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U.S. Intelligence and Soviet Armor

Paul F. Gorman

A case study in conventional military force assessment (with exhortations) for intelligence managers, collectors and analysts.

U.S. INTELLIGENCE AND SOVIET ARMOR

Paul F. Gorman
Major General, USA

This thinkpiece aims at 1) identifying a central, unresolved issue in conventional force assessment, and 2) conducting a tutorial for senior intelligence officers in associated problems of collection and analysis. It begins with a review of the centrality of maneuver armor to the Soviets, and a refutation of the commonly-held belief that NATO antitank guided missiles (ATGM) offset the Warsaw Pact's advantage in armor. There follows a retrospectus of recent trends and a laying out of the options open to designers of armor protection and armor penetrants, with a specific forecast of Soviet interests. Finally, there is an exegesis on intelligence implications, culminating in a broadly sketched plan of action.

SUMMARY

Soviet strategy in Central Europe is buttressed by armored vehicles—some 9,400 Soviet tanks are the most visible element of Soviet power there. Since 1968 the USSR has built over 65,000 armored vehicles for maneuver: nearly four times as many tanks as the United States, some three times as many armored infantry carriers. The best Soviet armored vehicles are clearly superior to U.S. counterparts, less because of technological breakthrough than the resolute, relentless Soviet materiel acquisition process. Soviet industry, supported by procurement funds for land force arms which triple U.S. outlays, grinds out new models which outstrip ours in quality and quantity. The near-term outlook is for more of the same: through 1984, the Warsaw Pact will outproduce NATO in large-gun, advanced-armor tanks more than 4:1. NATO's precision guided missiles (PGM) are unlikely to give the Soviets doubts about the continued efficacy of their armor, since their counters are both impressively numerous and redundant.

Nor are longer term prospects more promising. While U.S. innovations since 1974 promise two effective new tanks for the 1980s (the M60A3 and XM-1), plus a range of potent new tank penetrants and incapacitants, Soviet measures against U.S. anti-armor weapons, which we now know have been quite effective in the 1970s, could keep them well out in front of American developments throughout the 1980s. In the arms likely to dominate the outcome of a future battle for Central Europe—armored fighting vehicles and counterweapons—the U.S. Army, then, probably will remain qualitatively and quantitatively inferior. The domestic and international implications of this inferiority—were it generally appreciated—are grave indeed.

[redacted]

What could change this bleak prognosis is better intelligence on the nature of Soviet armor and projectiles for tank guns, and on Soviet countermeasures against U.S. precision guided missiles (PGMs). Intelligence community leaders must appreciate that:

- It is true neither that antitank missiles have outmoded the tank nor that armor and penetrants have reached their respective technological performance limits.
- In the 1980s, fielded tanks could be uparmored to counter new threats, and upgunned via new ammunition to defeat unforeseen forms of adversary armor.
- An armor can be designed to fend off any *known* penetrant; a penetrant can be designed to defeat any *known* armor.

More than in any other field of armaments, the development of tanks and precision guided missiles is sensitive to and can benefit enormously from timely acquisition and interpretation of intelligence. The men and women of the U.S. intelligence community can thus exert powerful and immediate leverage on the crucial balance of conventional military forces arrayed in Europe.

Given perceived nuclear parity, apprehension over the balance of conventional armaments could bear decisively on the cohesion of the Atlantic alliance in peace, or its armies in war. Moreover, there are large sums of U.S. defense funds involved in decisions which turn on intelligence estimates of Soviet development of penetrants and protection. Most U.S. intelligence gaps pertaining to strategic weapons would, were they closed, scarcely affect on-going programs. But the intelligence shortfall *re* Soviet armor has already influenced billion-dollar decisions on the XM-1, TOW, and tank ammunition programs. Further clearing of uncertainty could have immediate impact. Here is a case where modest improvements in intelligence could cause multiple reallocations of defense funds, and conceivably, become the linchpin in NATO's confidence and credibility.

I. OVERVIEW

Armor in Soviet Strategy

A nation's outlays for war materiel telltale its anticipated style of combat. Over the past 15 years, armor for land force maneuver has stood second highest among the top 20 Soviet separate weapon systems procurement programs, and well up among general categories of weapons (see table, page 3). This investment has provided the USSR with an active inventory of about 50,000 main battle tanks—five times the U.S. fleet—and more than 30,000 modern infantry combat vehicles—three times the U.S. fleet. [redacted]

This emphasis leaves little doubt that the Soviet Union sees armor as its principal means of controlling land and people. This is so notwithstanding NATO's deployment of large numbers of precision-guided missiles and other antiarmor ordnance, and despite the strains armor procurement imposes on Warsaw Pact economies beleaguered by growing shortages of energy, manpower, and raw materials. The Soviets perceive armor as the makeweight in the conventional arms balance in Central Europe, now and for the foreseeable future.

Table I.
Major Weapon Procurement Programs

Top 20 Individual Systems
(Ranked by Cost)

1965-79	1980-85
Flogger	Flogger
*Armored fighting vehicles**	*Armored fighting vehicles**
D-class submarine (with missiles)	Modified Foxbat
Y-class submarine (with missiles)	New SLBM
Hip/Haze	Backfire
Foxbat	SS-20
Fencer	Fencer
SS-11	SS-19
Backfire	Advanced fighter
Fitter	Follow-on to V-class submarine
SS-18	SS-18
Fishbed	Hip/Haze
Flagon A	New long range bomber
Candid	New large ICBM
V-class submarine	SA-X-10
SS-19	AA-X-9M
SS-20	Candid
SA-5	Hind
SS-9	SS-20
Hind	New class general purpose submarine

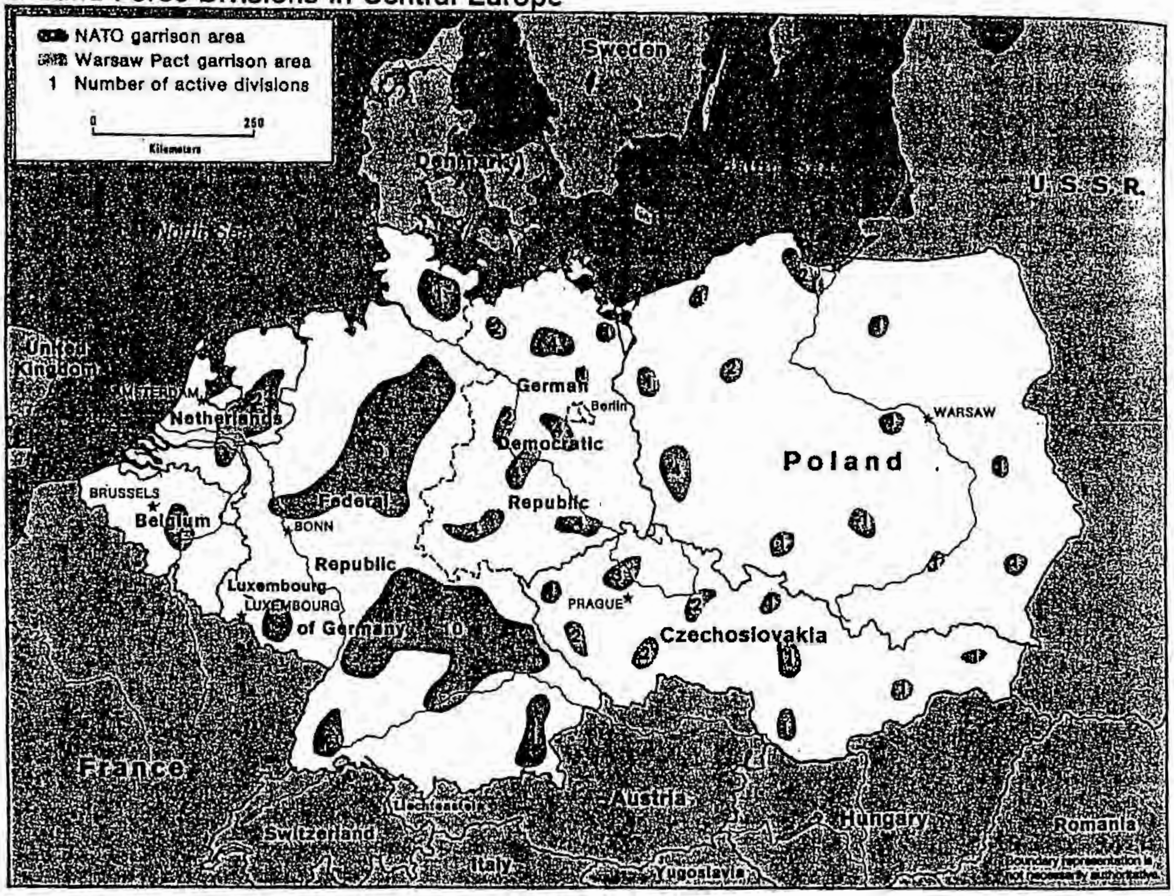
Soviet Weapon Procurement Categories

Top 10

1965-79	1980-85
Fighter/interceptors	Fighter/interceptors
ICBMs	ICBMs
Ballistic missile submarines	General purpose submarines
Helicopters	Bombers
*Armored fighting vehicles**	SAMs
SAMs	Helicopters
General purpose submarines	*Armored fighting vehicles**
Bombers	MR/IRBMs
Surface combatant ships	Transports
Transports	Surface combatant ships

*Weapon systems, equipment, and initial spare parts (exports excluded); includes main battle tanks (T-62, T-72) and four types of armored personnel carriers or infantry fighting vehicles (BMP, BMD, BTR-60, and BRDM). N.B.: 1979 expenditures for these were up 500 percent from 1965.

Ground Force Divisions in Central Europe



Ground Force Strengths in Central Europe

	NATO		Warsaw Pact	
	US Only	Total	Soviet Only	Total
Active divisions*	4	27	27	58
Personnel	204,000	797,000	482,000	970,000
Tanks**	1,475	6,460	9,400	16,480

*Divisions vary in size and type from country to country.
**In active units.

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[redacted]

Soviet Medium Tanks

	Main Armament	Armor	Weight	Overall Length	Year Operational
T-54/55 	100 mm	Steel	36 tons	6.2 m	1949/58
T-62 	115 mm smoothbore gun	Steel	37 tons	6.6 m	1961
T-64 	125 mm smoothbore gun	Laminate	38 tons	6.3 m	1970
T-72 	25 mm smoothbore gun	Laminate	41 tons	6.9 m	1974

Secret

[redacted]

Soviet Combat Infantry Vehicles

	Main Armament	Speed		Capacity	Overall Length	Year Operational
		Land	Water			
BTR-60PB 	14.5-mm and 7.62-mm machine guns	80 km/hr	10 km/hr	[illegible] crewmen, [illegible] troops	7.2 m	1961
BMP 	73-mm gun, 7.62-mm machine gun, Sagger or upgraded antitank missile	55 km/hr	8 km/hr	[illegible] crewmen, [illegible] troops	6.7 m	1967
BMD (with airborne units) 	73-mm gun, three 7.62-mm machine guns, Sagger or upgraded antitank missile	[illegible] km/hr	10 km/hr	[illegible] crewmen, [illegible] troops	[illegible] m	1970

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[redacted]

BACKGROUND

— In the 1920s and 1930s, the tank proving grounds of Russia were the womb of the Nazi panzer armies.

— Marshal Tukhachevsky was practicing "blitzkrieg" with actual tanks and close air support when Guderian *et al* were still experimenting with plywood mock-ups.

— Only the USSR exploited the genius of the American tank designer, Walter Christie, whose inventions underwrote World War II's best tank, the Soviet T-34.

— But Stalin's purges of Tukhachevsky and other Red Army leaders vitiated the effectiveness of Soviet armor, and Hitler's armor leaders nearly defeated a Soviet tank fleet outnumbering theirs by more than four to one, teaching the Soviets a powerful lesson in how many tanks are enough.

— The Soviets' military history of World War II depicts the Red Army's armor as the spearhead of victory. Yet in 1945, tanks comprised less than 6 percent of USSR ground forces; today, tanks are more than 25 percent. The current Soviet motorized rifle division has 16 times the tanks of its World War II counterpart, 37 times the number of armored infantry carriers.

— Since 1945 armor has been used frequently to underwrite Soviet politics in East Europe.

— Armor is fundamental to contemporary Soviet strategy in Europe, the Middle East (exports to client states), and Asia (forces opposite PRC, Afghanistan).

"The Soviets have been first in space, first in tanks, far behind in computers, and last in ladies' lingerie" . . . Robert Kaiser, *RUSSIA*.

The USSR builds and fields large numbers of armored vehicles because:

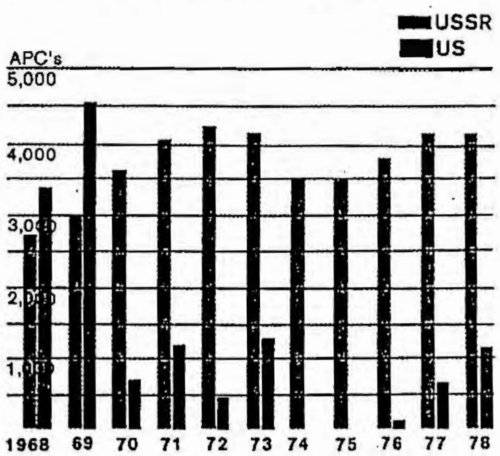
- That has been its practice ever since the nascent Communist state seized world leadership in armor development after the Rapallo Treaty in 1922.
- The Soviet armored vehicle industry is one of its largest enterprises, employing millions of workers, and consuming huge quantities of steel, other raw materials, and energy.
- Tanks and accompanying armored vehicles are *sine qua non* for the high-tempo, offensive operations prescribed in Soviet military doctrine for either nuclear or conventional warfare.

Even if, after Brezhnev leaves the scene, the new Soviet leadership wanted to divert resources from armor programs, it might well be stymied by sheer societal inertia: the USSR seems irrevocably committed to producing armor, in huge quantity, and of high quality.

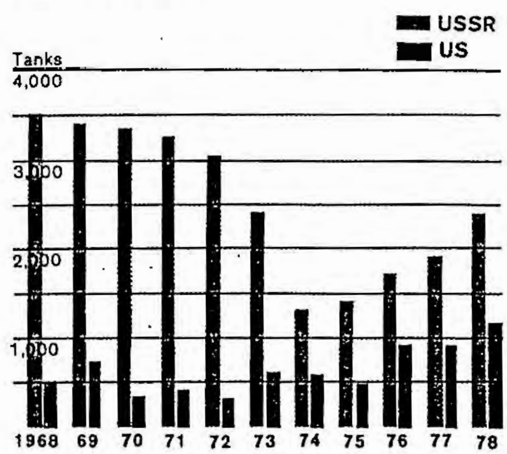
Soviet Armor Production

In recent years, Soviet tank and APC production has dwarfed that of the United States. Since 1968, Soviet factories have turned out over 65,000 armored fighting vehicles: about four times as many tanks, and about three times as many APCs as the United States. In 1979, production of outmoded models ceased, and at least one large plant at Omsk was refurbished. Assuming past production trends continue, total annual production of tanks could increase 30-40 percent over the next few years.

Deliveries of Armored Personnel Carriers



Tank Deliveries



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The Soviets have systematically modernized their armor inventories. Since the early 1960s, when the United States began to issue the M-60 series tank and M-113 series armored personnel carrier (vehicles which remain in 1979 our *only* armor production items), the Soviets have fielded no less than three types of main battle tanks and three new armored personnel carriers. Some 13,000-15,000 T-64 and T-72 tanks have been manufactured—more than the whole U.S. fleet of the M-60 series. Moreover, while U.S. forces are still dependent (with the M-60 series) upon homogeneous steel armor and rifled, manually served guns, Soviet T-64 and T-72 tanks are protected by more advanced armor and mount large-caliber, high-velocity, smoothbore, automatically loaded cannon. Soviet armored infantry vehicles have both smoothbore antitank cannons and on-vehicle antitank guided missiles as well as firing ports, while the U.S. M-113 mounts only a World War II vintage machine gun, and has no firing ports. Soviet tank crews have been reduced from four soldiers to three by the addition of automatic loaders, and the newer Soviet tanks incorporate both stabilization and electro-optical fire control instruments further to automate gunnery, and to increase first-round hit probability with less training.

It is *not* that Soviet armor designers have access to technologies beyond the reach of their U.S. counterparts. The United States could have built and fielded superior, or at least comparable, armored vehicles. To the degree that the Soviets today enjoy a technological advantage in their deployed, high-quality armor systems, that edge proceeds from compressed development cycles in close sequence, plus their willingness to put a partially developed vehicle into production and into operational

[redacted]

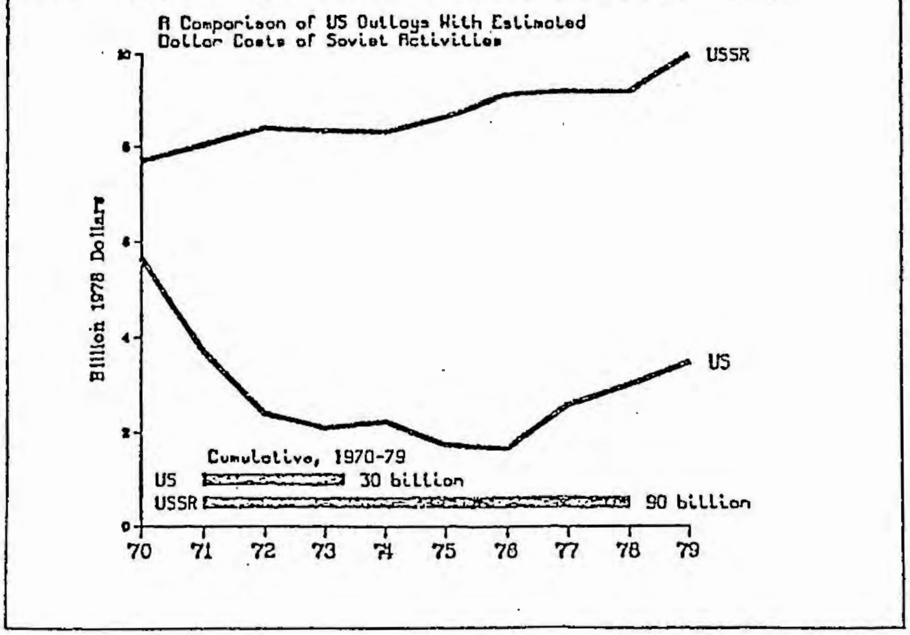
units, allowing the vehicle to mature in use via product improvement.* Thus, the gap between U.S. and Soviet armor forces is less a function of advanced Soviet technology than of a resolute, relentless materiel-acquisition process:

ARMOR MATERIEL ACQUISITION PROCESS

United States	Soviet
Discontinuous and lengthy system development, product improvement, follow-on development.	Telescoped development, product improvement, follow-on development.
Turbulence in design, production and test teams resulting from discontinuous development.	Continuously operating design bureaus working on successive models.
Requirement for cost-effectiveness analyses based on operational tests stretches time prior to production decision.	Tests in operational units, production and improvement via retrofit in units.
Design for mission versatility, even at risk of complexity in manufacture and maintenance afield.	Designs for narrow missions, at low technological risk to insure better manufacturability, reliability, and maintainability.
Search for significant advances beyond current system capability, to limit of technology; "state of the art": a better system.	Acceptance of modest improvement over predecessor system, using "off-the-shelf" technology and design ingenuity: an adequate system.

*For example, although their T-64 tank, the mainstay of their forces in Germany, has been trouble-prone since its fielding, it has been improved over time via extensive and expensive modifications, including a whole new power plant. While such defects in a U.S. tank would have caused a major scandal, we could detect almost no perturbations in the Soviet defense establishment over their issue. During the 6 months (April-October 1979), improved T-64s were replacing older T-62s and T-55s among Soviet forces in Germany at the rate of about 100 per month.

The Soviet materiel-acquisiton process for land forces is supported lavishly by U.S. standards. In fact, the estimated dollar cost of Soviet outlays for land force arms over the past decade has been three times the comparable U.S. outlays.



US and Soviet Land Forces Procurement

[redacted]

The Question of Quality

The U.S. Army rates the best current Soviet tank clearly superior to its main battle tank:

1979

	PROTECTION	FIRE CONTROL 1/	MAIN GUN	MOBILITY 2/	NIGHT VISION	AMMO LOAD 3/	NBC 4/	AUTO LOADER 5/
M60		✓		✓	✓	✓		
T-72	✓	✓+	✓ +	✓+	✓		✓	✓

NOTES:
1. T-72 possesses automatic electronic rangefinder, possibly laser rangefinder.
2. T-72 has "snorkel."
3. M60A1 has 60 rounds vs 40 rounds in T-72.
4. T-72 possesses antiradiation liner.
5. M60A1 does not have automatic loader.

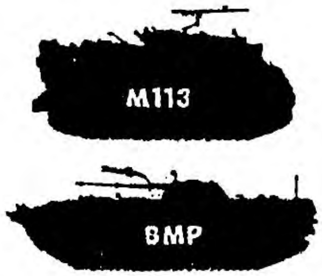
By 1984 or 1985, when an upgraded version (designated XM1-E1) becomes available with both additional armor protection and a 120-mm gun, the U.S. Army expects the United States to be producing a tank as good as the Soviet follow-on to the T-72.

1984

	PROTECTION	FIRE CONTROL	MAIN GUN 1/	MOBILITY 2/	NIGHT VISION	AMMO LOAD 3/	NBC	AUTO LOADER 4/
XM-1	✓+	✓	✓	✓+	✓	✓	✓	
T80	✓	✓	✓	✓	✓	✓	✓	✓

NOTES:
1. Assumes 120-mm gun for XM1.
2. XM1 will have advanced torsion bar suspension, superior horsepower/weight ratio.
3. Assumes 120-mm gun for XM1.
4. XM1 will not have automatic loader.

Similarly, the U.S. Army rates its current APC clearly inferior to its Soviet counterpart, the BMP:



1984

	MOBILITY 1/	NIGHT VISION 2/	NBC 3/	IFV 4/	AT 5/
M113	✓	✓			
BMP	✓+	✓+	✓	✓	✓

NOTES:

1. Judgment based on size, weight consideration.
2. BMP has passive IR sight.
3. BMP possesses collective protection, filter, chemical alarm.
4. BMP mounts 73-mm gun, has firing ports.
5. BMP mounts Sagger ATGM.

By 1984, as the United States Infantry Fighting Vehicle becomes available, the Army figures it may close the gap in quality, if not in quantity, compared with the BMP follow-on:

1979

	MOBILITY 1/	NIGHT VISION 2/	NBC	AT	CANNON 3/	RATE OF FIRE 4/
IFV	✓+	✓+	✓	✓	✓+	✓
BMP FO	✓	✓	✓	✓	✓	

NOTES:

1. IFV will possess superior suspension, horsepower/weight ratio.
2. IFV will have thermal night sight.
3. Judgment based on IFV Bushmaster. automatic cannon
4. Judgment based on IFV Bushmaster. automatic cannon

Confronted with the foregoing data, or comparable presentations, NATO supporters usually adduce two arguments which they feel offset putative Soviet strength in armor:

— In assessing armor, all of NATO's tanks, not just those of the United States, should be counted.

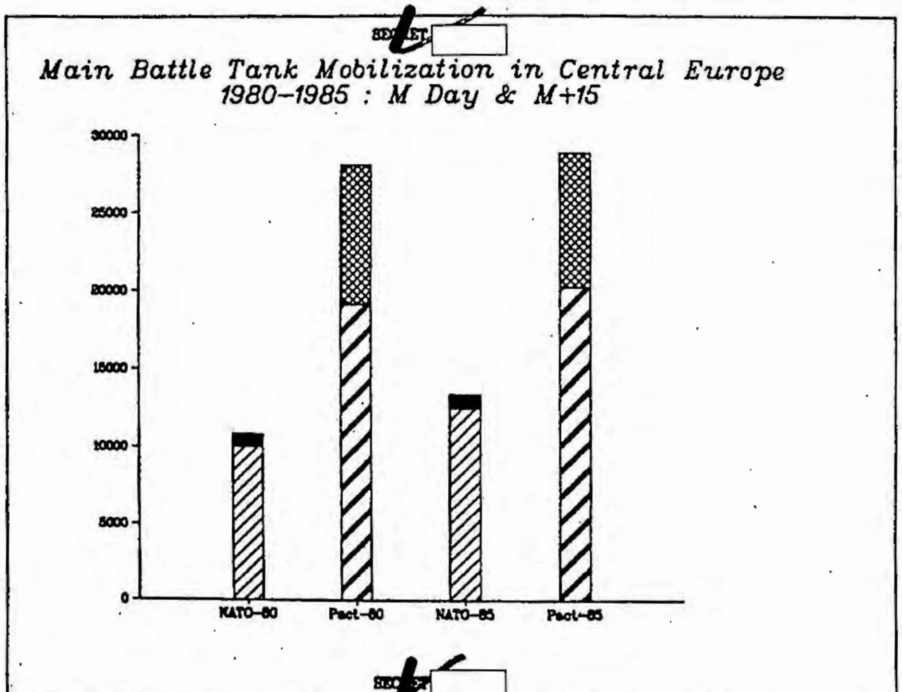
— NATO relies not just on tanks, but on antitank guided missiles (ATGM) and other advanced weapons to counter Soviet armor.

NATO vs. Warsaw Pact Tanks

Warsaw Pact tanks now outnumber NATO's (2:1 in peace, better than 2.5:1 postmobilization) and NATO is unlikely to improve its position by 1985. Quantitatively, the Warsaw Pact is likely to maintain about the same edge.

The first argument has merit, but proffers little comfort. Over the past five years (1975-1979) NATO's procurement of tanks has averaged less than half that of the Warsaw Pact.

While NATO is expected to add some 3,000 tanks to its inventory between 1980 and 1985, these increases will be mainly from new British procurement (about 100 120-mm gun Chieftain Challenger tanks) and U.S. POMCUS (prepositioned overseas



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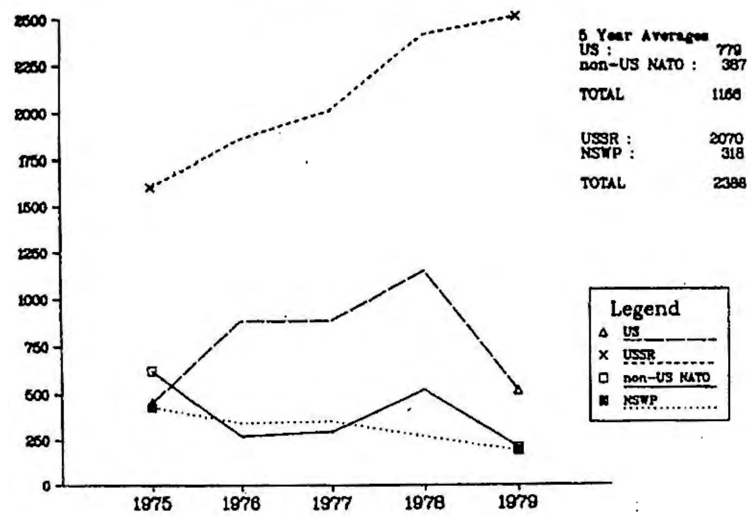
NATO and Warsaw Pact Main Battle Tank Procurement 1975 to 1979



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materiel configured in unit sets)—all M-60 series. Qualitatively, NATO will remain dependent on tank types with 105-mm or smaller main guns, and old-style, homogeneous armor, while the Warsaw Pact will be turning out larger numbers of tanks with guns of 120-mm or larger bore, and advanced armor. If only such large-gun, advanced-armor tanks be counted, the Warsaw Pact will probably outproduce NATO by more than 4:1.

This difference in quality is significant. Presented below is a U.S. Army comparison of the effectiveness of key tanks of the recent past and near future. The U.S. Army Materiel Systems Analysis Agency* has used for this purpose a dynamic model of combat between two tanks (one-versus-one duel). The mathematical model is informed as feasible by data from battles (for example, the October 1973 War), and actual firings and other tests. It aggregates outcomes of duels at various combat ranges, in which each protagonist is 50 percent of the time fully exposed in the attack, and 50 percent in hull defilade defending. Variables in the model also account for time of firing, probabilities of hit and of kill, round reliability, and probability of sensing (using one shot to advantage in aiming the next). Thus, this duel model evaluates two tanks by comparing the vulnerability and lethality of each, plus their respective rates of fire and accuracy, combined significantly over range and engagement time. Thus

*AMSAA generated this analysis expressly for this paper; data are Confidential. Note, however, that the XM1-E1, due circa 1985, is not modeled.

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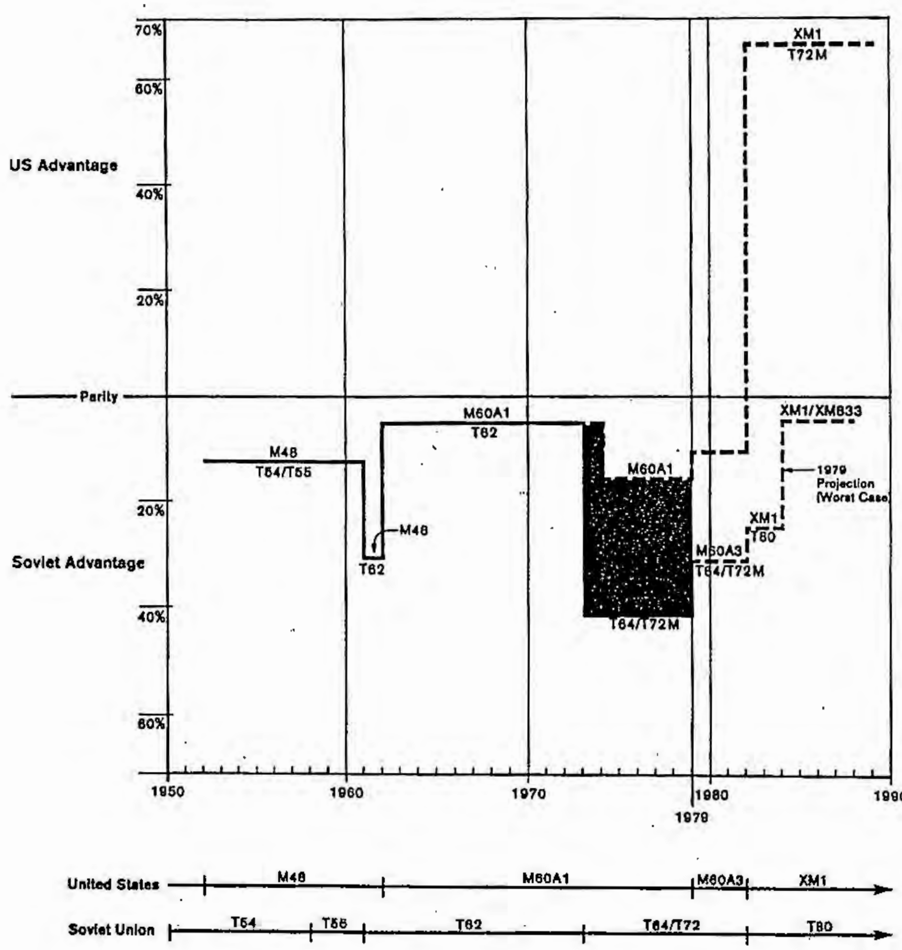
measured, the current and recent Soviet advantage in *quality*, tank for tank, is evident in the chart labeled "Tank Quality."

Tank Quality: The AMSAA View
(One vs. One Duels)



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The area on the chart labeled "Intelligence Shortfall" will be discussed at greater length in the concluding section of this paper, but suffice to say here that possible comparisons between current and prospective U.S. and Soviet main battle tanks are defined by the upper curve (T-70 lines), which is the 1974 intelligence projection used by the Army in seeking approval for its XM-1 development program, and the lower curve (T-64/72, T-80 lines), which represent current intelligence projections crediting Soviet armor with high protective prowess (upper bound, or worst case armor). Information available now indicates that the actual state of affairs is much closer to the bottom curve than the upper curve. In brief, the United States is now behind, tank for tank, and even when our developmental XM-833 depleted-uranium round for the 105-mm cannon becomes available, the XM-1 is likely to be no more than an even match for the T-80.

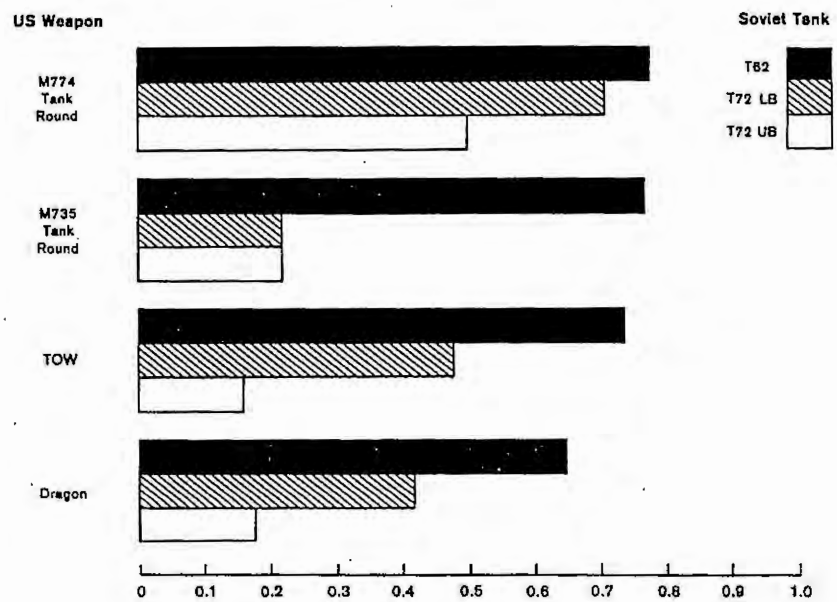
[redacted]

U.S. Army data, were it available in Moscow, would confirm Soviet sensings of the superiority of their T-72 over contemporary U.S. tanks. The chart below draws on data from the U.S. Army Ballistic Research Laboratory, based on test firings, which compare the four main tank-killing weapons of the U.S. Seventh Army in Europe against three Soviet tanks: the T-62, and the T-72 with our high and low estimates of its armor thickness. The T-72 LB is a lower bound or "best case" version, the T-72 UB is an upper bound or "worst case" version. The U.S. weapons include the DRAGON and TOW antitank guided missiles, and two 105-mm tank cannon rounds: the M-735 is the current tungsten alloy fin-stabilized round, and the M-774 is the depleted uranium (Staballoy), fin-stabilized round about to be issued. The plots depict probability of kill assuming hit on an attacking, fully and frontally exposed tank:

		$P_{K/H}$*	
CURRENT WEAPONS	T-62	T-72 (LB)	T-72 (UB)
DRAGON ATGM	.65	.42	.18
TOW ATGM	.74	.48	.16
M-735 APFSDS	.77	.22	.22
COMING WEAPONS			
M-774 APFSDS	.78	.71	.50

* Probability of Kill Given Hit, Firer and Target Stationary, Target Fully Exposed, 0° Azimuth (Front).

Probability of Kill Given Hit, Firer and Target Stationary, Target Fully Exposed, 0° Azimuth (Front)



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As may be seen, while all weapons have provided high assurance of kill against the T-62, the M-735—planned to be the most numerous round aboard U.S. tanks—is impotent against the T-72. Our two most powerful ATGM are marginal in a frontal attack against the lower bound-best case T-72, and virtually useless against the upper bound-worst case T-72.*

To sum, whether one uses informed U.S. or Soviet calculations, the conclusion is that NATO can expect, through 1984, no advantage over the Soviets in quality of armor or antiarmor weapons, and only a modest redressing of its present quantitative disadvantage.

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*The graphic assessment techniques used here are in some cases original, and, in all, unusual. Among other problems intelligence faces, that of presenting comparisons in this field of armaments is most difficult. With vehicles protected by homogeneous armor, it has been easy to express lethality of threat weapons using as a common denominator the ability of each to penetrate some standard armor, such as "rolled homogeneous steel plate at 0° obliquity." But with the advent of nonhomogeneous armors, such as that we believe the Soviets employ on the T-64 and T-72, new comparative measures must be sought. As the U.S. Army Ballistic Research Laboratory puts it: "The Soviet Union has fielded two new tanks, the T-64 and the T-72. As intelligence data on these tanks accumulated, it became apparent that (a) the T-64 and T-72 were very similar in most respects, and (b) both appeared to have an unconventional armor over most (or all) of their frontal areas. Continual analysis of the accumulating intelligence data has led to technical estimates of what this unconventional armor might be, and how well it may perform. If our estimates of what this unconventional armor could be engineered into the tanks [sic], then this armor also would provide substantially improved ballistic protection over that of an equivalent weight of homogeneous steel armor. Further, it appears that the magnitude of the improvement in ballistic protection with the unconventional armor is probably *not* some simple multiple of the equivalent weight of homogeneous steel armor, but instead varies from weapon to weapon in a complicated way.

"The advent of a new unconventional armor on fielded Soviet tanks causes two immediate problems. The first, biggest and most obvious problem is that we must immediately reconsider the capabilities of our existing and developmental weapons systems, and decide what actions are prudent in the face of this new threat. The second, less obvious, problem is that this reconsideration of the capabilities of our weapons systems is made much more difficult by the complicated phenomena involved in the terminal ballistics of attacking munitions and the unconventional armor as we perceive it now.

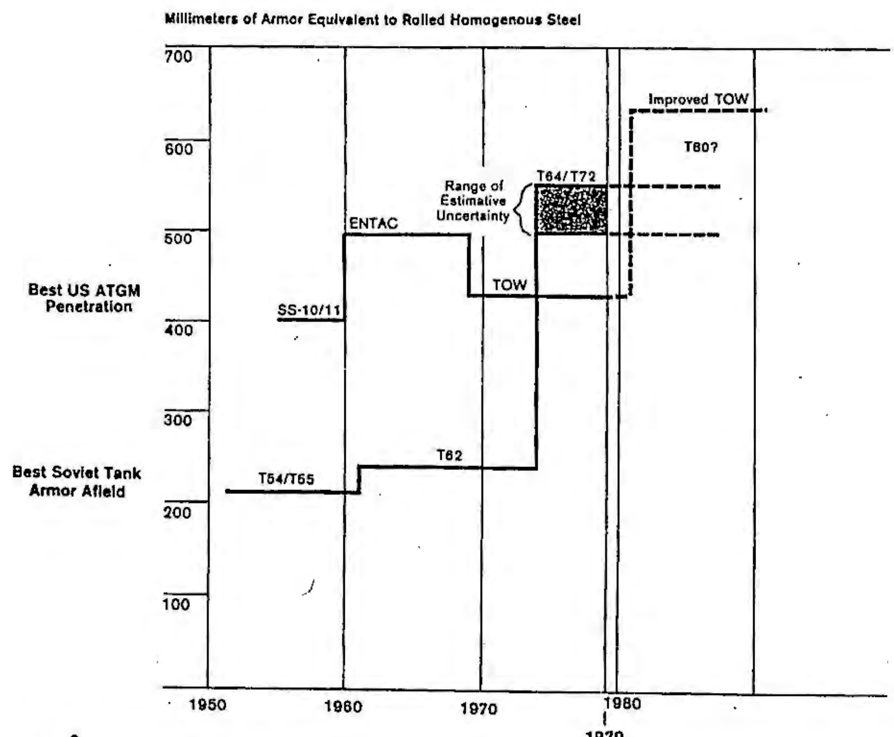
"When tanks were made of homogeneous steel armor, it was relatively easy to get a fair idea of the lethality of most weapons against such tanks by comparing the penetration capability of the weapon into steel armor to the known or expected thickness of armor on the tank. Thus, if a weapon could penetrate X mm of steel armor, and it had to penetrate Y mm of steel armor to reach the internal volume of the tank, then if X>Y the attacking weapon could be said to have some significant lethality, and the *more* X exceeded Y the greater the lethality was likely to be (up to a point). *Such simplistic concepts are not workable with the new unconventional armors.* Attempts to communicate weapons systems lethality against such armors have led to great confusion among DoD decision makers unfamiliar with the complicated terminal ballistics technology involved."

Antitank Missiles

Does NATO's hope lie in more and better antitank guided missiles? In precision-guided munitions? Here, too, near-future prospects are bleak. As indicated above, even the numerous, once-formidable U.S. TOW ATGM is now a questionable asset. As the chart depicts,* when the Soviets deployed their T-64 and T-72 tanks, they ended nearly two decades of U.S. ATGM superiority. While it is possible that an improved (larger, faster) TOW-like missile may redress this deficiency vis-a-vis these current tanks, Soviet armor on the T-80 and T-80I could stymie this development as well.

*While the previous footnote deprecates such simplistic measures as those of ordinate, these can be used with some validity to rate the comparable ATGM warheads shown.

US ATGM vs. Soviet Tank



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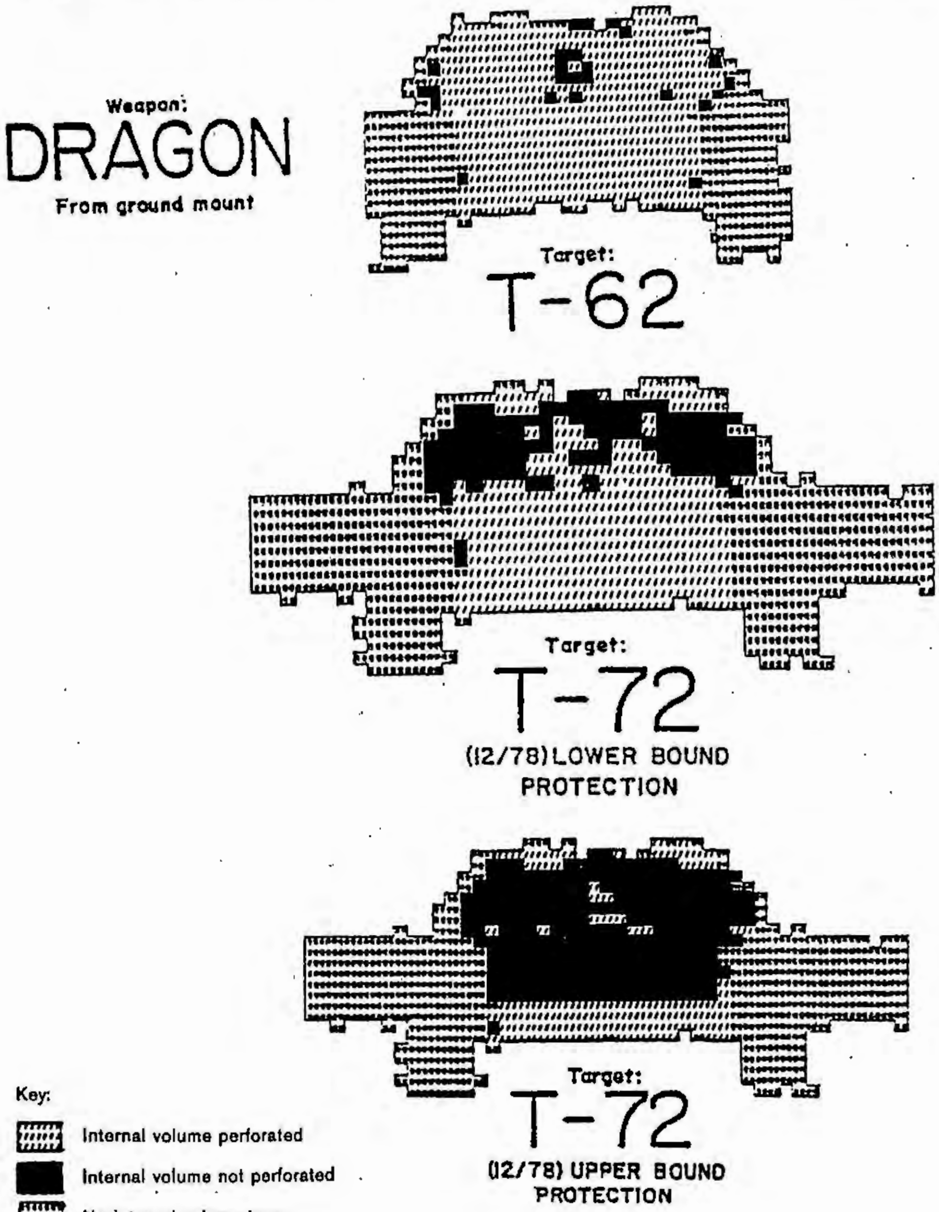
Here are diagrams generated by the computer of the Ballistic Research Laboratory which portray the vulnerability of the T-62 and T-72 against frontal attack by DRAGON and TOW, the two ATGM now deployed throughout the Seventh Army. The depiction for DRAGON is valid for a 0° frontal attack from 100 to 1,000 meters range; that for TOW for a 0° frontal attack from 500 to 3,700 meters range:



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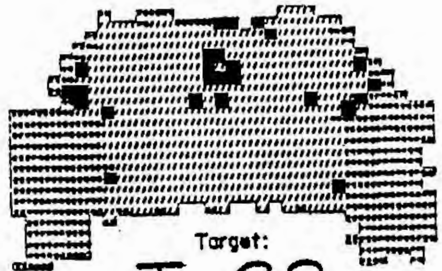
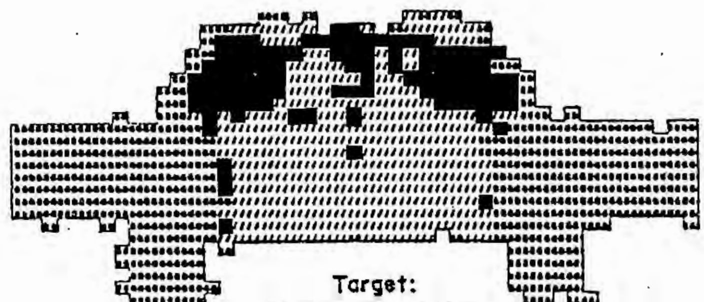
Weapon:

TOW

(Current)
From vehicle mount



Target:
T-62



Target:
T-72
(12/78) LOWER BOUND PROTECTION

Target:
T-72
(12/78) UPPER BOUND PROTECTION

Key:
- Internal volume perforated
- Internal volume not perforated
- No internal volume here

Secret

These diagrams illustrate vividly the intelligence dimensions of the ATGM problem facing U.S. commanders in Europe today: our ATGM clearly can defeat the T-62, but the T-72—and the like-armored T-64—could be largely invulnerable to them. In fact, chances are better than 50-50 that either TOW or DRAGON would explode without effect against the nose of the T-72, even if that tank's armor is only of "lower bound, best case" toughness. In the upper bound, worst case, the probability of kill declines to less than .20. Prudence dictates a change in tactics to seek flanking, rear, or top shots for our ATGM—adjustments which to some extent will require them to sacrifice their range advantage, and render them more vulnerable to suppressive fires and infantry attack. (The U.S. Army is now developing an improved TOW missile which uses a larger warhead plus a nose probe to optimize penetration—but this will not appear until 1982.)

Tactics of Suppression

In any event, for coping with NATO ATGM the Soviets probably rely as much on suppressive fires as on armor protection. Soviet doctrine stresses four types of suppression for ATGMs and other antiarmor defenses: direct fire from tanks, supporting infantry fighting vehicles, and attack helicopters, and indirect fire from artillery and mortars.

The Warsaw Treaty Organization intends to use its tank superiority to overwhelm NATO ATGM. They believe that a high density of attacking tanks can saturate the defense in any given sector. They know tank guns can fire more rapidly than ATGM, and that Soviet tanks are heavily armored to the front, and built low to present a minimal target. Their crews are drilled in frontal engagement of ATGM while on the move. Whereas ammunition aboard U.S. tanks in Germany consists mainly of steel darts for killing tanks (less than 20 percent high explosive or incendiary rounds), Soviet tanks carry mainly high explosive antipersonnel rounds for ATGM suppression.

Aside from tanks, the Soviets prize for suppression other direct fire weapons which can reach deep into NATO defensive positions to destroy defending tanks and ATGM on vehicles or in bunkers. Here Soviet ATGM play a role. During the 1960s and 1970s, while the United States has fielded just two ATGM systems—DRAGON (range 1,000 meters) and TOW (range 3,000-3,700 meters)—the Soviets have fielded six. The latest Soviet antitank missile is the AT-6 SPIRAL, a radio-controlled, semiautomatic, command-to-line-of-sight system of 5,000 meters range. Although NATO has many more antitank weapons than the Pact, and will substantially increase its lead in numbers of fielded AT weapons over the next several years (through 1984),* most such weapons will be of short range and of doubtful use against advanced armor like that of the T-72. Considering only antitank systems with ranges greater than 1,000 meters, which are generally the more capable systems which figure in suppressive fires, by 1984 the Warsaw Pact will have increased its advantage over NATO by 70 percent. As for armored vehicles to move these and other infantry support weapons about the battlefield, the Pact has a clear superiority now, and will maintain a 5:1 superiority in infantry fighting vehicles through 1984.

Attack helicopters provide a type of mobile firepower most useful against ATGM, for which the Soviets are pressing hard. As the table on page 3 makes evident, helicopter procurement receives high priority in Soviet defense spending. Over the six months (April-October 1979), in Central Europe alone, the Pact increased its ground attack helicopters some 40 percent, and formed two new MI-24 regiments.

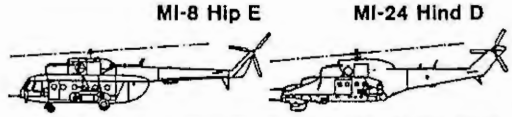
*For example, the U.S. VIPER, replacing the M72A2 LAW, will add many thousands of short-range AT rockets to the NATO inventory.

[redacted]

Both the HIND D and HIP E are heavily armed with direct fire weapons which can suppress or destroy NATO tanks and ATGM. Both are being produced in large numbers, and by 1984 the Pact is expected to have a 1.7:1 advantage over NATO in attack helicopters.

Figure II-15

Warsaw Pact Ground Attack Helicopters



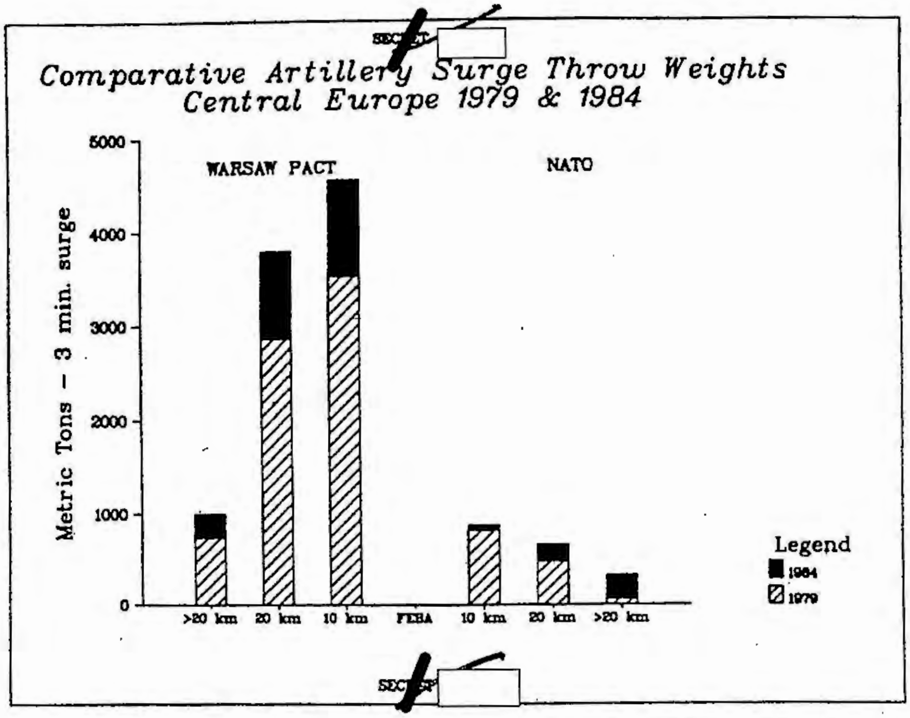
	MI-8 Hip E	MI-24 Hind D
Year operational	1977	1976
Length (m)	18.2	17.3
Maximum useful load (kilograms, fuel and payload)*	4,500	5,300
Maximum combat radius* (nm)	95	120

*Maximum useful load and combat radius calculated with a maximum payload at maximum gross weight using a rolling takeoff.

Secret

As for artillery, which the Soviets regard as their main suppressive counter to ATGMs, the Warsaw Treaty Organization will maintain its current overall superiority in numbers of tubes (about 2.5:1) through 1984. Soviet artillery modernization programs include both mechanization (self-propelled guns/howitzers) and upgraded munitions, including bomblet dispensing rounds, flechette-type shrapnel, and proximity fuzes calculated to be especially effective against ATGM, even if protected by currently issued nylon blankets. The crucial difference for the force balance in Europe is perhaps best measured by relative firepower surge capabilities. These express on the Warsaw Pact (WTO) side the capability for fires to kill or blind preparatory to an attack, or ATGM suppression/obscuration during an attack. On the

NATO side, these show maximum counterbattery fires. As the chart below makes evident, by 1984 NATO's relative inferiority will increase:



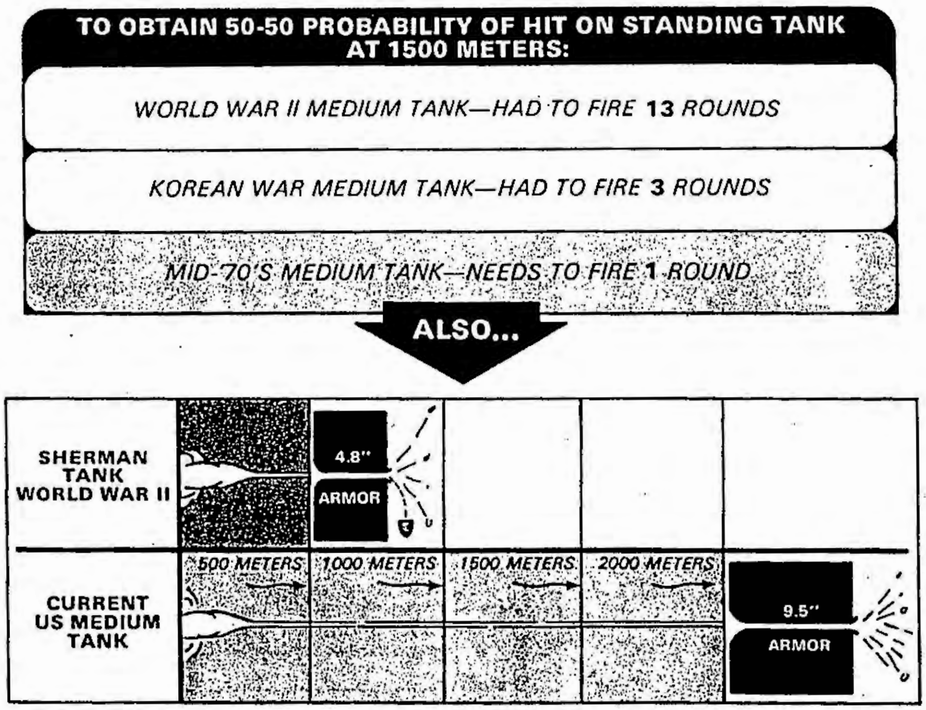
To summarize, through 1984 at least, large numbers of Soviet armored vehicles will weigh heavily in the balance of forces in Europe:

- The Warsaw Pact will retain numerical superiority in armor and will increase their qualitative edge.
- The Pact is building ever more effective counters to NATO ATGM in the form of both direct fire weapons on armored vehicles and on helicopters, and a preponderance of indirect (artillery) fires.

II. THE OUTLOOK FOR ARMOR

Trends in Armor-Antiarmor Warfare

Tanks are designed to provide direct fire from cannon, machinegun, guided missile or flame weapons which are both armor-protected and mobile. Modern tanks are significantly more lethal than the armored vehicles which fought in World War II. Trying to hit another stationary tank at a range of 1,500 meters, the U.S. Army medium tank of World War II could fire 13 rounds, and would still have only a 50-50 chance of hitting. The standard U.S. medium tank of the mid-1970s commanded the same hit probability with a single shot.



The Sherman tanks of General Patton's Third Army had to close to within 500 meters of the German PzV Panther tank before the American 76mm gun could punch through the German's 4.8 inches of frontal armor. Current US medium tanks can penetrate nearly *twice* that much armor at *four times the range.*

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[redacted]

These charts plot characteristics of the main battle tanks of the two major tank-producing nations over three decades, up to the mid-1970s. Each point records the year in which a significant improvement was introduced. By 1975, the technical developments shown led many to conclude that the tank had been engineered to expectable economic limits.

TANK GUN SIZE

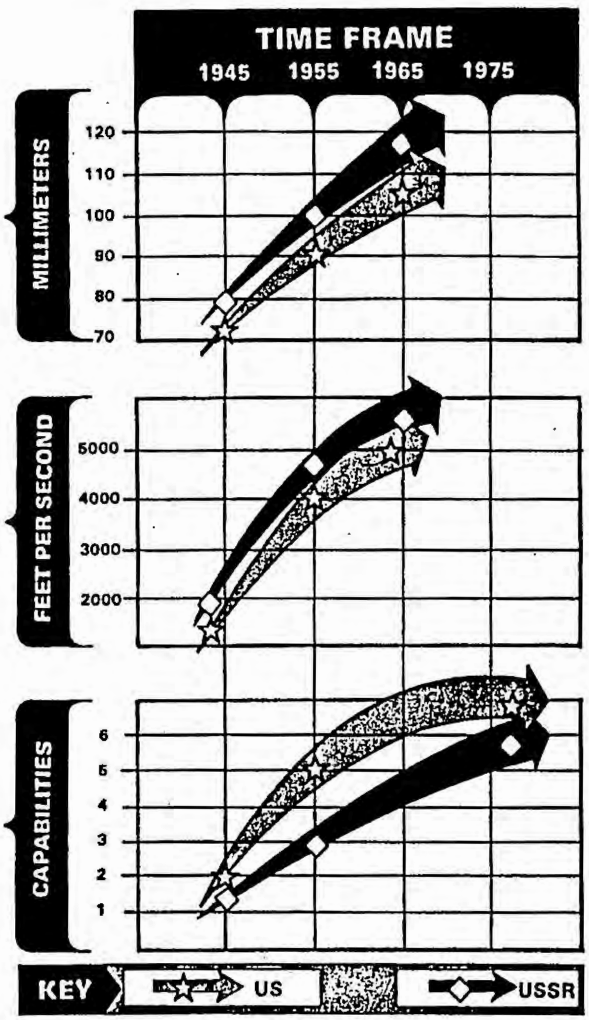
Modern tank guns are larger by one-third than the guns of 1945.

MUZZLE VELOCITY

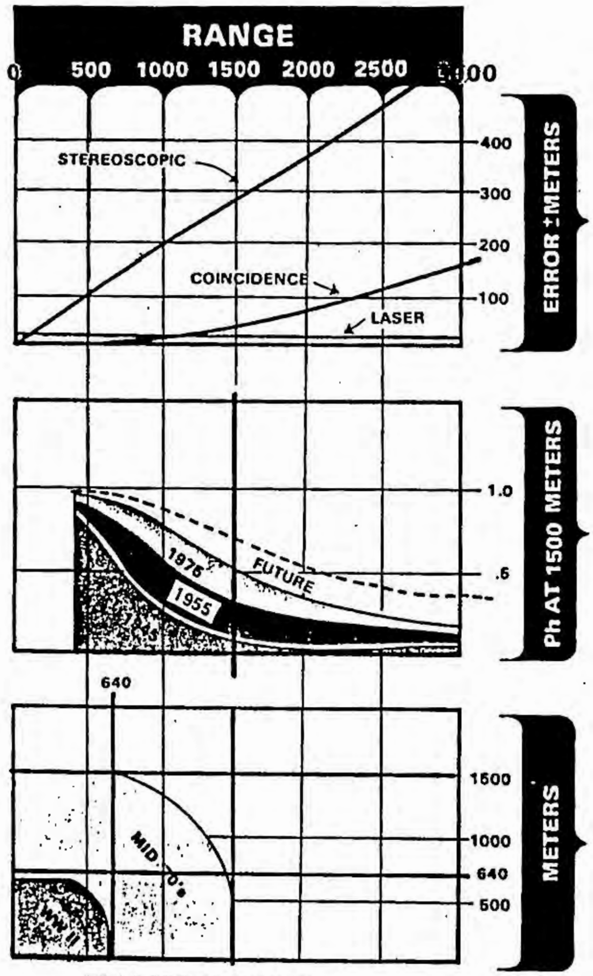
The muzzle velocity of tank projectiles has more than doubled. Rounds travel nearly one mile per second.

FIRE CONTROL INSTRUMENTS

Range finders, computers of superelevation and lead, sights and other aiming aids have improved by a factor of 4.



Improvements in gun accuracy and range have increased the area a single tank could command with its weapon.



50-50 PROBABILITY HIT

ACCURACY OF RANGE FINDERS

Since most tank misses are caused by inaccurate range estimation, the unaided optical sights of WW II were replaced first by stereoscopic range finders, then by coincidence range finders, and finally, in the mid-'70's, by laser range finders.

ADVANCE IN TANK CANNON TECHNOLOGY

Taken together, these advances have increased hit probabilities ten-fold--and future tanks will mount guns of even greater range and accuracy.

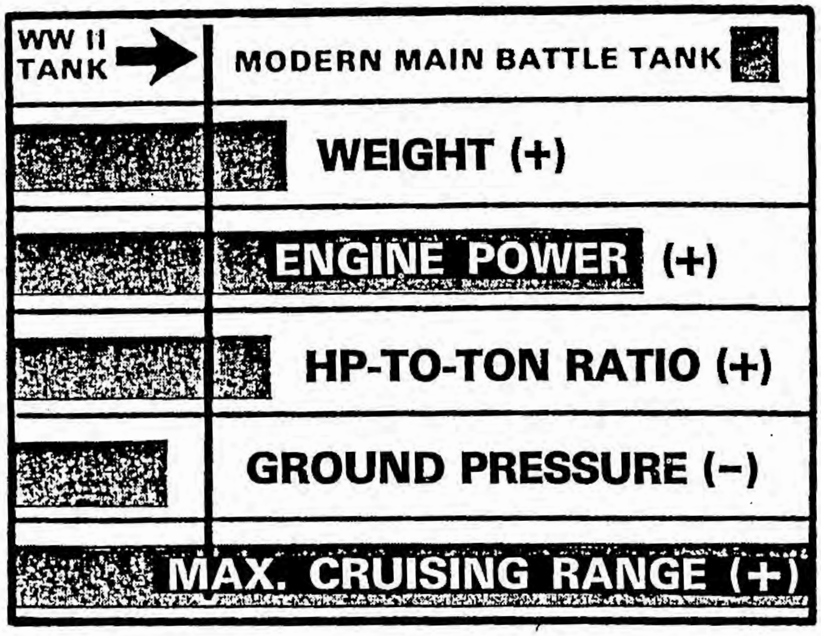
Ph: Probability of hit

COMMAND OF GROUND

One implication of this increase in range and hitting power is that the tank influences much more terrain than formerly. The tactical reach of the modern tanker extends over 7 times as much ground.

Modern tanks have not only bigger guns, improved ammunition, and more sophisticated fire control apparatus, but armor protection roughly double that of World War II tanks. Nonetheless, the chief tank-producing nations have designed their main battle tanks to constrain bulk, and to balance increases in engines, track and suspension systems.

For example, while the modern U.S. main battle tank is one-third heavier than its World War II predecessor, it's equipped with an engine more than two times as powerful. Its agility has actually increased: its horsepower-to-ton ratio has *increased* by one-fourth, its ground pressure has *decreased* by one-fourth, and its maximum cruising range has increased by three times. Both the United States and the USSR have fielded amphibious light tanks, and many nations have developed various snorkeling devices for underwater fording. Tanks of the United Kingdom have tended to be somewhat heavier than U.S. designs over the period; Soviet and German designs have tended to be lighter. But virtually all new designs have added armor protection and firepower.



At the same time, mechanical reliability has advanced. During the German thrust through the Ardennes into France in May-June 1940, more than half the tanks participating went out of action due to mechanical failures. Modern main battle tanks are expected to average 300-400 km between mechanical failures.

Tank development accelerated in the 1970s with emphasis on increasing firepower and improving armor protection. Tanks appeared which can fire antitank guided missiles as well as cannon rounds. The missiles have much higher accuracy and greater range than cannons—50-100 percent greater. Such missile-tanks can hit tank-size targets nine out of ten times at a range of 3,000 meters.

Also, most modern tanks have been equipped with night vision devices. Active sights let soldiers see targets illuminated with invisible infrared beams out to ranges of 1,500 meters. More significant, there are passive sights with comparable range capability, which let the operator see targets by natural light (for example, starlight), or by detecting the heat emitted by the target (thermal imagery sights). Thermal sights are effective out to 4,000 to 6,000 meters.

Not the least of modern developments are tanks with stabilized turrets which materially aid gunners acquiring a target, and facilitate firing on the move.

In sum, the capabilities of modern tanks have been extended to as far as the tanker can see. What he can see, he can hit.

THE TANK, WITH ITS CROSS-COUNTRY MOBILITY, ITS PROTECTIVE ARMOR, ITS FORMIDABLE FIREPOWER, HAS BEEN AND IS LIKELY TO REMAIN THE SINGLE MOST IMPORTANT WEAPON FOR FIGHTING THE LAND BATTLE

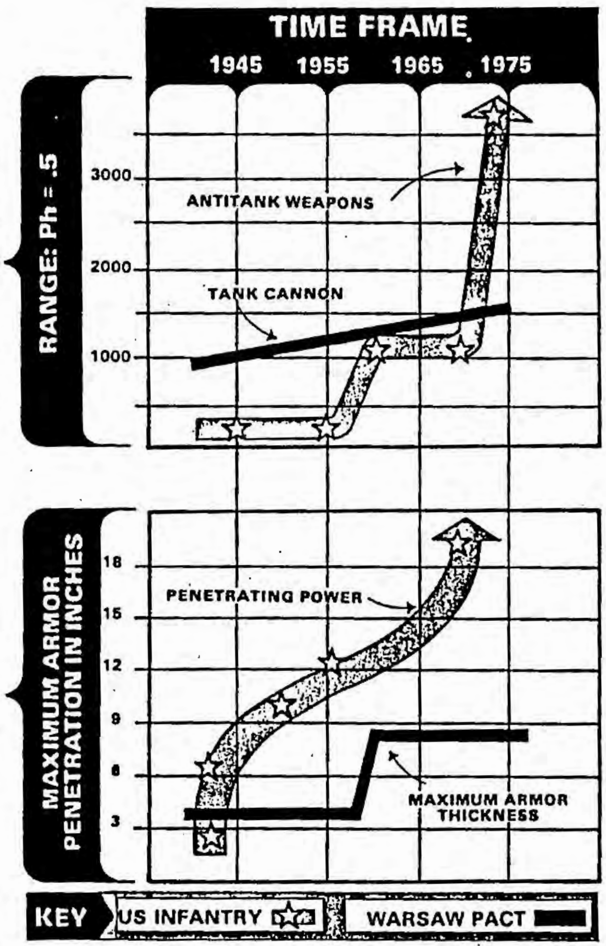
While tanks are usually rated vis-a-vis another tank, it is well to remember that infantry-manned weapons are both a main target for tanks and a main threat to them. Tanks were invented to defeat the infantry defenses of World War I, and remained for nearly 50 years the nemesis of foot-soldiers. During World War II, shoulder-launched rockets with shape-charge explosives (for example, bazooka, panzerfaust) began to erode the tank's invincibility. But rockets, and the related recoilless rifles which followed soon thereafter, called for infantrymen courageous enough to duel a tank well within the lethal range of the tank's cannons and machineguns. By the 1970s, infantry weapons could outreach those of the tank, and their penetrating power outstripped the protective capacity of armor, leading many to anticipate the elimination of the tank as an effective instrument of war.

ANTITANK VS. TANK RANGES

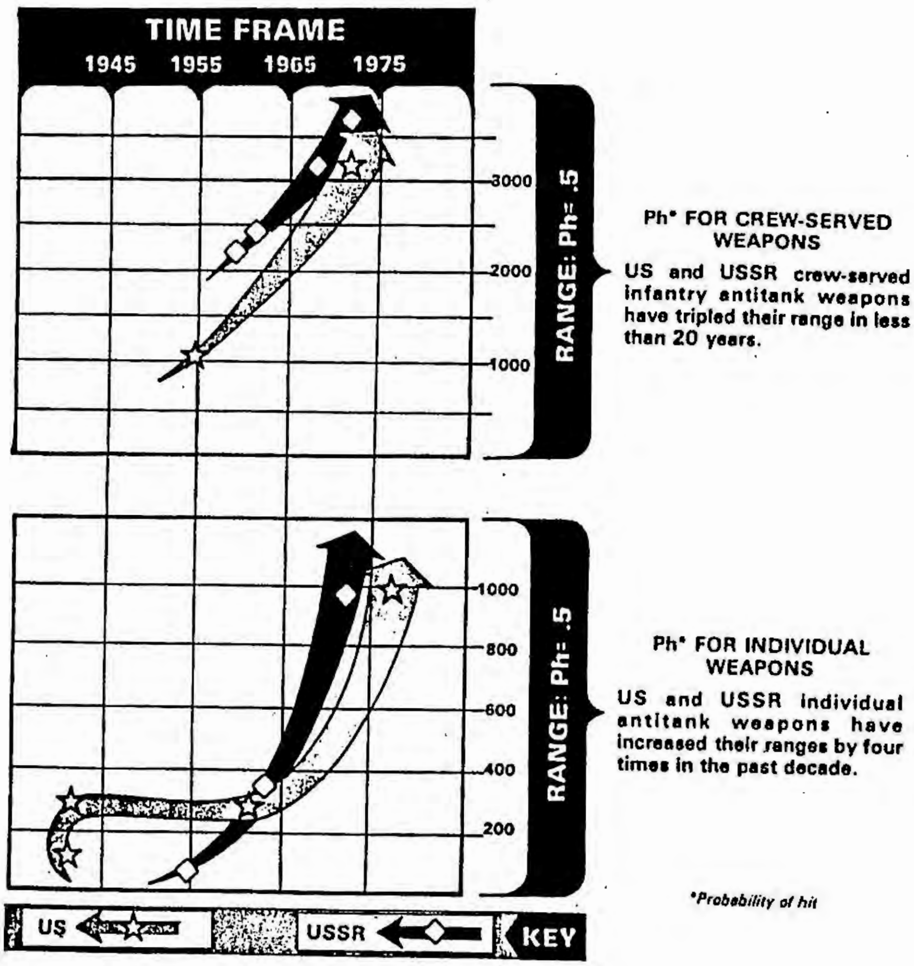
The line across the middle of the chart shows the trend for the principal Warsaw Pact medium tanks. The other line shows the trend in range capability for the antitank weapon of the US Army Infantry in the same time frame. The leaping crossover was the result of introducing the tube-launched, optically-tracked, wire-guided (TOW) missile in the early '70's.

PENETRATION VS. ARMOR THICKNESS

Increases in armor penetrating capability kept pace with the increases in range and accuracy. This chart shows the trend in penetrating power of US weapons compared with the growth in the maximum thickness of armor of the Warsaw Pact tanks.



Other nations, notably the USSR, progressively fielded anti-tank (AT) missiles and rockets of comparable range and accuracy and hitting power. Additionally, both the United States and the USSR improved shorter range weapons, so as to achieve high accuracy with light, man-packed, hand-held weapons within a range of 1,000 meters or so. The charts below reflect the ATGM status of the mid-1970s.



*Probability of hit

Future Designs

Trends cited for both tank and antitank weapons have posed complex technical problems for armor designers, who must devise counters to antiarmor penetrants and incapacitants. *Penetrants* defeat armor by punching through it to attack the men or the machinery inside. *Incapacitants* impair the vehicle's ability to move, to shoot, or to communicate. Penetrants rely on one of three forms of energy: kinetic, chemical, or nuclear. Incapacitants may be either active or passive; the former might use chemical explosives or toxic gas, the latter physical obstacles. In general, armor developers are concerned with the following types of threat, and attempt to cope with them as indicated:

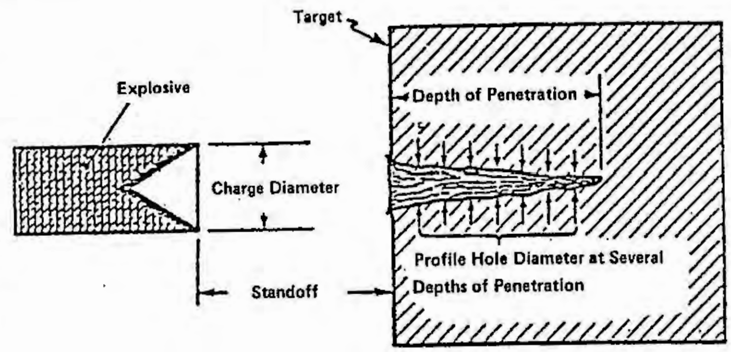
Threat Type		Example	Probable Design Counter
Penetrants	Kinetic energy	Armor-Piercing, fin-stabilized, discarding sabot projectile (APFSDS)	High obliquity armor, especially for frontal surfaces; low silhouette; stand-off plates and skirting
	Chemical energy	High-explosive antitank (HEAT) rocket	
	Nuclear energy	Enhanced-radiation warhead (ERW) for artillery projectile	Anti-radiation liner
Incapacitants	Active	Pressure-fuzed blast mine; chemical (gas) mine	Turbines for high horsepower/ton; agile vehicles with rugged tracks and protected suspension; closed, filtered crew air system
	Passive	Tank ditch	

Over the past several decades most NATO antitank weapons have sought to exploit chemical energy penetrants: metal jets formed by the Munroe Effect, typically a warhead consisting of a metal-lined, conical cavity imbedded in a cylinder of an explosive. Shaped charge warheads have figures in almost all U.S. ATGM or AT rocket designs, from the World War II "bazooka" through TOW. Today's shaped charge designs achieve extraordinary penetrating power, readily perforating steel of five (or more) warhead diameters in thickness.* Even relatively small warheads—60-mm or so in diameter—can perforate armor of the T-62 or M60A1 tanks. Short-range, unguided, shoulder-launched rockets thus armed, such as the U.S. M-72 LAW, or the Soviet RPG7, provide the individual foot soldier with an organic self-defense capability against such tanks. Longer range, guided missiles, such as TOW, achieve high hit and kill probabilities at ranges beyond the reach of their cannon, and hence can be employed in defensive or offensive overwatch roles from highly protected or even unarmored vehicles, such as APCs or helicopters. Modern armor, such as that of the T-80, could change some or all of these tactical relationships. But in the meantime chemical energy warhead evolution proceeds apace, and some believe it can equal or surpass armor evolution.

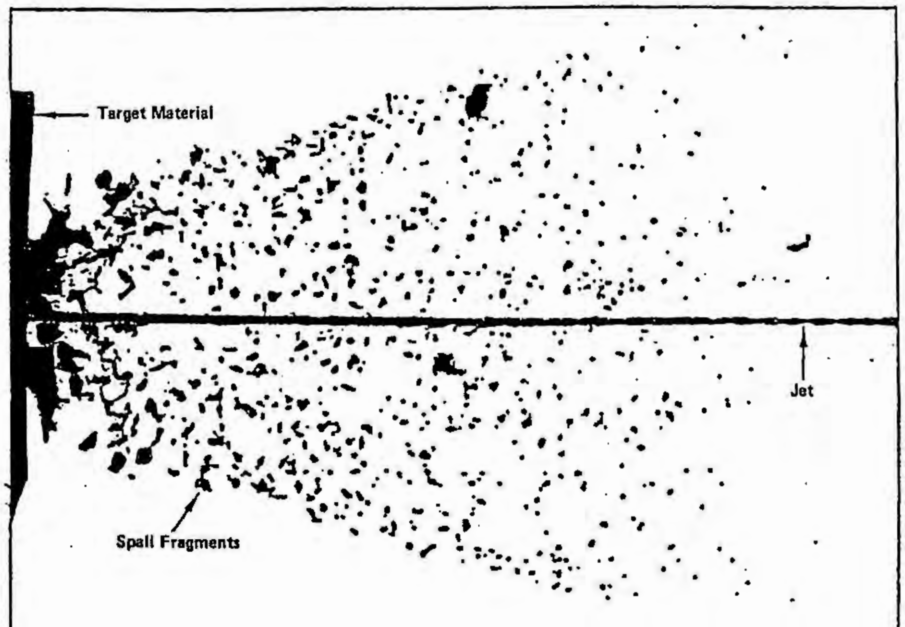
Within the past ten years, NATO antitank weapons designers have also exhibited marked interest in kinetic energy penetrants. Unlike missile-borne chemical energy penetrants, which form their penetrators explosively on impact, and hence do not rely on projectile velocity to kill the target, kinetic energy penetrators accumulate their lethal energy as they are accelerated down a gun tube by expanding propellant gases. The capacity of any to penetrate depends upon its velocity at the target, and its length, diameter and density. To achieve deeper penetration with a fixed-mass penetrator, longer, thinner, faster and denser bullets are better in principle, and evolving in practice: the objective is a very high ratio of Length to Diameter, high L to D.

Early tank guns borrowed from small arms technology, and had rifled barrels firing short, steel, full-bore-diameter bullets. In the 1940s the sabot concept was developed. The sabot is a cylindrical shoe which carries a "less-than-bore-diameter" bullet down the barrel, impounds the propellant gases, provides structural support to the penetrator, and is discarded on muzzle-exit. Since the sabot's energy is not delivered to the target, designers attempt to minimize sabot weight and maximize

* Penetration is also a function of "standoff," the distance from base of cone to surface, and damage is a function not only of the jet, but "spall," pieces of armor blown into the interior of the target.



Performance Characteristics for a Shaped Charge Warhead.



Typical Behind-Armor Spall Fragments Formed when a Shaped Charge Perforates Armor.

penetrator weight, under the constraint that both must survive the violence of launch. Even with such constraints, the result is not that of a zero-sum game. Sabots opened the way to higher muzzle velocity and penetrators of denser if somewhat weaker alloys than steel, since structural loads on the penetrator can be reduced by good design. Rifled bores could still be used to spin the saboted bullet for accuracy, but the length-to-diameter ratio of such "spin stabilized" penetrators is limited to about six. Thus, spin-stabilized armor-piercing discarding shot (APDS) rounds reached some natural limits.

To achieve stable, accurate flights without spin using higher L to D penetrators, gun ammunition designers added fins to the base of the rod. Armor-piercing, fin-stabilized, discarding sabot ammunition (APFSDS) is now a main threat to tanks. Rifling was no longer necessary, but could be used depending on what other ammunition might be fired from the gun. With the T-62, the Soviets switched to a smoothbore, 115-mm tank gun, firing an APFSDS steel penetrator. Current NATO APFSDS penetrator designs use very dense uranium (staballoy)—for example, the U.S. M-774 round for the 105-mm cannon about to be fielded, and the XM-833, the very high L to D staballoy round, being developed for the mid-1980s.

Guns, of course, have the advantage over missiles in rate of fire, ability to "fire-and-forget," and relative invulnerability to smoke, fog, dust or other obscuration; NATO's modern, high-velocity guns and APFSDS penetrators are formidable tank killers, notwithstanding their comparative shorter range and inaccuracy vis-a-vis some ATGM.

These facts, of course, well known to the Soviets, must be cause for concern in their design bureaus. And this, in turn, should be a focus for the attention of U.S. intelligence collectors and analysts.

Probably the Soviets are also worried by NATO's tendency to develop ever larger shaped-charge warheads for ever more precise antitank guided missiles. (The Soviets' own Munroe Effect designs do not seem to be similarly driven. Some late Soviet ATGM, such as the AT-6, have featured warheads of smaller diameter than predecessor designs, leading to speculation that they may incorporate dual cones of explosive, one behind the other. Such an arrangement is something U.S. designers regard as theoretically feasible but, up to now, impractical.)

Perhaps even more worrisome for the Soviets must be NATO's propensity to develop missiles which climb and dive to attack normal to sloped armor, or other weapons for attacking the top, bottom, and rear of tanks, where heretofore Soviet designs have kept armor thin. Such NATO weapons include the new HELLFIRE ATGM, the 30-mm depleted uranium projectiles fired by the USAF A-10's automatic cannon, the 40-mm shaped-charge grenades fired by U.S. Army helicoptors or ground troops, and broadcast shaped-charge artillery submunitions in the form of grenades or mines. Even more dangerous will be forthcoming precision-guided munitions (PGMs) which employ various kinds of sensors to acquire the target, to either point and fire the warhead toward it, or to guide the warhead to it. These sensors generally detect and measure one component of energy from the electromagnetic spectrum, or a combination of such components. The energy may be in the form of energy reflected by the target or from its background, energy reflected off the target by a target illuminator, or energy emitted from the target due to its inherent operational or material properties. Such PGMs pose a severe threat because of their high probability of hit, but they offer the Soviet designer an additional facet to exploit in countermeasure design, since it may prove easier to foil the sophisticated sensor than to build armor to foil the kill mechanism (warhead/projectile).

U.S. development effort and fielding of the family of scatterable AT and AP mines (FASCAM), and NATO interest in these systems, is undoubtedly of great interest and concern to the Soviets. These broadcast mines can be fired from 155-mm artillery, or strewn about by ground vehicle, fixed-wing aircraft, or helicopters. The individual AT FASCAM mine has a magnetic fuze and explosives formed in a type of shaped charge (Misznay-Schardin plate charge) about five inches in diameter. The mine is activated under the vehicles belly or tracks. The explosion penetrates up to 66mm of belly armor, yielding about a three-inch diameter hole. The mine requires about an 18-inch standoff for proper penetrant formation, and therefore its effect is readily attenuated by soil or other overburden. This suggests that enemy countermeasures to the FASCAM mine threat may include means to push dirt over the mine, for example, with a dragmat under the belly. Also, attempts to provide spall suppression liners in the belly region are considered likely. At present nothing is known of Soviet attempts to counter FASCAM mines through more rugged belly armor/track and road-wheel design, or the addition of equipment (for example, dragmat) to provide overburden, but intelligence should be looking for these.

Finally, Soviet designers appear to be quite conscious of nuclear penetrants, especially neutron radiation. They seem to have installed antiradiation liners on the interior of the T-64 and T-72 expressly to counter this threat, and future designs will probably include similar precautions.

Soviet Armor: A Forecast

Some commentators have held that tank design has been pushed to the outer limits of technology, and that the 1980s will see missiles dominate the battlefield. But he who sounds the death knell for the tank had best ask for whom the bell tolls. The press of technology seems to be disclosing more highly protective, weight-efficient armors as rapidly as missiles appear with unprecedented range and lethality. Soviet armor designers seem to be alert to their technical possibilities for defeating the threats described above. Presently, there are five basic approaches open to them:

- Homogeneous armor (e.g., U.S. M-60 series)
- Spaced armor (FRG Leopard 1A1 mZ.)
- Laminate armor (USSR T-64 and T-72)
- "Special" armor (U.S. XM-1)
- Reactive armor (FRG Leopard 3)

Homogeneous armor is by far the most common type. But even when constructed of high-grade steels, such as electro-slag purified steel or alloys, it is bulky, heavy, and inefficient against high L to D penetrators. U.S. tank designers aver that metallurgy—quality or metal—can contribute only 10-15 percent to modern armor protection. While they state they would reach for such a margin when weight and cost penalties permit, they prefer the much more cost-effective solutions available via use of certain laminar materials, or the geometry of spaced plate array, or the type and configuration of reactive armor. Soviet designers evidently agree, since the Soviets abandoned homogeneous armor for their main battle tank a full decade ahead of the United States.

Spaced armor uses an outer-armor plate to cause premature triggering of attacking Munroe Effect warheads, an inner airspace, and a second armor surface finally to defeat the jet penetrant. In general, these designs have not proved to be as effective against modern penetrants as other approaches, but are being used to up-armor fielded tanks. For instance, the West Germans have sought to protect their Leopard 1 tank against Soviet missiles by such added-armor (Zuzatzpanzerung).

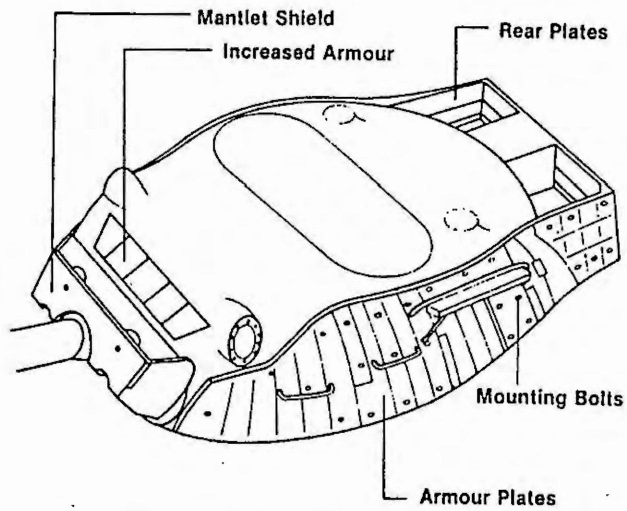


Figure 26. FRG Leopard Tank with *Zuzatzpanzerung*

The Soviets' last two production tanks—the T-64 and T-72—are believed to have **laminate armor**, steel layers sandwiching unknown material(s)—possibly silicates, ceramics, Fiberglas, or steel balls in a matrix—which affords tough, relatively light protection. Our present information leads us to believe that the armor designed for their next production tank (the T-80) will follow a similar approach. As discussed above, we have reason to believe that the Soviets already have under development a more advanced follow-on to the T-80, the T-80I, which they consider has even higher levels of protection. Such a tank could exploit **"special" armor**—like that which the United States has devised for the XM-1-[redacted]

Analyses conducted by the U.S. Army show that an effective medium tank satisfying perceived Soviet design constraints (interior volume, exterior dimensions, track pressure, turret balance, etc.), could be built using U.S.-style "special" armor, per the XM-1. But the Soviet "T-80I" may be built with **reactive armor**—steel plates sandwiching explosive cells which literally blow penetrants to pieces. The West Germans have been experimenting with such armor, and have found it promising enough to design a follow-on to the Leopard 2 around it. While U.S. experiments with reactive armor are as yet inconclusive, prospective tanks thus armored could be small, light, and agile.

One feature of laminate, "special" and reactive armor is high potential for upgrading armor protection on fielded tanks. By bolting on new laminate or "special" armor arrays designed to defeat specific threat penetrants, or by hanging reactive armor plates over vulnerable areas as a "battle dress" for tanks, a tank fleet can be substantially "uparmored." It is possible that the Soviets have already designed such

[redacted]

ways to make their tanks proof against current NATO anti-tank guided missiles--TOW, HOT, MILAN, SWINGFIRE, etc., and that these methods may be applicable to the already fielded T-64 and T-72 (via add-on plates) as well as to the forthcoming T-80 and T-80I.

Both the T-64 and T-72 are relatively small, low tanks: they weigh 20 percent less, and their presented area is 30 percent less than that of the contemporary U.S. M-60 series tanks. From what we know of the T-80, it is also small and low slung. The Soviet predilection for small, low-profile tanks probably conflicts somewhat with the use of "special" armor, since it costs heavily in weight and volume, as the newest U.S., UK, and FRG designs attest. Use of reactive armor would facilitate the relatively light and agile tanks the Soviets favor. Given the breadth and depth of Soviet armor programs, as well as the extent of Soviet espionage within NATO, it seems prudent to credit the Soviets with involvement in both "special" and reactive armor technology. From past Soviet design choices, we would expect them to opt in the future for smaller, lighter, faster tanks, with a very large main gun and formidable armor, especially across the vehicle's frontal arc.

The Soviet designer is faced with a vexing problem when it comes to designing countermeasures against precision guided munitions which attack armored vehicles from the top. On the one hand, protecting against the kill mechanism (warhead) requires the same type of armor technology considerations discussed above, and may result in unacceptable weight and space penalties. On the other hand, protecting against the PGM's sensor may require detailed intelligence information on the operating frequencies and sensor logic used to process the measured target signal. To counter the sensor, the designer must develop some method of modifying the energy spectrum of the reflected and/or emitted target signature. The modification may consist of eliminating certain components in the energy spectrum of the target, or of changing the ratio between components of the energy spectrum in the signature. The intent of the signature modification is to make the target blend in with the background, or to make the target appear to the sensor as something which it is programmed to ignore (that is, a false target). Signature modification can be accomplished by simple means such as blankets, plywood shielding, or chaff, or by more complicated means such as jammers. We can expect strong Soviet intelligence efforts to inform their sensor designers of U.S. efforts in tank signature modification to preclude fielding expensive precision-guided munitions which could be *completely* negated by U.S. countermeasures.

Soviet tank designers, like our own, probably now believe that they can design armored vehicles proof against virtually any penetrant, *provided they are informed of its composition and size*. Probably too, they hold that they can design a penetrant or incapacitant for any tank *provided they know how it is protected*. Their intelligence service will no doubt strive to provide the key information in both respects.

Over the whole range of armament technology, that of armor/anti-armor weapons seems in unusual flux. It is far from being the case, as is often supposed, that missiles have won assured ascendancy over the tank, or that the lumbering mechanical monsters have been engineered to the limits of their potential. New armors, engines, fire control devices, guns and munitions have made possible tanks of new capabilities, including levels of protection beyond the penetrants of most current ATGM. The penetrant-protection race is likely to be intense throughout the 1980s. As of this writing, the Soviets can be expected to develop some or all of the following:

- Tanks with variable armor, and capabilities to "uparmor" existing fleets to meet perceived new threats.

- Tank guns increased in range and accuracy, to redress much of the gun's disadvantage vis-a-vis the ATGM evident in the 1970s.
- ATGM with larger-diameter, heavier warheads, and nose probes for optimizing stand-off and attack angle, and/or multiple cones per warhead, as well as precision guidance mechanisms.
- Individual infantry weapons for top, bottom or rear attack of tanks, and deemphasis on direct-fire, shoulder-fired rockets or missiles for frontal attack.
- Infantry combat vehicles built with armor offering levels of protection comparable to that of tanks.
- Dragmats and bottom shields to counter broadcast mines.
- Trellis-like spaced armor to protect from top attack.
- Automatic range finders coupled with thermal imagery sights.
- Electronic detectors and emitters for countering threat lasers and PGM.
- Drapes for camouflage and thermal suppression.

III. WHAT IS TO BE DONE

The Stakes

Like all nations, the United States nurtures myths about its strengths. We are confident, for example, that our national genius for war lies in applying advanced technology to solve military problems: early in the 19th Century, Eli Whitney's power-milled, interchangeable parts for muskets armed us against France and England; in the mid-19th Century, American inventors and industrialists made possible the first of the modern wars; in the late 19th to early 20th Century, machine guns invented by the Americans Gatling, Maxim, Browning, Lewis, and Thompson armed us for both internal and external wars. But it is a sober fact that in the world wars of the 20th Century what has counted militarily for the United States is less advanced technology than superior manpower resources and sheer preponderance of materiel. In 1918, Pershing overwhelmed German defenders in the Meuse-Argonne with fresh reserves. In 1944, Patton's slash across France was underwritten with dominance in numbers of tanks (overall 3:1), guns and planes—often not *better* weapons (for many compared poorly with German counterparts), but assuredly *more* weapons. And, it is also sober fact that World War III, were such a calamity ever to come in Central Europe, would pit U.S. soldiers against adversaries armed as our national myths would have Americans armed. We would have to fight that war in Europe outnumbered, against Soviet-equipped forces trained to thrust through our defenses in just days or weeks, before we could mobilize our reserves, long before our industry could be brought to bear. It is well to remember that Patton's numerical edge in armor in 1944 was achieved by five years of industrial mobilization in the United States, Detroit having begun war-volume tank production with the inception of Lend-Lease in 1939. We shall not have five years, or even five months, to turn our trickle of armor to full flow.

It is also well to remember that Soviet armor has, in at least one war, torn deep into American defenses: in Korea, 1950, when the vaunted U.S. 2.36-inch antitank rockets, the World War II "bazooka," exploded without effect on the frontal armor of North Korean manned T-34 tanks, more than one U.S. unit broke in panic, word spreading that U.S. weapons had failed. Victory of Soviet-built armor was one probable cause of the "bug-out fever" that ultimately infected our whole force afield, and presented General Ridgway with his greatest leadership challenge. But tactical panic in the Eighth Army in Korea, disastrous as it was, proved remediable. Panic in the Seventh Army in Europe could have catastrophic consequences. Potentially even more catastrophic would be the peacetime equivalent of battle panic among the peoples and parliaments of NATO: defeatist presumptions that the alliance's arms were futile against Russian armor. In brief, World War III would draw closer:

if the Soviets field invulnerable armored vehicles, or *think* they have done so;

if our NATO allies come to believe that Soviet armor is invulnerable; and

if U.S. soldiers lose confidence in their antiarmor weapons.

Short of these larger implications of the current penetrant-protection race, there are large sums in U.S. defense funds involved in decisions which turn on our intelligence estimates of Soviet development. The chart on page 14 identified the

[redacted]

"intelligence shortfall" vis-a-vis the T-72 tank, depicting the billion dollar-plus XM-1 tank program directed toward a projected superiority which has diminished significantly over time as our estimate of the Soviet armor sharpened.

But, other development/procurement decisions were affected as well. For example, the U.S. Army has moved to protect its ATGM inventory by upgrading TOW's warhead to hole the T-72 UB (upper bound, worst case), a $100 million-plus decision. At the same time, it rejected reengineering of the DRAGON because weight, time of flight, and range could not be kept within tolerable limits for attacking the same threat armor. Had intelligence led the Army to put its credence in the T-72 LB (lower bound, best case estimate), the decision might have gone the other way: accept TOW as is, and up-engineer DRAGON. Similarly, confronted with evidence of the M-735 105-mm APFSDS tank round's dismal performance against T-72 UB armor, the Army reduced its purchase of that munition and transferred funds to the more capable XM-774 APFSDS. Yet, in 1980, these and comparable decisions pertaining to Soviet tanks fielded eight years ago still rest on uncertainty.

The Intelligence Cards

For Soviet armor developers, the penetrant-protection race is an open game: every move the United States makes is potentially known to our adversaries. In years past, in weapon system after system, we have seen the Soviets move to field counters before we could bring a lengthy development cycle to fruition. Conversely, for U.S. developers it is a closed game, our developers perforce proceeding largely uninformed of what their Soviet counterparts have under way. Often U.S. intelligence will collect early, sketchy information foreshadowing a new Soviet armor weapon system, but years pass before we are able to estimate its effectiveness. Thus, **a sure assessment of armor on the T-64 and T-72 tanks, which seem to have been issued to Soviet troop units as early as 1972, remains a significant intelligence shortfall.** The T-80, which underwent field trials with troops in 1976, is even more problematic, and the T-80I remains an enigma. Our information on current and coming generation Soviet antiarmor weapons—ATGM or PGM—is likewise sparse. However acceptable it may have been in years past to trust American technology and industry to equip U.S. troops well enough to cope with such Soviet unknowns, that trust scarcely seems prudent for the 1980s.

The U. S. Army properly takes the lead in tracking Soviet armor developments. Throughout the Army apparatus, there seems to be an understanding of the issues, and high priority accorded to resolving them. For example, the Assistant Chief of Staff for Intelligence, Department of the Army, has a special task force focused full time on collection and analysis *re* Soviet armor, and has used Army resources imaginatively in both respects. But this is an intelligence problem of much larger dimensions than the Army itself can tackle. Here are examples:

What Sort of Intelligence Might Have Made a Difference?

- Exact warhead diameters and details of internal cone construction for late model Soviet ATGM (AT-4, 5, 6, 7, 8, and 9) from which the effectiveness of chemical energy penetrants could be calculated.
- Dimensions of Soviet APFSDS rounds, particularly the length of the ogive (nose), the diameters of the projectile, from which L to D might be inferred.
- Evidence of use of staballoy (depleted uranium) penetrators; extent thereof.
- Data on the materials used in manufacturing Soviet unconventional armor, and the thickness thereof.
- Soviet capabilities with "special" armor.
- Evidence of Soviet interest in, or capabilities, for reactive armor.
- Date of issue of new model tanks or ATGM to troops.
- Data on new or advanced training techniques—for example, night firing, use of lasers for gunnery simulation, or very long-range target engagement—which portends new materiel capabilities.
- Other indications that Soviets are working with the developments previously listed.

Recommendations

While it may have been reasonable in past years to assign to collection on the armor penetrant-protection race a priority lower than that for strategic armaments or tactical nuclear systems, two considerations urge reconsideration:

- Strategic nuclear parity raises the premium on non-nuclear weapons.
- Given the centrality of armor in Soviet strategy, increments of effort expended on better intelligence could exert strong leverage on the "conventional balance."

Some U.S. armor designers hold that there is no undertaking across the whole field of armaments which is in greater technological flux, none more sensitive to intelligence inputs, and few with higher stakes. This view seems well founded: while we have many intelligence shortfalls pertaining to nuclear weaponry—for example, the range of the BACKFIRE or the SS-20, refires for the SS-4/5, nuclear artillery in East Germany—few of these would, if overcome, cause any change whatsoever in U.S. defense programs. In contrast, intelligence on the armor of the T-80 or T-80I, or on Soviet 125-mm tank gun ammunition penetration potential, or on Soviet antiarmor PGM sensors, could alter the XM-1 tank and PGM programs directly and quickly.

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