW Bn to be well balanced in the organization for combat in spite of its apparent extreme imbalance.

The TOW Co (Mech) is almost exactly like the current organization in this respect.

Both the TOW Co and the AT Plat improve balance somewhat by balancing the nominal organization by type battalion.

Supportability

The current organization generates a requirement to cross organizational lines and lacks a dedicated TOW infrastructure, especially low level CSS managers and operators, particularly in the tank battalion.

The TOW Bn offers advantages in infrastructure but at the expense of some flexibility.

The TOW Co (Mech) offers small advantages in terms of leader density but, on balance, is no better than the current organization.

The TOW Co eliminates the need to cross organizational lines in the general case and enhances the CSS infrastructure within (but not above) the task force.

The AT Plat also eliminates the need to cross organizational lines and consolidates the CSS infrastructure, thus enhancing it somewhat.

Training

Significant shortcomings in the current organization are caused by the fundamental nature of the organization, the low leader density, and the concentration of TOWs in the mechanized battalion. This impacts adversely on training in all areas.

The TOW Bn and TOW Co (Mech) alternatives offer some advantages for individual and crew and section training but neither facilitates combined arms training.

The TOW Co and AT Plat also facilitate individual and crew and section training. In addition they offer advantages for combined arms training. Because of its greatly increased leader density, the TOW Co offers the greatest advantages in all areas.

Cost

With a net increase of 113 spaces, the TOW Bn is the most expensive alternative.

The TOW Co (Mech) and TOW Co show little net increase. The TOW Co, however, requires an increase of forty-nine officers, a substantial expense not entirely offset by the reduction in enlisted spaces and TOW systems.

The AT Plat is the only alternative which is less expensive than the current organization and that is almost entirely due to the fact that it deletes TOW systems.

Overall Summary

These results are summarized in Table 20. The current organization is shown as the base case (0) and alternatives were assessed to be much better than (++), moderately better than (+), about the same as (0), or moderately worse than (-) the current organization.

Table 20

Summary Results

Factor for Comparison	Current Orgn	TOW Bn	TOW Co(M)	TOW Co	AT Plat
Concentration	0	++	+	++	+
Command and Control	0	0	0	++	+
Balance	0	0	0	+	+
Supportability	0	+	0	+	+
Training	0	+	+	++	+
Cost	0	-	0	-	+

OVERALL ASSESSMENT

Optimum TOW potential is achieved when TOWs are organized into companies organic to both the tank and mechanized battalions. This is due primarily to the increased capability for concentration and enhanced command and control. The latter, however, is achieved only at a significant cost in officer spaces.

The second most desirable alternative is the organization of Antitank Platoons in both the tank and mechanized battalions. This alternative surpasses the current organization in terms of all factors for comparison and is significantly less expensive than the TOW Co. It is not, however, as desirable as the TOW Co in terms of concentration, command and control, and training.

IMPLICATIONS

The scope of this thesis was constrained to focus on a "here and now" optimization. The limitations in the scope and the assumptions projected a static environment. One must ask, however briefly, about the effects of loosening those constraints. What about spaced armor? What about the fielding of an infantry vehicle that mounts an ATGM? What about continuing advancements in other antitank systems?

Spaced armor can potentially defeat shaped charge munitions such as the TOW. In the long run, it is conceivable that virtually all fighting vehicles may employ shaped charge defeating armor of one kind or another. In such a radically changed environment it is illogical to suppose that antitank technology will not have advanced far beyond second generation ATGMs such as the TOW. Of more concern is the

intermediate term, the years just beyond the 1984 boundary on the scope of this thesis when it is not unlikely that many tanks with shaped charge defeating armor plate will be in the field. In that transitional period, target selection will become more critical than it is now. Specific weapon systems will have to be targeted against specific target vehicles. Weapons such as tanks and mines can be targeted against vehicles with spaced armor. Weapons such as ATGMs will have to be targeted against vehicles with homogeneous armor and against soft targets. In an environment such as this, the four TOW, TOW platoon becomes even more desirable because of the training and fire control required.

Similarly, the introduction of more and more ATGMs onto the battlefield as on-board armament for infantry fighting vehicles would not decrease the desirability of dedicated TOWs--ATGMs allocated for combat support. The vehicles would carry ammunition instead of people and could be positioned independently of the maneuvering infantry fighting vehicles. Here again, the small platoon would remain an asset.

ENDNOTES

ENDNOTES

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[8]Kenneth Macksey, Tank Warfare: A History of Tanks in Battle (New York: Stein and Day, 1972), Appendix following p. 270.

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[14]Ibid., p. 12

[15]Fredrich Wilhelm von Mellenthin, Panzer Battles: A Study of the Employment of Armor in the Second World War, Trans. by H. Betzler and ed. by L.C.F. Turner (Norman, OK: University of Oklahoma Press, 1956), p. 12.

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[37]TETAM, Op. cit., p. 13.

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[39]Elizabeth Monroe, MG A.H. Farrar-Hockley, UK, and others, The Arab-Israel War, October 1973: Background and Events (London: International Institute for Strategic Studies, Adelphi Papers, 1975), p. 34.

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GLOSSARY OF ABBREVIATIONS AND ACRONYMS

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ADATM - artillery delivered antitank mine
AGF - Army Ground Forces
AT Plat - antitank platoon (mechanized and tank battalion), specifically the notional antitank platoon described in Chapter 3
ATGM - antitank guided missile
APC - armored personnel carrier
APDS - armor piercing, discarding sabot
A^2S^2 - AntiArmor Systems Study (see bibliography)

Bn/Bns - battalion/battalions

CACDA - US Army Combined Arms Combat Development Activity
CFA - covering force area
CGSC - US Army Command and General Staff College
CGSS - Command and General Staff School (later the Command and General Staff College)
CLGP - cannon launched guided projectile
CSC - combat support company
CSS - combat service support

Div - division
DRS - Division Restructuring Study
DS - direct support

FASCAM - family of scatterable mines
FM - field manual
FMF - Fleet Marine Forces

GEMSS - Ground Emplaced Mine Scattering System
GS - general support

HS - headquarters and service (company)
HAW - heavy antitank weapon
HEAT - high explosive, antitank
HEP - high explosive, plastic
HQ - headquarters
HVAPFSDS - high velocity, armor piercing, fin stabalized, discarding sabot, (also just APFSDS)

IISS - International Institute for Strategic Studies
ITV - improved TOW vehicle

LAW - light antitank weapon

m - meter(s)
Maint - maintenance
MAW - medium antitank weapon

MBA - main battle area
Mech - mechanized
MIA - missing in action
mm - millimeter
MMAS - Master of Military Art and Science
MOPMS - Modular Mine Packed System
MTOE - modified table of organization and equipment

OPCON - operational control

PM TOW - TOW-Dragon Project Manager
POW - prisoner of war

SAM - surface to air missile
SLUMINE - surface launched mine
SOP - standard operating procedure

TCATA - US Army Training and Doctrine Command (TRADOC) Combined Arms Test Activity
TEA - training effectiveness analysis (specific reference is to TEA-TOW, see bibliography)
TETAM - Tactical Effectiveness Testing Antitank Missiles (Evaluation) (see bibliography)
TLAT - TOW Light Antitank Battalion
TOW - tube launched, optically tracked, wire command link (ATGM)
TOW Bn - TOW Battalion, specifically the notional TOW battalion described in Chapter 3
TOW Co - TOW Company (Mechanized and Tank Battalions), specifically the notional TOW company described in Chapter 3
TOW Co (Mech) - TOW Company (Mechanized Battalion), specifically the notional TOW company described in Chapter 3
TRADOC - US Army Training and Doctrine Command

US - United States (of America)
USMC - United States Marine Corps
USSR - Union of Soviet Socialist Republics

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