

TRAINING TECHNOLOGY FOR MODERNIZATION

SUMMARY

One imperative of Army modernization is that training technology--systematic treatment of training--keep pace with the infusion of new doctrine, weapons and organizations. This paper sets forth five proposals for upgrading Army training in units, each supported from the experience of one USAREUR division undergoing the influx of new weapons systems.

PROPOSAL 1.....PAGE 2

The Army has published sound concepts for training, but not all the chain of command has accepted them. We need to transform these concepts into doctrine, solid consensus, and act accordingly.

PROPOSAL 2.....PAGE 9

Modern training technology can provide greater efficiency in unit training--more readiness per training dollar, or the same readiness with fewer resources. But the Army's best prospect for using that technology is to provide requisite capital to key training managers--division and brigade commanders--aggressively pursuing the Army's training doctrine.

PROPOSAL 3.....PAGE 18A

Battle simulation--wargaming--offers low cost and high effectiveness in training and evaluating commanders and staffs in the use of new weapon systems. Results of an FY79 exercise combining a manual board game with a terrain-based tactical exercise without troops show that it both discriminated well among participants and taught systematically.

PROPOSAL 4.....PAGE 31

Engagement simulation--two-sided free-play maneuvers with real-time hit assessment--is another superior method for teaching modern weapon use. Two techniques are described: REALTRAIN, a low-cost telescope and numbers approach, and MILES, the on-coming laser-based approach.

PROPOSAL 5.....PAGE 52

As battle simulation and engagement simulation were products of early 1970's R&D, the modernizing Army of the mid and late 80's will be heavily dependent upon the investments we make today in research and development of training technology. That Army will need better communication from Service schools to units for support of individual training, and from units undergoing modernization to the schools. The Paper-based communications of today are patently inadequate for the future; the Army must develop more compact means, e.g., videodisc. We must also develop graphic-transmitting, interactive teleconferencing feedback loops to supplement school trips to units. Above all, we must insure that our understanding of how to train and evaluate soldiers and leaders advances commensurate with our improvements in materiel for moving, shooting, and controlling in battle.

Training Technology for Modernization

At root, technology means "systematic treatment." Today's training technology has been proven, in some units, to be quite capable of systematizing the skills and knowledge relevant to modern battle, and of communicating them powerfully to leaders and soldiers who need them for combat readiness. But it must be universally applied, for only if training technology is developed apace weapons systems will the Army truly modernize. Most senior officers--lieutenant colonel and up--remain poorly informed about such technology; few, indeed, know much about the learning process, and fewer still bring either interest or competence to the macro-management of training. As a consequence, the Army has not moved adroitly to apply training technology as it has introduced new tactical doctrine, weapons, and organizations. And, most Army training managers are closet brown-shoes, prisoners of their experience, frustrated to teeth-gnashing by today's "hostile training environment" of evermore crowded schedules, constrained budgets, constricted ranges, stingy ammunition allowances, and sparse manning. Modern training technology cannot change that "environment," but it can do much to help unit commanders avoid wearing down their incisors. What follows are five proposals for "systematic treatment" of unit training, based upon concepts which proved useful in one division:

ACTION	WHEN
<ul style="list-style-type: none">• Implement Army-wide doctrine for training• Capitalize unit training	Now
<ul style="list-style-type: none">• Expand use of battle simulation• Exploit engagement simulation	Near Future
<ul style="list-style-type: none">• Develop school-unit communications for support of training, evaluation and maintenance	Mid- future

Proposal 1: Implement Armywide doctrine for training. "Doctrine" is a body of concepts understood, believed in, and acted upon throughout the force. Field Manual 100-5 sets forth some reasonably sound concepts for training:

"The US Army must prepare its units to fight outnumbered and to win... Must obtain powerful weapons, develop fully the proficiency of the men to man them, and train leaders capable of employing weapons and crews to best affect... The soldier receives most of his individual training in a unit. It is in his unit where he will have his greatest opportunities to gain confidence--with his weapons, as a member of a team, and by training under conditions approximating battle... Collective training in units should aim at maximum effectiveness with combined arms... Training for battle demands forging effective combined arms team work... The commander must manage his training with a sure knowledge of the present state of individual and collective proficiency within his units, and with programs especially designed to bring them up to prescribed individual and unit performance standards. To paraphrase Josephus on Roman training methods, our drills must be 'bloodless battles' and our battles 'bloody drills.' Even in wartime, in the midst of combat, training must continue. Training must be a full time job for all commanders, regardless of other operations or missions."

Unhappily, FM 100-5, with respect at least to training, is not yet doctrine: most Army leaders still expect the training base to carry most of the burden of individual training, most try to train units sequentially by echelon, most have only vague ideas of how to train or evaluate units in combined arms exercises approximating modern battle, and most expect the "system" to provide all the solutions to their training problems. In this respect, we are disadvantaged by Army history. In the wars of the 20th Century, the principal training functions of the US Army have been exercised by its training centers and schools: Detroit-like machining of conscripts into usable military manpower. The mobilizations of the two World Wars taught us to perceive unit training proceeding through a hierarchy of echelons, from small units to large, culminating in pre-deployment tests to certify that training was complete, and the unit ready for battle.

The Training Record

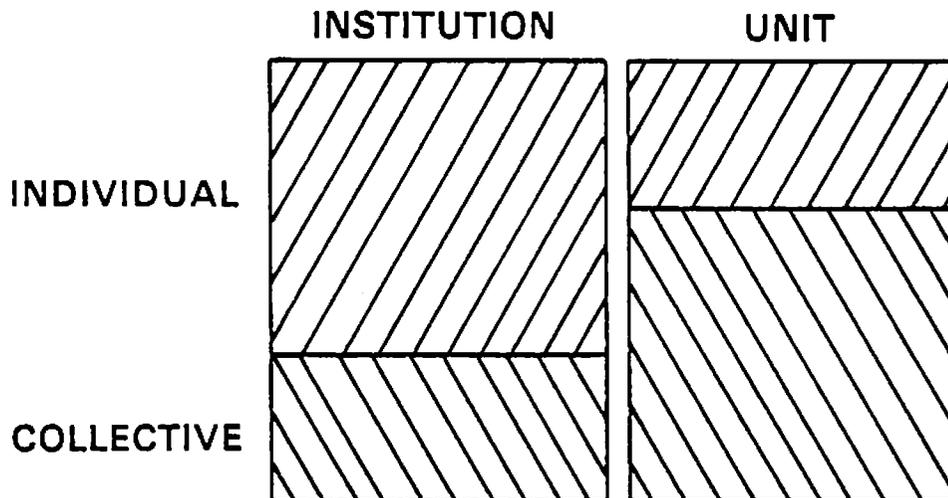
	<u>Total Trained</u>	<u>Divisions Deployed</u>	<u>% Draftees</u>
World War I 1917-1918	4,057,101	43	67
World War II 1941-1945	11,260,000	88	58
Korea 1950-1953	2,834,000	8	41
Vietnam 1965-1972	4,386,000	8	40

All four of these wars were infantry affairs, with fighting-on-foot driving overall training requirements. During the last two, the main task narrowed

to preparing individual replacements for short tours in a handful of war-zone divisions. Army trainers of yesteryear were remarkably successful, but their experience is largely irrelevant to the challenge facing unit commanders in an increasingly equipment-intensive force preparing for early, intense, possibly decisive battle.

To compensate, our doctrine should differentiate between individual and collective training (terms which describe who is being trained), and between institutional and unit training (terms which stipulate where the training is conducted).

ARMY TRAINING



Thus to describe the universe of Army training facilitates understanding how and why resources are allocated for training. For example, this paper charges that the U.S. Army, preoccupied with institutional training, has dedicated comparatively little of its conceptual or monetary resources to unit training, to the disadvantage of preparedness for war.

2

Army Regulation 350-1, "Army Training," has drawn such distinctions since 1975, because individual training is intrinsically different from teaching a collective, and is in many respects much simpler and more efficient. Because interaction among members of a group or unit affects resources required, rate of learning, and proficiency attained, collective training is both more complicated and less well understood than individual training: not only has the Army researched it less, but also academic literature focuses almost exclusively on individual learning in institutions.

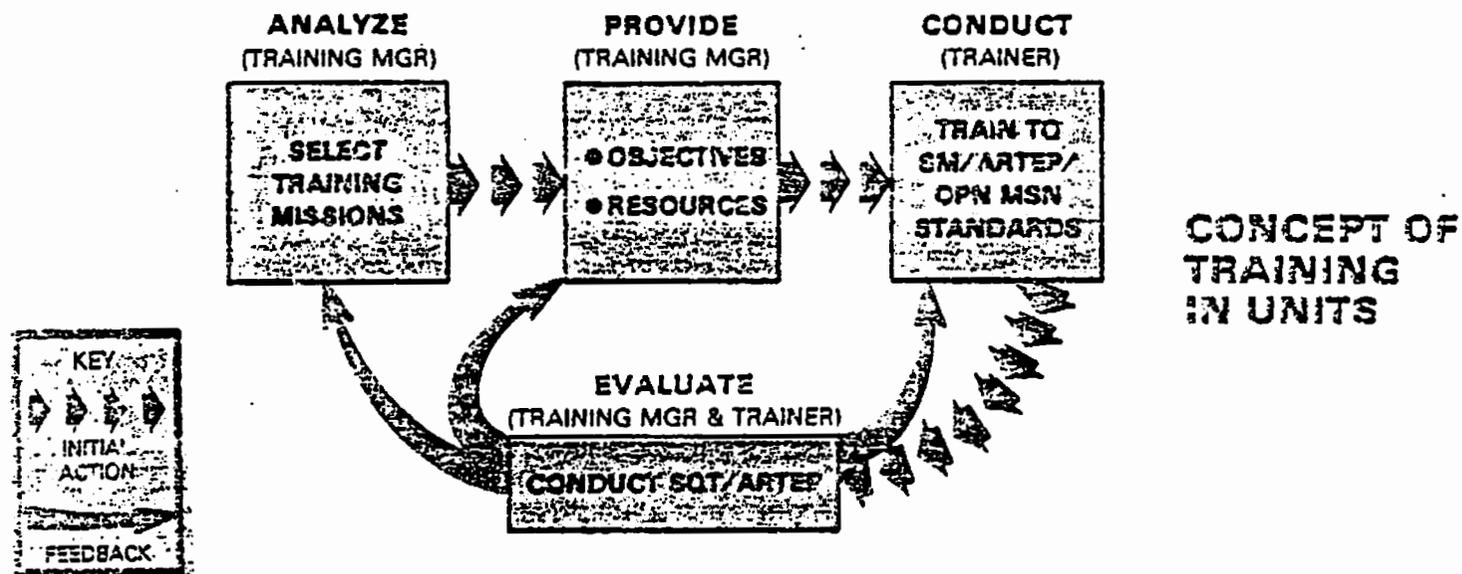
Institutional training - training in schools or training centers - is quite unlike unit training. An institute has the advantage of a fixed curriculum taught by a faculty of specialized subject-matter experts to a stream of students. In contrast, unit commanders have a relatively fixed "student body," but few genuine subject-matter experts, and a bewildering range of subjects to teach to individuals and collectives alike. Most institutional training is individual, although efficient collective training can also be conducted in institutions--for example, C&GSC's Combined Arms Tactical Training Simulator trains battalion command groups, and the National Training Center at Fort Irwin trains battalion task forces. While TRADOC is properly concerned over recent economy-driven inroads into institutional training, especially over foreshortened training for recruits, institutional training is the US Army's forte. Ninety percent of what the Army has spent on modern training technology has been lavished on institutional training, where cost-effectiveness is easier to demonstrate. We can view the future of such training with equanimity--at least its future is brighter than that of unit training. In fact, the major drawback of institutional training is likely to be that it will remain so well-resourced and so efficient that it will provide no useful models for unit training.

As FM 100-5 asserts, unit training should be the Army's strength. It is not. On the one hand, the Army provides precious little assistance for the commanders who plan and conduct unit training, leaving them literally to their own devices: they are expected to train their soldiers, individually and collectively, using the equipment issued the unit, problematic amounts of training ammunition, and questionably available ranges and maneuver areas. On the other hand, there are commanders who regard the provision of properly equipped ranges and ample ammunition a contractual obligation of "higher," the absence of which obviates their responsibility for training outcomes. The results are quite uneven, ranging from excellent to dismally bad from place to place, commander to commander, unit to unit.

Resources are less the fundamental issue in unit training than the doctrinal shortfall. Despite AR 350-1 and FM 100-5, resource managers and commanders throughout the Army still envisage unit training as proceeding in cycles. They expect units to proceed single step by step, through "echelons" or "levels" of training from individual through section/crew, to battalion, and brigade or higher. Resources are metered in time-units (e.g., Battalion Field Training Days), and proficiency is measured in "training readiness levels," which might recognize up to fourteen ladder-like steps. Senior commanders still express overall training objectives in terms like "achieve brigade-level proficiency," and some tout Aztec calendars for cyclic scheduling of training, ported to facilitate sequencing. Some apparently feel an irresistible urge to oppose new training technology, to suppress further change in Army training methods, and to centralize resource management.

At least a few behave as though they want to return to the Army Field Forces womb.

Yet over the past decade the Army has accumulated not only a sound training technology, but also knowledge and experience with applying it in unit training unknown to our professional predecessors. If our doctrine is deficient, if our unit training practice is uneven, our leadership should appreciate that we have in hand a demonstrably effective concept, based upon mastering well-defined tasks, under specified conditions, to exact standards:



The foregoing figure, from TRADOC's TC 21-5-7, Training Management (December 1977) encompasses standards for both individual training in units (Soldier's Manual, Skill Qualification Tests) and collective training in units (Army Training Evaluation Program and Operational Missions). Training Circular 21-5-7 also makes the point that "given (problems of) turnover, diversion, facilities, time management, and forgetting, training strategies which rely on linear progression from small to large units over a period of twelve months are doomed to failure. Soldiers in a unit will not be ready for combat at any point in the 'cycle.' Even in the very best of circumstances--a 36-month rotation--one-third of the personnel will be brand

new at the end of the year. The solution to this problem is training management which sets readiness as the primary goal. The training manager must provide for multi-echelon training which hones the proficiency of commanders, staffs, small units, and individuals simultaneously and recurrently. To ascertain progress or to detect training needed, he must sample or evaluate repetitively and often. The training manager must ascertain the rate at which individuals or groups learn specific skills, and, just as important, how rapidly that skill deteriorates over time. He must be alert to counteract the effects of personnel turnover within his unit. Readiness requires that the standards of training be clearly stated, that frequent evaluations be made against those standards, and that steps are taken to sustain proficiency year-round. Training managers must be concerned with the quality of training as much as quantity."

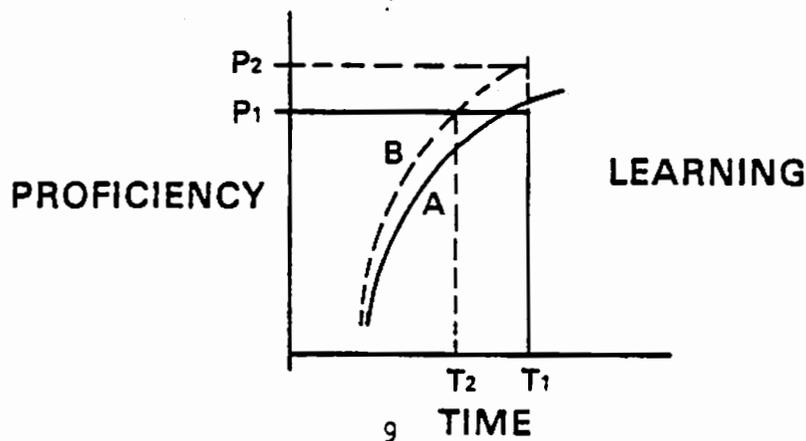
FM 100-5 puts it this way: "Readiness for modern battle means training aimed at payoff now. Constant readiness for the early battles changes presumptions previously governing the US Army's training: post-mobilization training, annual cycles, cadre development, and the like... The Army's need to prepare for battle overrides every other aspect of unit missions. This urgency derives from the danger present in the world scene, the lethality and complexity of modern war, and the ever present possibility that a unit in training today may be in action tomorrow."

While these concepts for training deserve elaboration, they have been shown to serve as the architecture for a systematic approach to continual

Moreover, they are relevant to unit training. In readiness, a genuine advance from notions of eventual readiness. They deserve a broad, well-resourced intervention by the top leadership of the Army to build a consensus to act on them, and to provide unit commanders the techniques, the tools, and above all the resources to transform these training concepts from mere admonitions in the Army's literature into a doctrine for waging those "bloodless battles" which should be the Army's main business in peace.

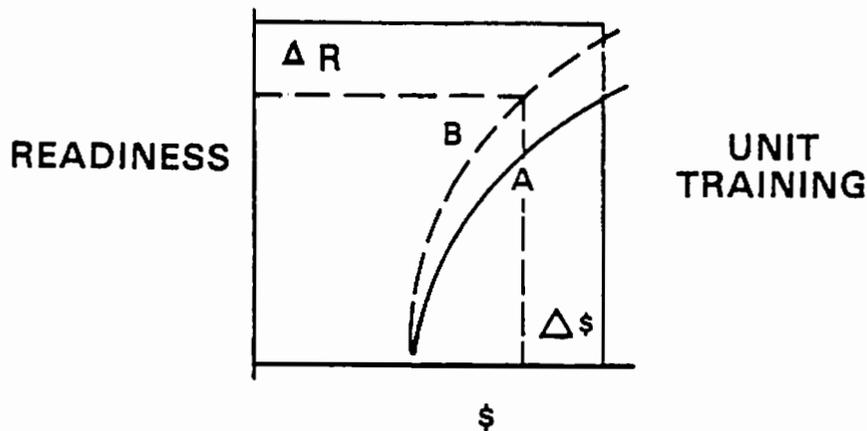
Proposal 2: Capitalize unit training. Training resources--money, materiel, ammunition, space, time, manpower--tend to be extruded from the Army's budgets under stress as procurement of modern weapon systems conflicts with inflation and legislative or executive parsimony. Resources for training technology are usually perceived in Washington to be in competition with force modernization, rather than a necessary adjunct thereof. For example, recently a senior DoD official proposed that the Army finance certain simulators for unit training by cutting one battery from its PATRIOT buy. Enthusiasts for the simulators might leap to adopt such a course of action, but that kind of management buys one indispensable form of modernization at the expense of another, and ignores the deeper issue of how readiness can and should relate to resources for training.

Generically, in any training undertaking, proficiency rises as a function of resources invested, but eventually encounters diminishing return. In institutional training, resources are typically measured in time expended, and training is continued until (on the average) further time spent produces disproportionately little gain in proficiency.



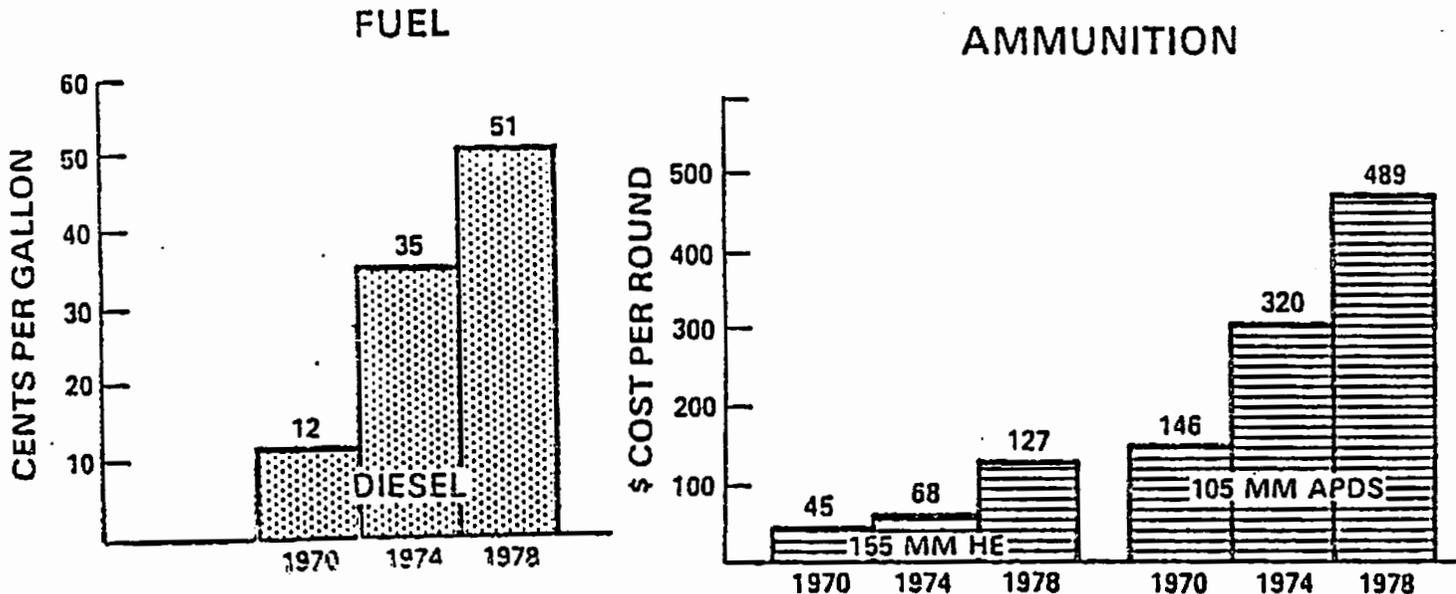
The diagram shows two training methods, A and B. If pursued for time T_1 , Method B produces higher proficiency P_2 , but also offers the trainer the option of equal proficiency P_1 for less time, T_2 .

In unit training, such relationships are much more difficult to measure, and are usually obscured because collective learning curves are compounded with reciprocal forgetting curves, and confounded by personnel turnover. Nonetheless, at the macro-level, there is some analogous relationship between unit readiness (proficiency) and funding for training activities or training (resources).



Here, as above, we should search for a Method B which offers a trainer with a constrained budget either ΔR , more readiness per \$ expended, or $\Delta \$$, equal readiness for less resources. But, of course, typically Method B requires capitalization, that is, it constitutes a course of action which cannot be adopted by a commander without his buying goods or services neither required for Method A, nor provided for by the programmers, who had allocated him his resources on the assumption that he would use Method A.

Let's look at a concrete example. One USAREUR division, with programed resources for training forecasted to remain level from year to year, confronted sky-rocketing cost trends. Moreover, its requirements for readiness were also increasing, as it sought to meet a heightened threat. For example:



In training its 360 tank crews:

$$\text{Cost} = \text{III} + \text{IX} + \text{T} + \text{V}$$

where: III is petroleum, oil, and lubricants

IX is parts

T is transporting tanks to the Major Training Area (MTA)
and V is ammunition.

Some of the POL and parts cost was constant, that is, consumption which is a "cost of ownership," stemming from day-to-day maintenance and training, wherever the unit may be. Tanks moving, shooting, and communicating on MTA tank ranges obviously consumed at a much higher rate. Transportation to the MTA was usually by rail, necessitating payment in German currency from the

divisional dollar allocation, and rail costs were rising rapidly. III and IX costs were also increasing. III, IX, and T costs all drew upon the division's Operating and Maintenance funding, and were interchangeable.

V costs were separately managed, ultimately representing Army procurement funds, and could not be traded off except among types of munitions. V costs of tank training ammunition (TP-T, TPDS-T) exploded between fiscal years 1978 and 1980, the average cost per round rising by a factor of 2.5 (driving the putative costs of tank training ammunition higher than the division's entire O&M budget, and rising the unconstrained requirements for this one type training in one division to one-third the entire USAREUR training ammunition "budget").

Guidance from higher headquarters was to hold V costs constant, and even to anticipate possible cuts. To do so, the division would have had to reduce tank firing substantially.

Cost V = Cost/round X Rounds/crew X No. Crews						
FY78 V	=	\$204	X	180	X	360 = \$13,219,200
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FY80 V Unconstrained	=	\$521	X	180	X	360 = \$33,760,800
FY80 V Constrained	=	\$521	X	71	X	360 = \$13,316,760

A wooden response by the division, to adopt the FY 80 constrained program, could have led to disasterously poor training. Especially in tank gunnery, proficiency is a function of iterative firing practice, and is sensitive both the frequency of such practice (the number of repetitions in a given training session) and the periodicity of the practice (the time lapse between sessions, during which proficiency tends to decay). Moreover, while an infantry squad can build some collective identity and purpose on a police-call skirmish-line, it is difficult for tank crew members to augment essential relationships with each other and their machine unless they are in the tank, functioning together on their primary task of gunnery. Slashing firing practices, or extending the period between practices, strikes at the very cohesion of the tank crew: the tank crew that shoots together sticks together. For the esprit of its tank crews no less than their combat readiness, the division elected to accommodate firing about 100 tank main gun rounds per crew within its overall ammunition budget, but to shoot more often during the year, and to increase significantly total firings per crew at each shoot by adding 1/2 scale engagements to its Tank Tables VIII and IX. The division DISCOM was instructed to build 120 M2-based .50 caliber sub-caliber guns (NACCA design) which, mounted on the search-light ball, and plugged into the tank's firing circuit, permitted main gun or .50 caliber engagements (either or both) on any firing exercise. But this construction required funds--capitalization. The division also concluded that, for training efficiency's sake, it should increase the

density (number) of targets presented per tank firing exercise. The cost effective solution seemed to be purchase of over \$250,000 worth of portable radio-controlled targets, presenting a further requirement for capitalization.

Tank training was but one of many types of training subjected to the cost-squeeze, each generating a comparable requirement for capital. For example, to cope with the rising cost of 155mm artillery ammunition, and to increase frequency and periodicity of firing practices, one brigade created a 1/10 scale terrain model of its wartime defensive section, by adding low relief to the off-runway areas of an airfield at its kaserne. That brigade's direct support battalion, Battalion 1, fired thereon substantial amounts of 14.5 mm sub-caliber ammunition. Over a 12 month period in FY78, Battalion 1 fired 7200 rounds, 60% of which was 14.5 mm. In the same months, another of the division's direct support battalions, Battalion 2, with easy access to German ranges, fired some 6800 rounds, only 40% of which was 14.5 mm. Divisional ARTEP evaluation at the US MTA, using service ammunition only, established that there were no significant differences in the performance of the two battalions. But Battalion 1 achieved that evaluated readiness for less than 72% of the V cost of Battalion 2. Divisional and brigade O&M capitalization of Battalion 1, including local purchase of 14.5mm ammunition not available through US Army issue, amounted to less than 10% of the V cost.

The division generated such capital by reprogramming railroad funds. The number of vehicles shipped per battalion to the US MTA was cut back, and limited, well-supervised pooling substituted. At first there was substantial resistance to this practice, especially among tankers who were convinced that each crew needed to fire its own tank. The division commander, however,

pointed out that there was battlefield utility in teaching crews to fire any tank, and thus developing precision in zero, loading plans, and crew SOP. In the event, the division experienced rising qualification scores and dramatically lower number of rounds for zero. (Since, an ARI study at Fort Carson has confirmed that "equipment turbulence," movement of crews among tanks, in fact does not affect firing performance.)

Ultimately, the division phased out the railroading of maneuver battalions to the US MTA, thoroughly integrated the evaluation of its infantry and tank battalions, and marched by road to a nearby German MTA for divisional evaluation--the move itself a contribution to readiness. Funds diverted from the railroad program were used to underwrite purchase of portable training equipment for upgrading both local training areas near the units' home kasernes, and German range equipment at their MTA. The capitalization, then, went well beyond tank sub-caliber guns, tank targets, and artillery range equipment, to include: radio-controlled infantry targets; a facility for battle simulation; modular knock-down building shells for teaching combat from villages; fortification materials for training; simulated battalion basic loads of ammunition, accurate in bulk and weight of issue container; radio-controller aerial targets; a maneuverable target tank; 1/10 scale HIND helicopter targets; a conduct of fire simulator for training and evaluating forward observers; and various communications equipment and training munitions not available through US Army issue. The new approach also required financing a divisional public relations and civic-action program designed to inform the German populace of the reasons for the increased American incursions into their midst, and to minimize their

burden on German public services.

Neither the difficulties nor the opportunities implicit in this capitalization should be underestimated. Many commanders within the division initially opposed the "burdening" of subordinates with additional material and attendant problems of accountability and maintenance. And compared with the pace of events in line units, the infusion of new training technology proceeded with agonizing slowness. But it soon became evident to most doubters that even modest upgrading had the effect of:

- Causing small units to train with their weapon systems more frequently.
- Integrating training, making "combined arms" a living reality day-to-day, in garrison or out.
- Motivating soldiers, literally fostering growth in confidence and competence.
- Rewarding leaders, especially NCOs, with frequent proof that their efforts were bringing about individual and collective progress toward higher readiness.

One brigade, stationed in an urban kaserne, invested more heavily than most units. There can be no doubt that its "training overhead" ballooned -- one estimate pointed to a tenfold increase! But whereas in FY77 the Brigade's training on weapons and tactics was perforce concentrated in semi-annual trips to the US M.T.A., by FY80 that training could occur year-round, to the evident advantage of leaders and soldiers at every echelon. Moreover, the FY77 outlays for the M.T.A. trips constituted opportunity costs much greater than the railway bills suggested, for after capitalization the Brigade could train daily in the following modes, none of which would be easy or even possible at the M.T.A.:

- Adjusting artillery on moving targets from ground and air OPs.
- Firing moving tanks at multiple targets, using flank or rear engagement techniques.
- Using the Improved Tow Vehicle (ITV) to its potential for both the direct and indirect fire systems.
- Operating from war-plan related maps on war-plan related 3D terrain models.
- Multi-echelon training, simultaneously exercising individual soldiers, weapon crews, and other collectives through the Brigade command group.

(The brigade, by FY 81, assimilated M60A3 tanks, M113A2, and M577A2 APCS, ITV, RISE M88s, the automatic telephone switchboard, the viscous-damp mount for DRAGON, the new mess trailer, and VINSON encryption equipment--and it is doubtful whether that modernization could have proceeded so well or so fast without the advanced training technology. In brief, a satisfactory alternative to "capitalization" did not exist.)

Over the two fiscal years FY 78 and FY 79, the division probably spent some \$2,000,000 in capitalizing its unprogrammed solution to its training problems. The arithmetic looked something like this:

Eliminated:

2 trips/year, kasernes to US MTA (avg. 412 km.) \$4,400,000

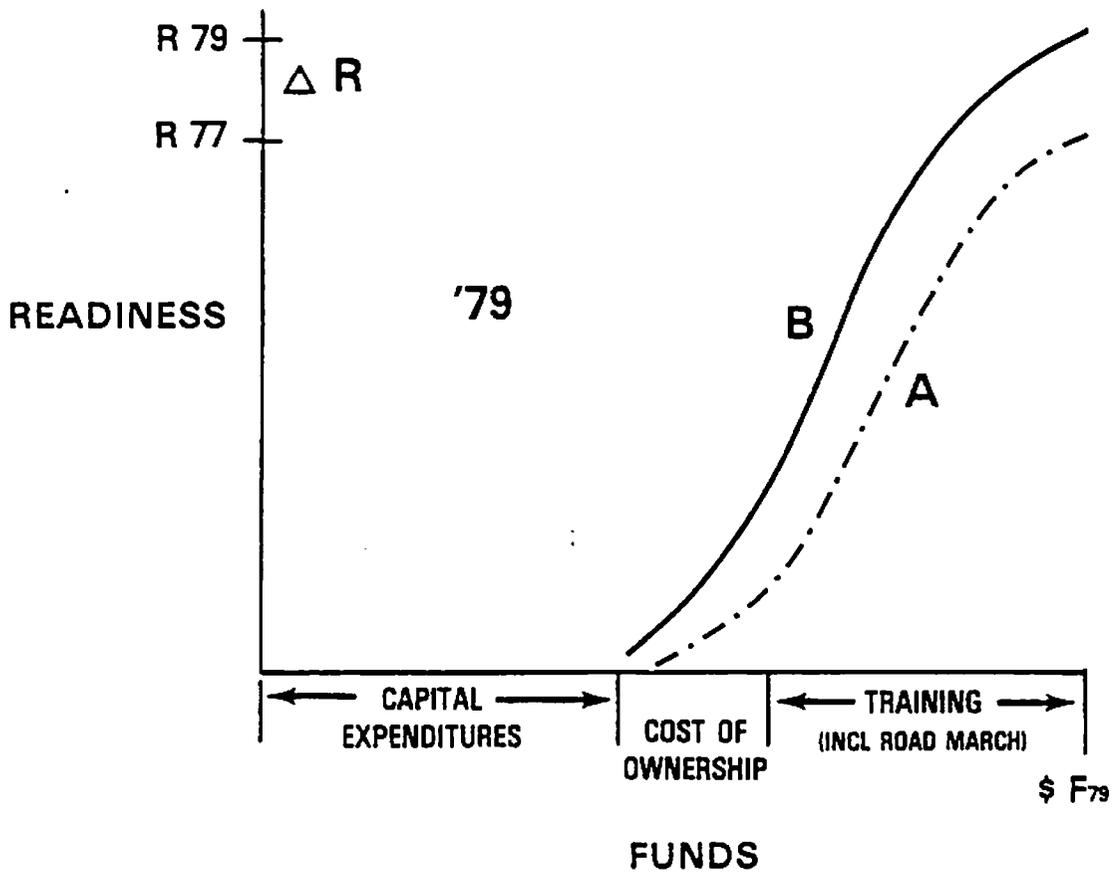
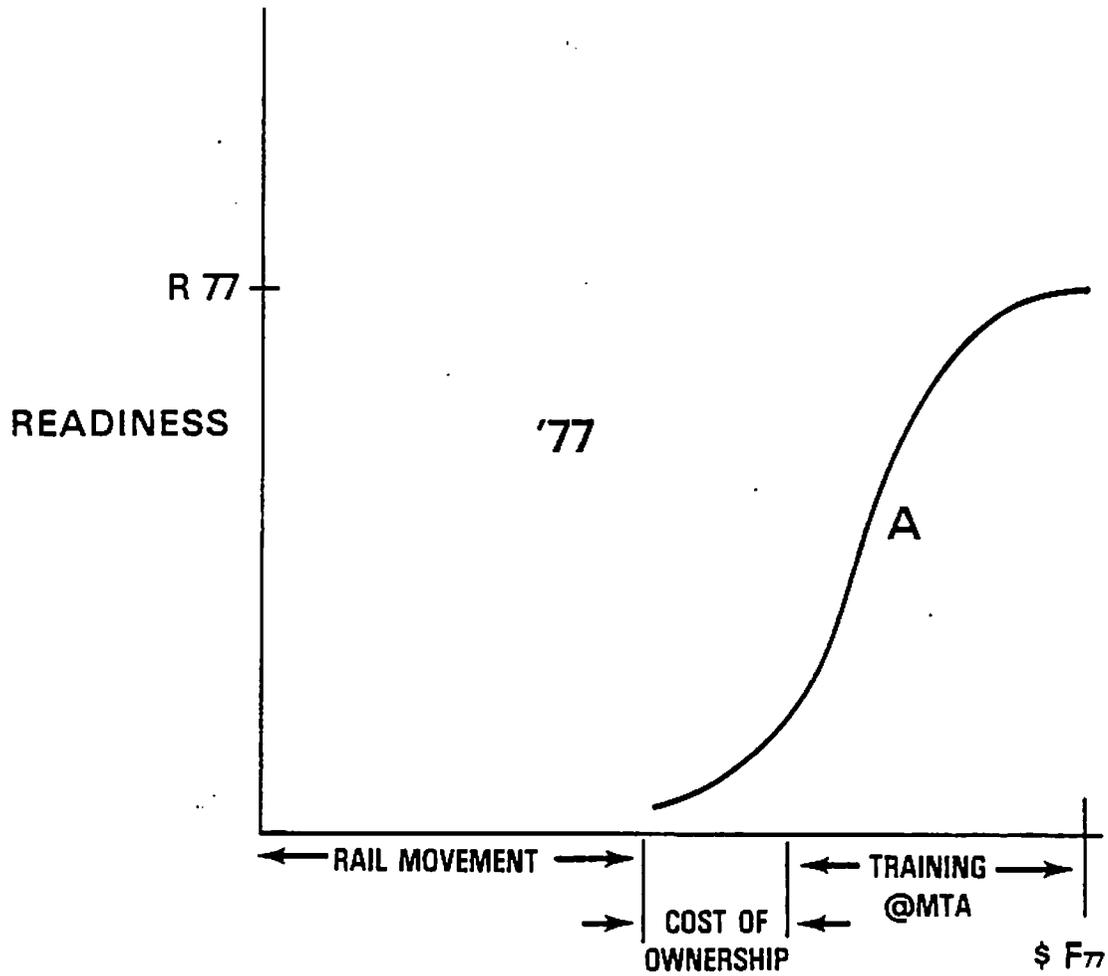
Added:

3 trips/year, kasernes to German MTA (avg. 74 km.) 1,800,000

Reprogramed for capitalization \$2,400,000

And, the division in fact bought higher readiness--a Method B FY79 relationship to its Method A FY77 program. While resources provided it by higher headquarters remained virtually constant, training efficiency patently improved, and there was a discernible, well-evaluated increase in readiness, reflected in higher confidence among commanders and soldiers alike. Some measures of that ΔR were these:

- Battalion times required to upload war ammunition were cut by over 50%.
- Battalions executed crossings of the Rhein and Main Rivers with division or German Army engineers.
- Incidents and accidents related to road movements declined dramatically, and march table precision improved markedly. War plan deployment times were reduced 15%.
- OR rates during and after field exercises improved.
- Number of tank rounds required for zero were cut substantially, and the number of crews qualified to USAREUR standards on Table VII, and platoons on Table IX increased significantly.
- Infantry platoons qualified on comparable live-fire exercises, with special emphasis to air defense and anti-tank capabilities.
- Brigade FASTS were trained and evaluated in prolonged field operations.
- Maneuver battalion commanders and staffs were trained and evaluated via battle simulation in employment of modernized weapon systems.



Actually the foregoing graphs are notional, for while resource data can be laid off on the abscissa objectively, measures of readiness for the ordinate remain quite subjective. The graphs should be understood as the plot of training readiness R as a variable dependent on training funds F, expressed as a multiple regression equation of R on F:

$$R = a + b_1 F_1 + b_2 F_2 + \dots + b_k F_k$$

where: a = "cost of ownership"

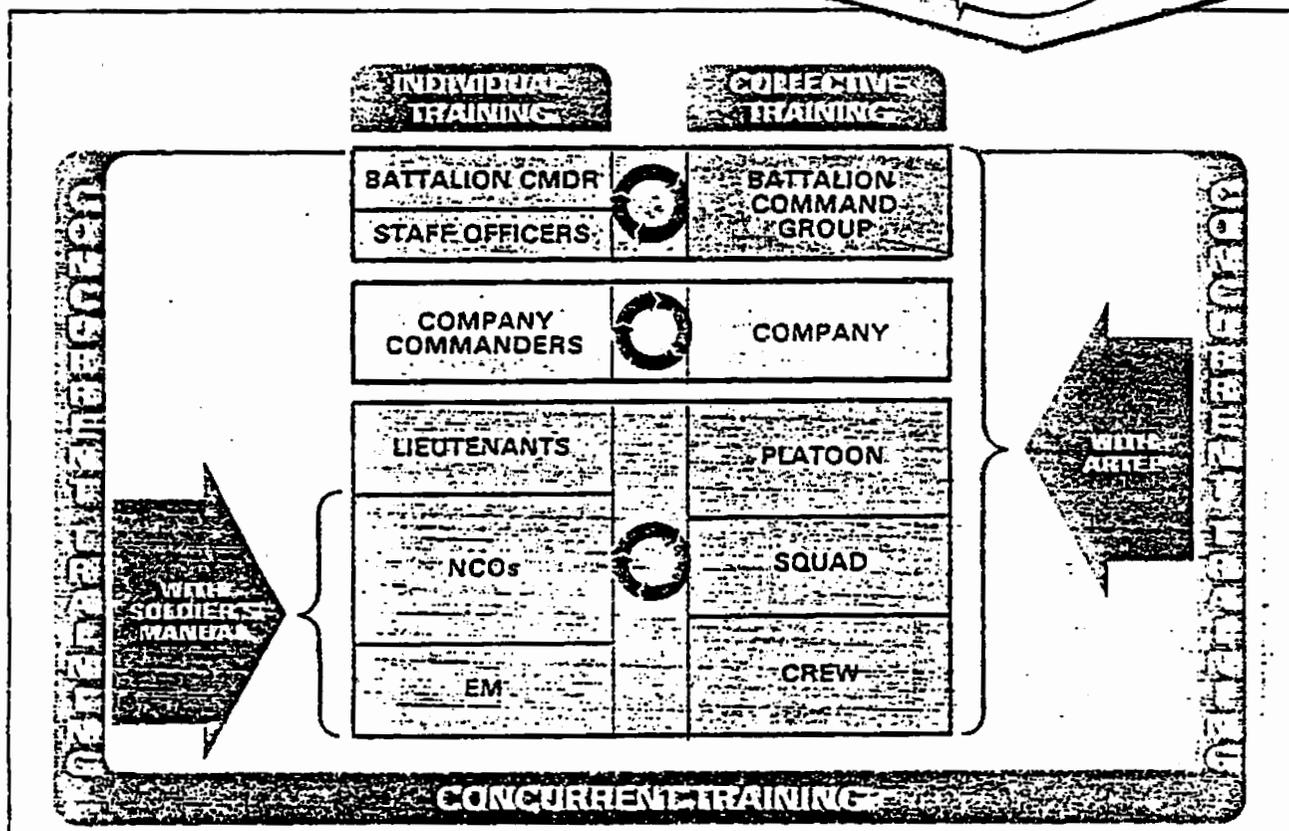
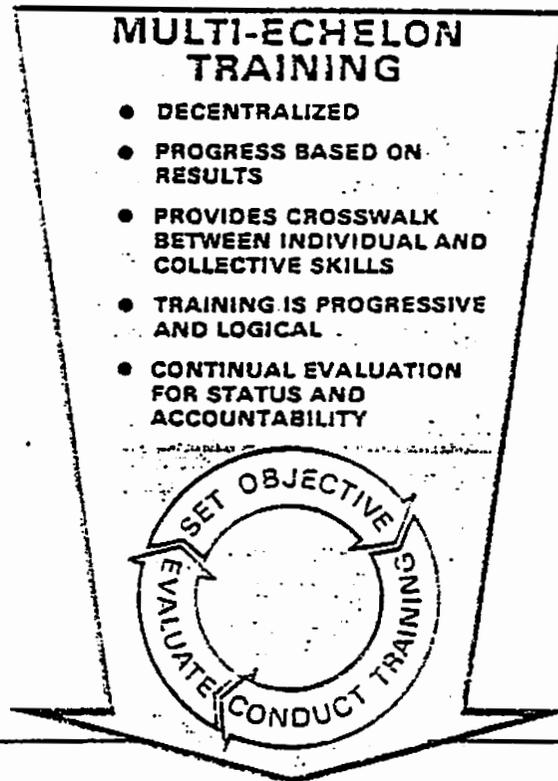
b ...k = regression coefficients, expressing $\frac{\Delta R_n}{\Delta F_n}$, the marginal change in readiness for each increment of funding, numbered for each task trained or evaluated by methods distinct from others by reason of place, training technique, or other significant differences. Each coefficient quantifies efficiency or cost-effectiveness, and there is probably at least one per ARLEP T&EO, and surely one for each combination of frequency and periodicity.

The resultant aggregated "learning curve" for a unit is then, the sum of many training processes, each perforce unique to that unit's circumstances of training and its training management. There are specific cases in which $\frac{\Delta R_n}{\Delta F_n}$ has been proven to be demonstrably high; Proposals 3, 4, and 5 address examples of such training undertakings, and argue for the Army's capitalizing these on a large scale to make them available for unit commanders. And if we look carefully, we are certain to find others. Moreover, modest progress has been made in fixing frequency and periodicity for some skill development, e.g., tank gunnery. But it would be unrealistic to expect that we will be able soon to proceed from microcosmic successes to sure macro-management of training funds for readiness. It may be

possible in some millennial day for higher commanders and the Army staff to consult a computer for quantified insights into training efficiency in any given division. But that day will come only after the Army learns much more about those efficiency coefficients that we know today, and only after ^{becoming} more artful in scaling readiness itself. In the meantime, "higher" will have to accept the judgment of the subordinate commander, even as it will in battle--and that is ^a not unsatisfactory state of affairs.

Looking for funds to support capitalization of training, the Army staff is no doubt handicapped in fund competition within DoD by inability to cite exact relationships between readiness and allocations for training, comparable to that enjoyed by the Navy (days of steaming) or the Air Force (flying hours). What we must make clear to DoD is that the Army is readying its units to fight in a very different way, and its readiness is less a direct function of time devoted to training than of the efficiency and diversity of the training. In battle, Navy and Air Force commanders enjoy near-perfect knowledge of the location, direction, velocity, and capabilities of their deployed fighting elements, which operate in homogenous environments in predictable modes. All these elements are officer-led, and communications with them are assured and instantaneous. Therefore, the modus operandi of the Navy and the Air Force is technologically assured centralization. Training the way they fight, the Navy and the Air Force can equate levels of readiness directly to the hours they are funded to operate their primary machinery in peacetime. But the Army's modus operandi is perforce decentralization. We fight amid all the complexities of the earth's surface as we seek to control land and people. Most of our fighting elements are not led by officers, and our communications among them are often uncertain, and seldom quick. Our commanders often have imperfect ideas of where their elements are located, what they are doing, or what their current fighting capabilities may be. These commanders must function in battle by assigning broad missions to subordinates, and relying on their understanding of doctrine and their tactical ingenuity in coping with unforeseen circumstance. Therefore, so must we train. Our training, like our way of war, must be visualized as a complex interaction

going on simultaneously and continuously, a never ending process of progress and regression not unlike organic growth. It is so depicted in this diagram from TC 21-5-7:



Given the many variables which affect efficiency of multi-echelon training (e.g., leadership, morale, equipment, degradation of skill over time, personnel turnover, training support, weather, terrain, and the like), commanders above division are unlikely to make proper choices on how often to train, or what method to use to fit the garrison circumstance or battlefield requirements of each subordinate unit. For example, division, brigade, and battalion commanders must make hard fiscal choices not only regarding how much training and evaluation to provide session by session (frequency), but also regarding how often to schedule such training/evaluation (periodicity). The choices faced by a division stationed at a division-post in CONUS are bound to differ from those of a division in the dispersed kasernes of USAREUR, if only concerning that amount of resource-pooling among units for training/evaluation which may be desirable or feasible, let alone the mission requirements faced in USAREUR vice CONUS. Hence, Department of the Army or major command policy should encourage in every possible way those budget executors who are also training managers--notably division commanders--to seek actively, capitalizing via reprogramming, experimenting with both frequency and periodicity, ways and means of maximizing $\frac{\Delta Rn.}{\Delta Fn}$.

DA policy is now, seemingly, exactly to the contrary. Year by year, with each DA version of procurement regulations, with each issuance of fiscal guidance, with each successive instruction on training ammunition, audio-visual devices, range safety and targets, and minor construction, the latitude permitted division commanders searching for Method B has been constricted. This fiscal myopia, combined with cost-shaving, would today virtually foreclose the divisional initiative described above. Capitalization from further bold divisional reprogramming thus denied, yesterday's Method B becomes today's Method A, and the division would face its future strapped to training approaches sufficient for the late 70's, but quite inadequate for

meeting the modernization it faces in the 1980's. But even if we rectify this state of affairs, reprogramming of O&M could not provide all the capital which force modernization will require. To discuss other funding sources, we shall have to address further proposals.

Proposal 3: Expand use of battle simulation. FM 100-5 emphasizes the centrality of weapon systems in modern battle. About five years ago, TRADOC tasked the Command and General Staff College to tool up the Army for a return to two-sided, free-play war gaming in which weapon system effects were realistically reflected in game rules for losses and movement rates. A century ago the US Army, having learned at Fredericksburg, Antietam, and a hundred other battles, the hazards of ignoring the lethality of modern weapons, and emulating the victorious Prussian Army's emphasis on Kriegspiel* for training its commanders and battle staffs, used board games rather widely, the schools at Fort Monroe and West Point being two centers for the technique. But as weapon tables derived from Civil War experience became outdated, and in the absence of techniques for predicting the effect of new weapons like the machine gun, the practice fell into disuse. Comparable 20th Century training techniques, such as the Command Post Exercise, were only rarely conducted as a genuine war game, primarily because there was no game apparatus to aid in computing the interactions among forces and weapons, and controllers assigned the task found it difficult to maintain a realistic pace for the players. Early in the '70s, the Combat Arms Training Board (CATB-now the Army Training Board) launched work on both computer-aided battle games and manual games.

*While modern German usage would confine use of the term "Kriegspiel" to exercises for commanders of corps, field armies, or Army groups, and would probably label the current U.S. practice under discussion "Planübung," the nineteenth century American characterization (cf. Livermore's "The American Kriegspiel") accurately reflects the two-sided, free-play nature of today's battle simulation.

By 1975, prototype board games were deemed ready for use both in institutional and unit training. C&GSC has since sponsored and fielded a range of such games, which it grouped under the rubric "battle simulation," capable of portraying real-time tactical interaction between units from company through corps. For example, in Europe the Reforger exercises of 1977, 1978, and 1979 used C&GSC battle simulations in which multi-division US corps were pitted free-play against Soviet-type armies on large wargame boards.*

Commanders who have used battle simulation have found that the technique facilitates multi-echelon training, since it trains and evaluates leaders, staffs, and communicators while subordinate elements are otherwise engaged, increases leader proficiency, and, hence, the units overall efficiency, on subsequent FTX.** Also, battle simulation requires relatively little preparation, can be interrupted at will, and is readily adapted to exercising war plans--all advantages which fit the needs of unit commanders. Manual games are more labor intensive than computer-aided

*N.B. Battle simulation is only a supplement to full-scale maneuver or FTX, and in the Reforger case permitted many more commanders and staffs to participate in addition to the corps-size force maneuvering across the German countryside.

**Experience suggests that a brigade battalion commander ought to take his whole command to the field within six months of assuming command, and annually thereafter. Battle simulation should prepare him and his subordinates to obtain full value from these FTX.

games, and can be slower and more demanding of players and controllers, but are much less expensive either to procure or to operate. Moreover, manual games have an advantage for units in that rules can be more readily understood by the player or controller--the logic is literally out on the table--and can be modified on the spot to accommodate a new weapon, tactic, or other anomaly. Most importantly, board games whether computer-aided or manual, train and evaluate effectively, in ways which can capture the interest, fire the imagination, and elicit the initiative of leaders of all ranks.

It should be clear that "battle simulation" is a term which can be applied to any mechanism or procedure which permits two-side gaming, and in that sense includes not only board games, but also forms of field training in which opposing commanders employ notional units, fire and maneuver on actual terrain under rules which reward or penalize players proportionate to the combat power of engaged "forces." Combinations of field exercises with board games are feasible, as is the gaming in the field of notional or skeletal forces umpired with rules governing employment and effects of weapons.

Again, let's return to the fiscally beleaguered division mentioned above for an example of battle simulation used for divisional training and evaluation of maneuver battalions, per the Army Training Evaluation Program 71-2. In FY 78 the division laid out its evaluation so that each pair of participating battalions followed this sequence of seven main events, over a period of 12 consecutive days:

A11

- (1) Alert; full upload of ammunition, ~~par~~-combat inspection
- (2) River crossing and road march
- (3) Assembly area; form task force
- (4) 2 day FTX (active defense); 1 co. team builds strongpoint

TF Cdr, Staff
Co Cdrs, FISTs, Spt Plat Ldrs

* (5) Battle simulation

Platoons (sections)

* (5) Live fire and engagement simulation

All Officers

(6) Mounted navigation course

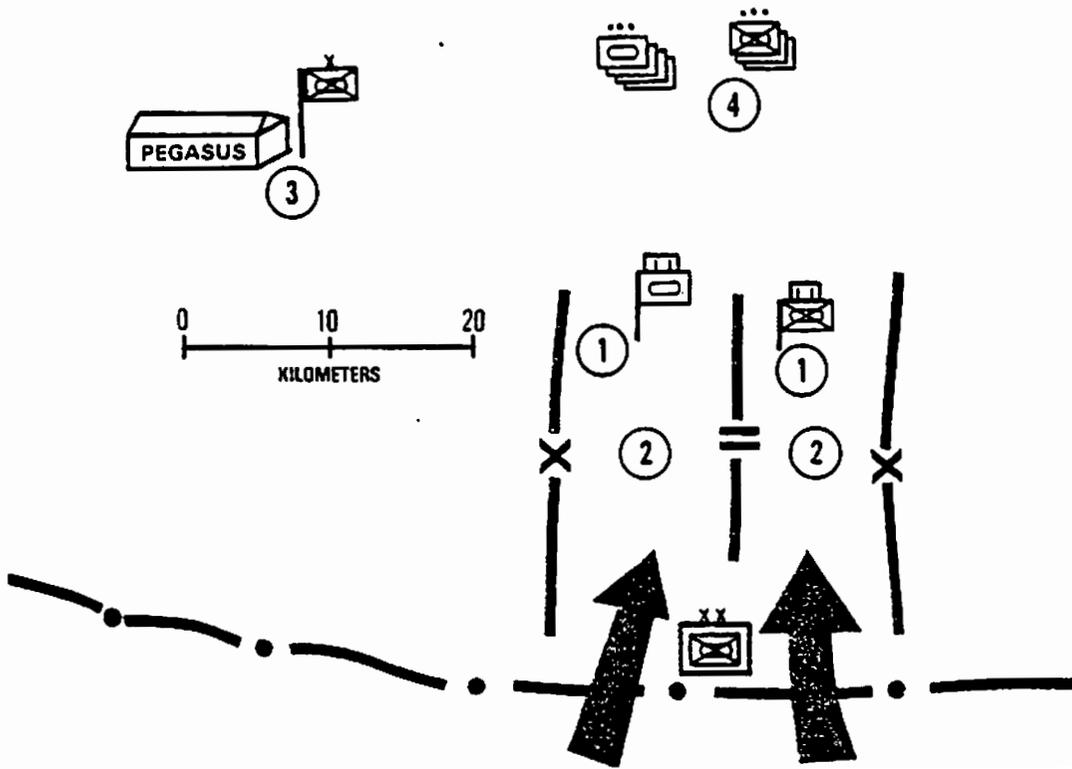
Unit, less officers

(6) Road march home; prepare for inspection

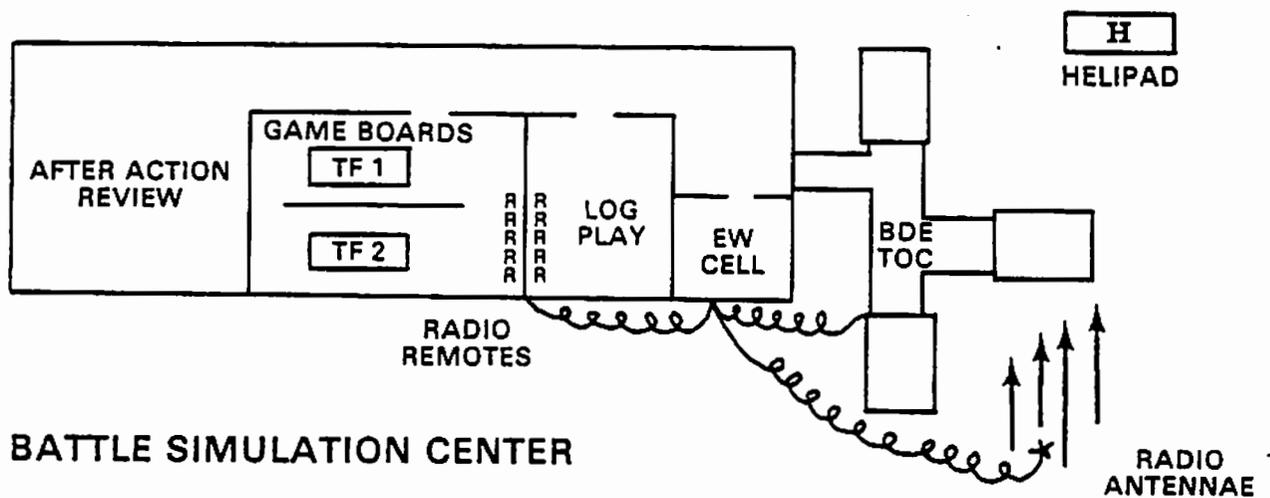
A11

(7) Post-operation inspection

Event * (5), above, actually took place in 4 locations simultaneously;
as shown here:



① and ② were in the German countryside, near an international border, randomly selected and changeable zones of rolling terrain, covered with grass crops and forests, with a modest secondary road net and small villages. ③ was at the German MTA, and consisted of a brigade Tactical Operations Center colocated with a large, rented, carnival tent housing players using C&GSC's PEGASUS battle simulation. ④ represents some 20 different locations at which evaluation of platoons or sections were proceeding simultaneously, both on and off the MTA. The "Battle Simulation Center," ③, was laid out something like this:



Typically a Task Force operating under Brigade A, would finish its FTX, event (4) on a Saturday A.M., assemble its leaders for a walk-through and review of the strongpoint, and then be "chopped" to Brigade B, the battle simulation control headquarters. Saturday P.M. it would receive a warning order directing movement to the southeast, to a defensive position behind a covering force. As it began movement, it passed OPCON of all its platoons and sections to other headquarters administering the divisional evaluations (within the battalions, usually the Command Sergeant Major and the 1st Sergeants saw to the internal coordination and combat service support for the platoons, who rotated among the several evaluation sites, county-fair style, Monday through Thursday). Each Task Force Command Post moved as directed to a field location, and set up for tactical operations. On Sunday the Task Force commander with his company commanders conducted a reconnaissance of their assigned zone, devised a plan for an active defense, and coordinated passage of the covering force. Late Sunday the notional OPFOR crossed the border, and intelligence began to flow, via brigade, on the developing "battle." The covering force withdrew, and on Monday morning OPFOR closed with the Task Force battle positions. Actually, on Sunday, as soon as the Task Force commander announced that he was satisfied with company team plans for fitting forces to the terrain, the team commanders were flown to the Battle Simulation Center, briefed on the game apparatus, and allowed to position their weapons and other elements on the game boards. Each of these used a 1:10000 color-contoured map of a Task Force zone, covered with a hexagonal grid, over which were moved appropriate unit/weapon markers. A divisional team of intelligence officers maneuvered the OPFOR. The brigade commander acted as the chief controller, and there was a field-grade "board controller" for each Task Force, to referee the spirited, often heated, give-and-take

over the course of the action. As the battle unfolded, Company Team commanders reported by FM radio to Task Force, FIST Chiefs talked via radio to the Liaison Officer or to FDC; and the log players(the S4's, the company executive officers, and the battalion support platoon leaders) operated on the Task Force logistic net. Each Task Force CP, of course, reported to brigade, which operated all the nets which the Task Force would normally enter, including the several logistic, air request and artillery nets. The division's ASA company monitored all these nets, evaluated COMSEC, and interjected OPFOR jamming or deception per instructions of the OPFOR commander. The game apparatus permitted the exercise to proceed realistically in actual time, with fidelity in both time-sensitive player moves, and player decisional stress. *

The general outline of the battle simulation had been described to participants in an ARTEP Training and Evaluation Outline distributed three or more months previous to the event, to facilitate training up for the evaluation. New equipment or munitions expected in the division within the following year was played as though already issued, and latest threat weapon systems were employed by OPFOR.

Four "battles" were fought, one per day, each lasting from 4 to 14 hours. In the first two, the Task Force defended, first against a hasty OPFOR attack, then against a deliberate attack. The situation then changed with arrival of US reinforcements, and two offensive battles were fought, a deliberate attack, followed by a breakthrough and exploitation.

After each battle an after-action review was held, in which first the brigade commander led a discussion for all participants of what went right and wrong, and then each Task Force controller, one of the division OESOs, privately briefed his TF commander on his observations. The format was flexible enough to permit

*PEGASUS is inherently a complex and slow game, especially if it includes extensive logistic play, but with practiced controllers and OPFOR players, appropriate pace can be maintained, and even varied as desired by the senior controller.

whole battles to be replayed, or additional situations to be introduced whenever the brigade commander elected to do so. During any battle TF Commanders were allowed to confer face-to-face with any Company Team commander whenever they chose, but were required to leave their CP and "go forward" for that purpose. TF commanders were also encouraged to huddle with their subordinates following each after-action review to concert plans for the next battle, and when the situation warranted, were permitted additional terrain reconnaissance with subordinates, although the pace of the "war" stepped-up as the exercise progressed.

The battle simulation permitted evaluation per every T&EO in ARTEP 71-2. Moreover, an Army Research Institute (ARI) team piggy-backed on the exercise to investigate the validity of certain behavioral criteria of performance by Task Force commanders and their staffs. The results of the ARI evaluation, separately and independently reported, confirm that the battle simulation was a valid instrument for both training and evaluating. ARI used two sets of measures of effectiveness (MOE):

- Military MOE: mission accomplishment, geographical area controlled, resources remaining, and force exchange ratio.
- Organizational Effectiveness MOE: sensing, communicating information, decision making, stabilizing, communicating implementation, coping actions, and feedback.

The outcomes, reduced to a common scale or scoring, looked like this:

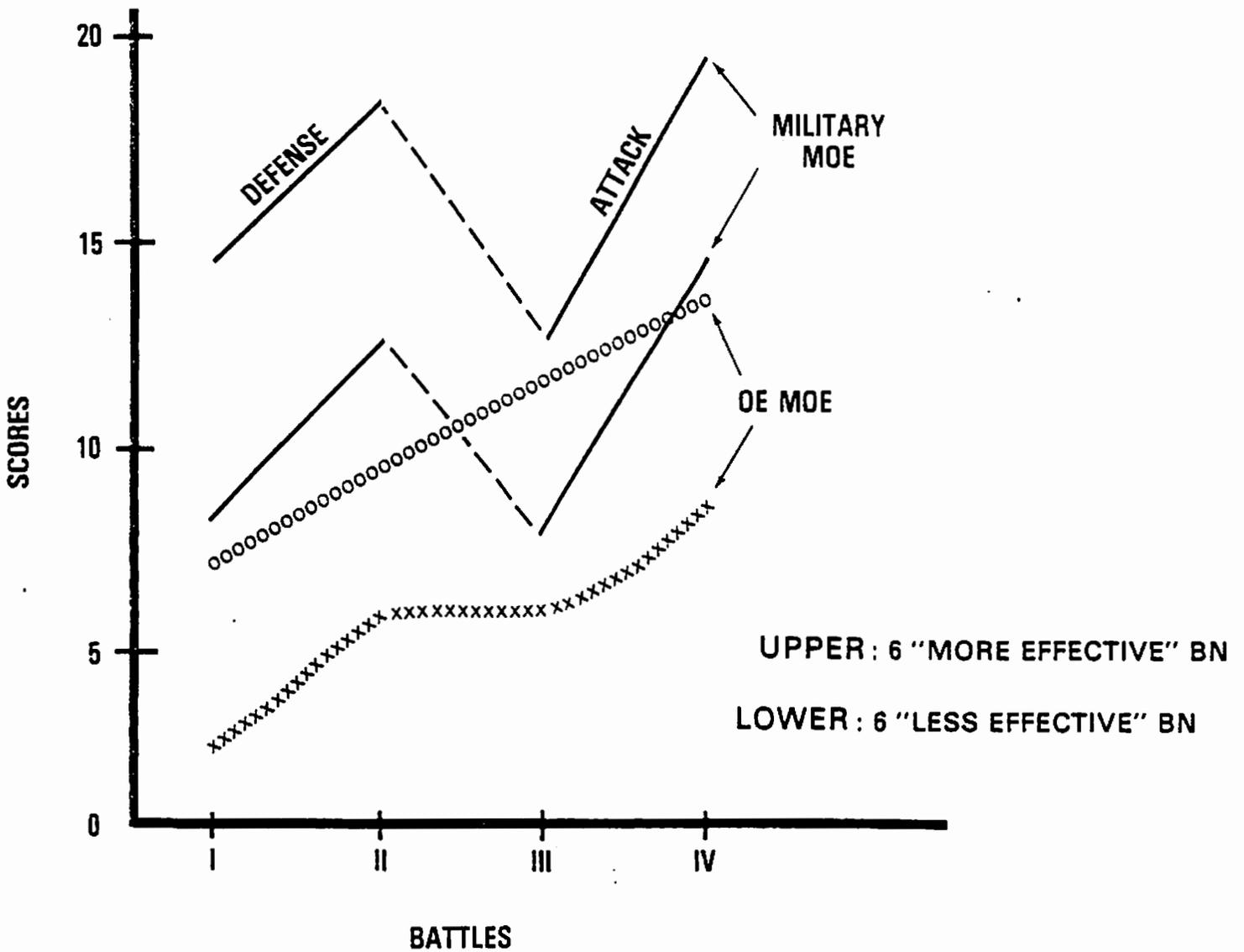
Several aspects of these data confirm the presence of superior training technology:

- The data across 12 battalions was internally consistent.
- "Learning curves" are recognizable (N.B., the "setback" evident from Battle II to Battle III in the military MOE follows logically from the transition from defense to offense).
- Lower half battalions finished about where upper half battalions started, but all improved, at about the same rate.
- From all indications, a Battle V would have benefitted all participants, i.e., rate of learning had not begun "flattening out."
- As an evaluation method, the battle simulation easily sorted the 12 participant commanders/staffs into upper and lower performance groups. Moreover, evaluation was consistent with both sets of MOE.

Being able thus to evaluate differences in tactical proficiency among battalions is anything but a trival accomplishment. Usual ARTEP evaluations using full scale maneuvers are both expensive and less reliably discerning, in that the scenario is often dictated by available land, and the portrayal of crisis inherently awkward. Moreover, today's board-selected battalion commanders tend to look alike and act alike in anticipatable circumstances. Here "realism" rested on confronting the commanders and staffs with the unexpected, and differences promptly became evident.

In the ARI report on this battle simulation, the authors noted that the largest differences among participants were scores on mission accomplishment and force exchange ratio:

BATTLE SIMULATION RESULTS



"The latter is particularly noteworthy in view of current US Army doctrine for fighting a central battle against near overwhelming odds. The doctrine calls for trading time and terrain, within well defined limits, for the opportunity to inflict disproportionately high losses on the enemy. This clearly will work only if friendly forces have the skill to achieve a highly favorable loss exchange ratio. Battalions with high competence scores (OE MOE) had better loss exchange ratios (military MOE)."

Concerning the OE MOE, the ARI researchers further noted that more effective battalions were rated strongest in "reality testing," the ability of the command group to look at the combat environment realistically, to determine what was actually happening (sensing), to communicate information about that, and to tell what effect Task Force reactions were having upon the situation (feedback). These findings have already been useful in bringing the Army's Organization Effectiveness undertaking more directly into service for combat readiness.

But there are broader implications for Army modernization. TRADOC, in its assessment of the 1986 Army (Draft Battlefield Development Plan II) asserts that: "... The introduction of new technology into the Army's inventory in the 80's and 90's will occur at a rate unparalleled since World War II. The US Army's ability to achieve the benefits of its modernization will be limited by its ability to train the force up to the potential of the fielded systems and to assimilate rapidly changing doctrine and tactics.

⁴Experience derived from fielding the TOW weapon system provides a simplified indication of the complexity and danger of introducing rapidly

changing doctrine and technology.... The performance capabilities of the TOW were not immediately achieved. The doctrine, tactics, maintenance, soldier and ARTEP manuals lagged years behind the introduction of the system. Our units simply were incapable of rapidly exploiting the advantage of a fielded system....

"The challenge is to develop the means to integrate dynamic doctrine and technology rapidly into Army organizations effectively. The components of this challenge include systems, doctrine and tactics, command control and communications, and training of commanders, staffs, crews and organizations. As systems and organizations become more sophisticated and complex, decisions will increasingly rest on information embedded in our battlefield systems and control will be exercised increasingly through internal manipulation of embedded information....

"More highly cost-effective training systems are required if the Army is to modernize and maintain a high state of readiness in an era of declining manpower resources and increasingly sophisticated weapon systems...."

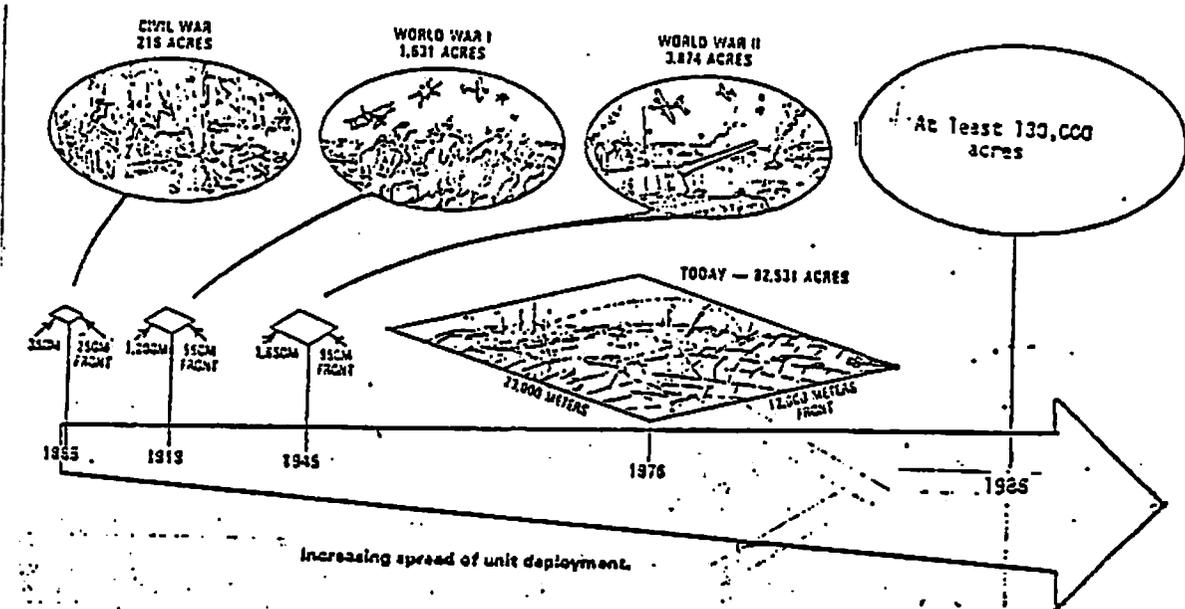
The Army cannot afford, as it did with TOW, to underestimate the difficulties of training leaders in the technical capabilities and appropriate battlefield employment techniques for novel weapons--in the instance of TOW, a cultural leap was in order; infantry leaders had to acquire tactical awareness extending some 3,000 meters, vice the more constricted sentience theretofore adequate for rifles or machine guns. To such ends, battle simulation is both effective and cheap. It goes to the heart of the problem of teaching serving commanders and staffs how to use new weapon systems. In the FY 78 PEGASUS exercise described above, participants learned how to employ, inter alia, artillery-delivered mines and thermal sights for TOW and tanks well in advance of the

arrival of the hardware. N.B., readiness of command groups to deal situationally with advances in chemical or nuclear warfare, enhanced conventional firepower, new air defense systems, improved reconstitution, or other aspects of modernization may be far more important than the training of individuals or weapon crews. While the latter is sine qua non for modernization, the former, if lacking, can obviate the latter no matter how well done. And if we train command groups well, they can compensate for any a deficiency in the training system overall.*

* Here is an excerpt from a 1980 letter from a brigade commander:

"My favorite battle simulation remains Pegasus because of the flexibility and non-dependence upon ADP. It is here where the combined arms come together from Co team thru Brigade to include adjacent units... Pegasus (is) the single most important means for preparing for our GDP mission. It ties together terrain walk detail with tactical concepts and allocation of resources into a coherent whole which can be practiced again and again against various threats. Commanders and staffs are stressed, mistakes are made--and corrected--relationships are crystalized, liaison exercised, holes are filled in thinking, tactic or technique, task organization tested, team and battalion TF hand-offs practiced, SOPs clarified and communication means streached. It also builds cohesion, teamwork, understanding, and an appreciation for what your flank units are planning to do and how good they will be at doing it."

The time is long past when a division commander can hope to train his division often or well by spreading all its units out on the ground in combat array, and maneuvering. Even when maneuver rights land is available, realistically stressful real-time maneuver by large units is severely limited by concerns for safety and maneuver damage. The German MTA mentioned above occupied an area of only 27,000 acres, of which half was impact area unavailable for maneuver. A US battalion committed to active defense in Germany is often expected to deploy and move responsively over an area 6 times that MTA's acreage. The prospects for training even a battalion as we did divisions during the Louisiana maneuvers of World War II are dim indeed:



Therefore, the Army should press hard to exploit battle simulation. TRADOC's 1986 Army study calls for "innovative training approaches":

"Simulators and devices will assist in attaining and maintaining proficiency on individual weapons systems. However, the Army has not yet fully exploited such mechanisms. The full range of battle simulations-- from the proposed ARTBASS* to the existing Dunn-Kempf**--will be the principal training tool for commanders and staffs. As such, these battle simulations will require frequent upgrading to reflect and train the latest tactical unit doctrine, weapons capabilities, supporting systems capabilities, threat capabilities, and the realistic environment of the integrated battlefield."

The Army need not wait for ARTBASS. Indeed, unless ARTBASS--or any other processor aided game--is artfully designed easily to accommodate changes in weapons and tactics, modernization may be better served by manual games with fully accessible algorithms which can be particularized by units for their suite of weapons and their threat. Battle

*ARTBASS (Army Training Battle Simulation System) - A high fidelity real time computer driven simulation that creates a realistic, pressure cooker battle environment for battalion command group training. ARTBASS is based on an improved Combined Arms Tactical Training Simulation (CATTS) model and is currently under development. A prototype is to be fielded in 1983. ARTBASS will be van-mounted and capable of operation in both remote field sites and garrisons.

** Dun-Kempf - A platoon and company manual game, currently fielded.

simulation is a readily available method of training for modernization: in the near future the Army should press it into use on a wide scale as a matter of priority. Capitalization costs should be low, but no weapon systems manager should be permitted to move beyond advanced development without having financed modules for his system for each of C&GSC's battle simulations.

Proposal 4: Exploit engagement simulation. Another training technology born under CATB, "engagement simulation" refers to forms of field training employing real-time weapon-effect assessment, plus an after-action review centered on causes for battle losses. Like battle simulation, it emphasizes teaching weapon system effectiveness and ways of minimizing vulnerability to modern weapons, but focuses on training trigger-pullers and their immediate leaders, rather than Task Force commanders and staffs. Its purpose is teaching tactics; as TC 21-5-7 puts it:

$$E = f (W, P, T)$$

"The battle effectiveness (E) of any weapon is a function of the capability of the weapon (W), the proficiency (P) of the individual or crew who mans it, and the tactics or techniques (T) of the leader who employs the weapon and crew in action.

"The training manager normally cannot change the factor (W).... His main goals are higher values of both (P) and (T) through better training.... Weapon training is especially important for the US Army in this era when greater numbers of more powerful weapon systems are being introduced than at any other period in US Army history.

"The British innovator of armored tactics, General J. F. C. Fuller, wrote that 'tactics are based on weapon-power and not on the experiences of military history... that commander who first grasps the true trend of any new, or improved, weapon will be in a position to surprise the adversary who has not.'

"One essential characteristic of the modern American military professional is a thorough understanding of each weapon he is likely to fight with and against. Moreover, he must be given

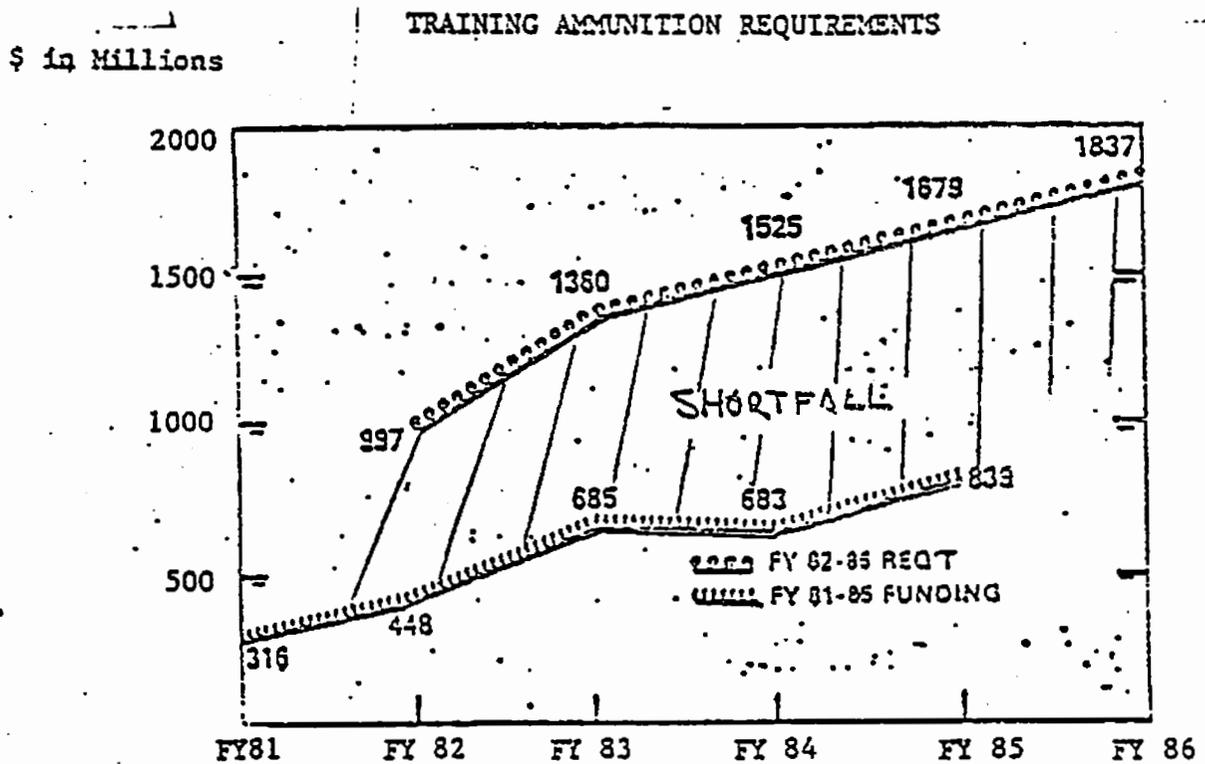
frequent opportunities to train with his own weapons. If he is to develop the ability to counter enemy weapons, he must train against them. Training managers throughout the Army must give first priority to weapon system consciousness."

Up until very recently, the Army has had little alternative except to train for these purposes with munitions, using live-fire exercises--very expensive training. The discussion above of the cost explosion in tank ammunition foreshadows the inflation the Army faces in the 1980's. Each new weapon seems inevitably to entail higher ammo costs, even when using sub-caliber training rounds. For example, in FY79 the division ARTEP TEO called for infantry platoons to engage a moving target tank with the M-72A2 Light Antitank Weapons (LAW), firing the small sub-caliber, matched-trajectory training rocket. For the first of its FY79 divisional evaluations, more than 1,000 such rockets were required. In the 1980's the division's LAWs will be replaced by VIPER, a weapon similar to LAW, with much higher effectiveness but costing four times as much per rocket as LAW. VIPER's sub-caliber round for training will also cost four times its LAW counterpart:

<u>AMMO</u>	<u>FY 79: LAW</u>	<u>1980's: VIPER</u>
SERVICE	\$114/rd	\$397/rd
SUB-CALIBER	\$ 9/rd	\$ 37/rd
COST DIV T&EO	\$11,700	\$48,200

These figures are typical. A 120 mm tank training round will cost around \$680, vice \$204 for the old 105 mm DSTP, or \$521 for the new 105 mm FSDS-TP round. A 30 mm TP-T round for the new attack helicopter will cost \$15, vice \$5 for the 20 mm TP-T used with Cobra. When DIVAD guns come in, a round costing more than \$50 will replace the \$3 Vulcan 20 mm round.

In plain fact, in future years Army trainers are unlikely to get the ammunition the ARTEP ^{now} prescribes for training and evaluation. The prospective shortfall between requirements and funding looks like this:



Since less than 50% of training ammunition requirements will be funded, the Army has no recourse except, as TRADOC's Battlefield Development Plan II states, "to substitute training devices for development of weapons proficiency wherever possible and to integrate such devices into training programs.

We must take advantage of new training simulator technology wherever possible to replace some of our live firing requirements and achieve the best proficiency at the most affordable cost."

While there are a number of promising simulators and subcaliber devices, one is ready for production which addresses both the (P) and (T) in the $E = f(W, P, T)$ paradigm: the Multiple Integrated Laser Engagement System, MILES. The acronym, chosen for congruence with the Latin for "soldier,"* describes a family of eye-safe lasers and laser detectors designed to simulate direct fire weapons of various types. Instead of firing a projectile, the weapon shoots a blank, acoustically activating the laser, which sends a pulse of energy down-range. Each pulse is coded for type weapon. The detectors, built with a logic-chip specific for type targets, can discriminate lethal incoming, determine whether there was a hit or a near-miss, and signal accordingly. At present, MILES components have been developed and troop-tested (OT III complete) for the M-16 rifle, for the M-60, M-2, and M-85 machineguns, for VIPER, DRAGON, TOW, and SHILLELAGH missiles, and for the 105 mm tankgun. Production plans remain uncertain, however, because of competing demands on procurement funds.

MILES is unlike most other simulators in that (1) the Army developed and fielded the training technology, engagement simulation, long before the laser-receiver materiel was ready, and (2) MILES was specifically designed for unit training. In 1972 CATB began looking for cost-effective ways of training combined arms teams in force-on-force combat. The MILES development

* It is not unconnected with the first name of DARCOM's then Project Manager, Training Devices (PM, TRADE).

program stems from design-to-cost criteria developed for CATB by LtGen Jim Gavin's Arthur D. Little Co., and written into DARCOM's Request for Proposal. But simultaneously, CATB fostered fielding of engagement simulation techniques developed with Army Research Institute cooperation (and some contract help), first SCOPES for infantry, then REALTRAIN, which incorporated SCOPES, for mechanized formations. Both these use commercial off-the-shelf telescopes mounted on weapons, and numbered placards on participant soldiers or vehicles: the power of the optics and the size of the numbers is so calculated that, when a firer can read a targeted number, the target is roughly within the range of the firer's weapon. Central to the training is an After Action Review in which lessons learned from the casualty assessment, or other tactical behavior germane to the outcome, are reinforced. Then another "battle" takes place to further reinforce individual and collective learning. In late 1975 and 1976, TRADOC was able to stage fairly large-scale REALTRAIN demonstrations in USAREUR, and some units there have used this training technology to great advantage.

ARA researchers have continued to test REALTRAIN against conventional training techniques, and have amassed evidence that engagement simulation is decisively superior. Thomas D. Scott of ARI, who participated in many REALTRAIN tests, in an article entitled "Tactical Training for Ground Combat Forces," (Armed Forces and Society, UNC Press, Vol. 6, No. 2, Winter 1980), presented these data, collected at several CONUS posts, comparing units trained with and without REALTRAIN; the "shoot-out" pitted latter against former:

Tactical Test Mission Outcomes

	Missions Accomplished				Casualty Exchange Ratios			
	REALTRAIN		Conventional		REALTRAIN		Conventional	
	Pretest (%)	Posttest (%)	Pretest (%)	Posttest (%)	Pretest (%)	Posttest (%)	Pretest (%)	Posttest (%)
Infantry Squads (n = 16)								
Attack	0	50	0	0	0.04	0.39	0.03	0.08
Defense	0	75	0	13	0.55	1.62	0.54	0.52
Shoot-out		74		26		1.54		0.64
Armor/Antiarmor (n = 8)								
Attack	25	75	25	0	0.04	0.41	0.08	0.05
Defense	25	50	0	25	0.28	0.90	0.16	0.60
Shoot-out		36		14		2.50		0.40
Overall: Pretest and Posttest	8	63	4	8	0.22	0.93	0.20	0.31

Percentage of Positive Scores on Measures of Infantry Squad Tactical Performance

	REALTRAIN		Conventional	
	Pretest	Posttest	Pretest	Posttest
Mutual Support	45.0	75.0	32.5	37.5
Protection & Observation	28.4	63.6	29.5	29.5
Control & Communication	44.6	35.7	50.0	39.3
Firepower & Tactics	33.9	37.5	33.9	25.0
Overall	36.3	76.3	35.8	32.1

Scott went on to say: "If the tactical proficiency of most small combat units is as poor as that of the test units, the degree of unpreparedness for combat has serious implications. Squads and platoons are the heart of the Army's conventional fighting capability, and without at least moderately proficient small units, larger units cannot be effective, regardless of how well equipped they are with modern weapons systems. Ill-prepared tactical units can only weaken the deterrent effect of US ground combat forces. As the data presented earlier have shown, engagement simulation training methods can provide one means for making much needed improvements in the proficiency of small combat units."

ARI and TRADOC have both trumpeted the good news about REALTRAIN with little success. Scott reports that "Company and higher-level commanders tend to indicate that they have considerable difficulty meeting the REALTRAIN support requirements, especially the requirements for exercise controllers... Commanders' comments suggest that they perceive REALTRAIN controllers as 'training overhead'...." Scott faults the Army for pushing into REALTRAIN too rapidly: "insufficient time was given to prepare trainers and training managers to use the system effectively..." And he evidently agrees with Lt. Gen. Ace Collins, who excoriated the Army for rushing into MILES:

"When REALTRAIN first appeared it was relatively inexpensive, easy to operate, and a boon to the most difficult of all training-- infantry training. REALTRAIN had hardly been tested and issued, on a most selective basis, when its proponents... were out promoting the second generation MILES. But was this progress?... Neither the schools nor the units had time to teach the chain of command how to get the most out of the first generation,... let alone be ready to utilize the second generation."

Scott concludes as follows:

"There is little doubt of the potential effectiveness of REALTRAIN or MILES as training tools. It is not REALTRAIN's effectiveness which has tended to be problematical, but rather its utilization in the training environment. If MILES is to become more successful than its predecessor, solutions must be sought in the training environment as well as in the system itself."

In the summer of 1978, the division cited above began using REALTRAIN for training and evaluating its armor and infantry platoons. QESO supervised post-training surveys established that participants--soldiers and leaders alike--valued engagement simulation more highly than any other type training, characterizing it as more meaningful even than live-fire evaluations. By the spring of 1979, the division was conducting company team versus company team engagement simulation, in which all organic or normally supporting direct and indirect weapons, EW assets and GSR were brought into play. After action reviews had become multi-tiered: non-leaders were excused following the general, all-participant discussion of weapon-effects, and the residual group focused on identifying NCO and junior officer problems. Finally, officers only met on tactics and command efficiency. Range firing evaluations for platoons continued, but were augmented by a "fire coordination exercise" (FCX) which trained and evaluated company team commanders in planning for and controlling direct and indirect fires on a 1/10 scale range. Attitudes toward REALTRAIN reportedly grew more affirmative as the interrelationships among full and reduced scale firing, battle simulation, and engagement simulation became more apparent to leaders.

But REALTRAIN found no such acceptance in CONUS. An ARI survey, conducted in April 1979, of attitudes toward engagement simulation in four FORSCOM divisions concluded that:

1. REALTRAIN is generally viewed in CONUS divisions as being a superior tactical training method. It is not much used because it is not required and because it is perceived as being "too resource intensive."

2. MILES is generally expected to be a more effective tactical training methods than REALTRAIN but is expected to be unusable in the real-world training environment.
3. MILES is generally expected to fail because of poor operational durability, maintenance requirements, logistics requirements, including storing, drawing, accountability, and security.

"The conclusions of this survey effort are that the expectation of MILES' failing will be a self-fulfilling prophecy."

In the fall of 1979, the European division tested MILES, furnishing units for the system's Operational Test III, during engagement simulation conducted in German countryside, on maneuver rights land. ARI surveys of OT III participants showed a clear preference for MILES over REALTRAIN and conventional tactical training:

% Respondents Marking MILES "Better"

<u>MILES</u> versus	Infantry			Armor			TOTAL
	EN	NCO	OFF	EN	NCO	OFF	
Conventional Tactical Tng.	76.8	95.7	100	64.7	88.1	100	78.9
REALTRAIN	73.0	91.7	100	75.4	88.4	100	79.5

The table on comparisons with live-fire is worth reproducing in its entirety:

MILES Versus Conventional Live-Fire Tactical Training: Players

RESPONSE	% RESPONDENTS						Total
	<u>Infantry</u>			<u>Armor</u>			
	<u>EN</u>	<u>NCO</u>	<u>OFF</u>	<u>EN</u>	<u>NCO</u>	<u>OFF</u>	
Don't Know	15.7%	4.5%	0.0%	11.3%	14.3%	0.0%	12.6%
Worse	11.2%	9.1%	0.0%	20.8%	38.1%	66.7%	19.1%
Same	20.2%	18.2%	0.0%	34.0%	16.7%	33.3%	22.3%
Better	52.8%	68.2%	100.0%	34.0%	31.0%	0.0%	46.0%

Note. Entries are the percents of players, by rank, in Infantry (n = 117), Armor (n = 98), and all units combined (n = 215) in MILES exercises selecting each response alternative to this questionnaire item: "Compare the tactical training you got with MILES with the training you usually get in: Conventional training with live-fire."

Note that armor participants were significantly less enthusiastic about MILES vis-a-vis live-fire. Subsequent inquiry disclosed that the tankers were "turned off" by the fact that MILES, since it fired point blank, obviated ranging, lead, burst-on-target, and other gunnery techniques; and that MILES could not penetrate foliage. Nonetheless, three out of four tankers rated MILES as good as live-fire, or better, for training to hit either moving or stationary targets:

MILES Versus Live-Fire Training For Still Targets: Players

RESPONSES	% RESPONDENTS					
	Infantry Units		Armor Units			Total
	Inf MOS	Other MOS	Inf MOS	Arm MOS	Other MOS	
Much Less	1.7%	0.0%	0.0%	4.2%	10.0%	3.1%
Little Less	5.9%	0.0%	0.0%	10.5%	20.0%	8.4%
Same	23.7%	0.0%	100.0%	37.9%	20.0%	29.6%
Little More	18.6%	50.0%	0.0%	20.0%	20.0%	19.5%
Much More	50.0%	50.0%	0.0%	27.4%	30.0%	39.4%

Note: Entries are the percents of players, by MOS, in Infantry Units (n = 120), Armor Units (n = 106), and both types of units combined (n = 226) in MILES exercises selecting each response alternative to this questionnaire item: "In comparison with live-fire training how much did training with MILES prepare you to hit: still targets?"

MILES Versus Live-Fire Training For Moving Targets: Players

RESPONSES	% RESPONDENTS					
	<u>Infantry Units</u>		<u>Armor Units</u>			<u>Total</u>
	Inf MOS	Other MOS	Inf MOS	Arm MOS	Other MOS	
Much Less	3.3%	0.0%	0.0%	6.2%	20.0%	5.2%
Little Less	8.1%	0.0%	0.0%	18.6%	20.0%	12.9%
Same	17.1%	0.0%	0.0%	30.9%	10.0%	22.3%
Little More	24.4%	50.0%	100.0%	21.6%	0.0%	22.7%
Much More	47.2%	50.0%	0.0%	22.7%	50.0%	36.9%

Note: Entries are the percents of players, by MOS, in Infantry Units (n = 125), Armor Units (n = 108), and both types of units combined (n = 233) in MILES exercises selecting each response alternative to this questionnaire item: "In comparison with live-fire training, how much did training with MILES prepare you to hit: moving targets?"

Participants in OT III were asked how often breakdowns of MILES equipment interfered with training, 54% said "never," 19% "once," 20% "a few times," 3% "many times."

OT III materiel reliability data for MILES components also confounded the CONUS prophecies and showed only two components, for M60 MG and VIPER, failing to meet or exceed design reliability criteria in terms of mission mean time between failures (MTBF).

<u>Component</u>	<u>Reliability and Cost</u>		
	<u>Avg Cost Per Wpn (\$)</u>	<u>OT III Mission MTBF (hrs.)</u>	<u>Criterion (hrs.)</u>
M-16A1	1,485	678	400
M-60 MG	694	691	800
DRAGON	1,335	4,713	800
TOW	7,147	809	350
Tank M-60A1	6,969	654	350
VIPER	1,618	590	800

The division, in its report on MILES following OT III, stated that:

"The Multiple Integrated Laser Engagement System (MILES) provides commanders with a greatly enhanced tactical training capability (particularly with respect to combined arms operations) and meets an existing critical training support requirement. Moreover, it appears to have considerable potential to effectively augment tank gunnery and small arms marksmanship sustainment training... .

"The system involves (1) the planning, support and execution of a two-sided free play tactical exercise utilizing laser devices to obtain realistic casualty effects, (2) an After Action Review (AAR) during which tactical mistakes or omissions are highlighted and solutions identified, and (3) multiple repetitions of tactical exercises and AARs to permit the application of new skills, the identification of new mistakes and the correction thereof. Each of the three components of the system is equally important....

"The actions and reactions of the leaders and individual soldiers resembled seasoned combat soldiers who had learned their lessons on the battlefield. Most important, each participant benefited. Individual soldiers were not merely training aids for junior leaders as so often happens during traditional field exercises. The training was also earmarked by tremendous enthusiasm on the part of each participant. The two-sided nature of the exercise coupled with the knowledge by each soldier that he would "live" or "die" as a result of his unique individual actions, appealed strongly to the basic competitive instinct of the American soldier. The verisimilitude of the system is such that the techniques our soldiers mastered to "win" during a MILES exercise are

identical to those required for them to win on the battlefield...

The value of the MILES goes far beyond tactical proficiency. Our observations indicated that it enhanced individual motivation, job satisfaction and unit morale. The secondary effect of this phenomena resulted in improved maintenance and weapons proficiency; the soldiers wanted their equipment to work so they could get out to the MILES training. After nearly 100 days in the field, the units which participated in OT III had operational readiness rates above 95% and the reliability of their weapons was significantly improved. There also appears to be considerable potential for the use of MILES as a gunnery trainer. The laser alignment (zeroing) device for the M16 rifle may well provide as effective a zero as obtained on many of the modified zeroing ranges currently employed in USAREUR. This would provide a tremendous benefit to the commanders of many of our isolated units. The small arms laser systems also provide a capability for training on flank engagements and multiple target engagements which is in many ways superior to that gained during live fire exercises due to restricted range fans. This is a particularly beneficial aspect of MILES in USAREUR in view of the LTA/MTA configuration which delimits our access to live fire ranges. Even in their current configuration, MILES devices make a direct contribution to tank gunnery skills. This capability will further improve as high velocity rounds and full solution fire control systems are introduced into the inventory. Moreover, MILES is capable of supporting aspects of tank gunnery which are currently extremely difficult, prohibitively expensive, or impossible with

service ammunition -- target detection, multiple target engagements, flank engagements and sustainment of gunnery proficiency in local training areas. The implication of this to current tank platoon gunnery tables is extremely interesting. Since the primary difference between crew and platoon gunnery is the command, control and coordination required at the platoon level, it may be possible to design more realistic tables to test these skills with MILES devices than with service ammunition. A MILES supported table would permit access to more challenging terrain, permit realistic flank engagements, and permit the platoon to encounter a broader spectrum of "enemy" situations as range fan or ammunition constraints need not be considered. Furthermore, the platoons could probably conduct more repetitions in the same amount of time because "dry" practice runs and extensive safety briefings would not be required. At locations such as (German MTA), where opportunities for night service firing are extremely limited, it would permit us to "fire" seven nights a week... .

" MILES offers many advantages over alternative training systems. It is superior to live fire exercises in that the participants are forced to react against an aggressive and intelligent opponent rather than cardboard targets; superior to traditional field exercises with respect to the detail and timeliness of the feedback it provides; and superior to REALTRAIN with respect to the fidelity of its feedback. The most exciting new capability it provides us is its ability to support night engagement simulation exercises. Within the next year, many of our maneuver battalions will possess over four hundred sophisticated night vision devices. We consider MILES essential to fully capitalize on

the potential these devices provide us for conducting night combat operations. MILES is also clearly superior to other tactical training systems with respect to the degree of personal involvement it provides each participant. This is particularly noticeable during TM/TF level exercises. Many individual soldiers often get little training value from exercises at these levels when traditional training systems are employed. During MILES exercises they receive immediate feedback with respect to their individual actions and quickly sense that their individual actions contribute directly to the success or failure of the TM/TF. MILES is thus the capstone of the multi-echelon training process....

"The utilization of MILES in USAREUR poses unique problems in that we do not have large on-post maneuver areas. The facilities we do have, however, are deemed adequate if properly managed. Many of our local training areas provide adequate maneuver areas for small unit MILES training. These are also the locations where we would gain the greatest benefit from secondary applications of MILES for gunnery and marksmanship training, particularly in concert with passive and thermal night sights. We gained considerable experience during OT III with the employment of MILES in the Maneuver Rights Areas (local German countryside). Thorough preparation was the key to our success in the MRAs. We conducted a detailed ground reconnaissance prior to OT III to select areas which presented minimum opportunities for maneuver damage -- no nurseries, few cultivated fields, sparse population, and so on. Furthermore, we selected sufficient alternative sites so that the exercise could be rapidly shifted to a new location if one particular area became overused.

Thorough and continuing coordination was conducted with the local officials to rapidly identify and repair maneuver damage. Special engineer teams were assigned to this task on a full time basis. We were delighted to learn that the MILES system itself assists in reducing opportunities for maneuver damage in that it "rewards" units for staying out of open, cultivated fields and off main roads. We are comfortable that with adequate preparation we can utilize MILES to a considerable extent in the MRAs; far more than we originally envisioned. The major limiting factors on MRA utilization are the fact that they cannot be fully utilized during the summer prior to the time that the crops are harvested, cannot be used during periods of extensive rain, and cannot fully support mounted night operations. Our Major Training Areas provide us with our best opportunity to conduct unrestricted MILES exercises. However, they are expensive to get to and must support gunnery training in addition to tactical exercises. Their greatest contribution will be in the support of TF level and night operations. While we do face severe maneuver constraints which are magnified by the intensity of MILES exercises, we are confident that through proper management adequate maneuver space can be made available to support MILES exercises. Our greatest concern with regard to the USAREUR environment is that adequate maintenance support be provided to maintain brigade packages of equipment at widely scattered locations. This is essential if we are to obtain maximum simultaneous benefits from our limited LTA, MRA, and MTA resources...

This USAREUR division, with broader experience with engagement simulation than any division in the Army, and with extensive live-firing under its belt, sees in MILES not only better training, but new opportunity:

- To train at night with passive and thermal sights against realistic targets.
- To extend range "firing" times at night and weekends beyond the German noise-imposed curfews at MTA.
- To train on farmland or at home station in ways never before possible.
- To reward tactics of engaging from flank or rear.

Moreover, the division seems convinced that, in re $E = f(W, P, T)$, MILES indeed operates on both P and T. It expresses a clear preference for training and evaluating with MILES close to home, as opposed to railroading to a US MTA for dubiously realistic live-fire drills in frontal engagement of flat, cold targets.

Ranges and targets for conventional style live-fire training are increasingly anachronistic. As weapon system capabilities have grown, it has been increasingly difficult and expensive to set aside land for ranges and to build the customary hard stands, roads, firing pads, drainage systems, latrines, and range control towers, or to install targets, power and communication lines, and range markers and signs. It is even more difficult to meet the outcry of environmentalists over diversion or "contamination" of land for ranges or impact areas. Or having invested in ranges, commanders often fail to use them efficiently under the constraints imposed by environmentalists concerned for noise pollution, flora or fauna. MILES offers a capability to train safely against either moving or stationary targets, under low-noise

conditions, without having to dedicate land, contaminate an impact area, close roads, or expend military construction funds. In seeking funds for MILES, DA and MACOM should examine cost avoidance--the target procurement and range construction funds which MILES might obviate.

MILES itself has growth potential, largely unrealized. Although the original concept encompassed a MILES component for every weapon which could figure in combat on the FEBA, including ground-to-air and air-to-ground systems, the present program is limited, and even obsolescent. It is difficult to understand why Army aviators, given their extensive difficulties in training attack helicopter crews, have not demanded MILES equipment for Cobra and AAH. For example, they could have, for an investment relatively slight compared to costs of even one of their elaborate institutional simulators, bought MILES Zsu 23-4 simulators, complete with "radar", against which to perfect "pop-up" engagement technique. And, air defenders must appreciate that however well trained in launch technique the REDEYE or STINGER gunner may be, some of the more difficult undertakings of command and control can only be trained in the context of combined arms field exercises involving both friendly and "enemy" air. The Army should require each project manager of a developing weapon system to fund development of a MILES component. We are overlate in getting started on many, such as COPPERHEAD, STINGER, extended range TOW, which will figure importantly in company team tactics.

When years ago TRADOC laid down its guidelines to MILES developers, it foreclosed "selling" MILES, in whole or in any part, for gunnery training.

MILES was to be justified solely on its own merits as enabling superior training technology, and not in any sense traded off against ammunition procurement. Yet, there seems to be a prima facie case that MILES, at least partially, obviates expenditure of conventional ordnance--e.g., the divisional VIPER TEO cited above. Moreover, TRADOC guidance was that MILES was to "stand alone" for maintenance, preferably via contractual, non-military maintenance support. That guidance is no longer appropriate. It makes MILES too expensive. Procurement shortfalls seem to be so extensive that unless MACOM are willing to cooperate with DA to capitalize MILES, both by adjustment of O&M programs and by procurement of training projectiles, the prospects are that MILES will die in its infancy. It is surely anemic now.

Proposal 5: Develop school-unit communications for support of training, evaluation, and maintenance.

Among the more formidable problems facing the Army as it modernizes is that of training the soldiers and leaders in units to which new equipment is being delivered. One of the brigade commanders cited above wrote in 1980 about this difficulty as follows:

"I was particularly struck last night with the incredible velocity of force modernization and what it portends for units, and even more importantly, for leaders of units. Standing in the darkened tower (on a tank range in Germany) wearing night vision PVS-5 goggles, I witnessed a platoon battlerun with M60A3 tanks conducted without external illumination against (automatic radio controlled) targets. As the targets were presented, gunners lased -- clearly visible through my goggles -- and then engaged with the main gun. The scene was not unlike a clip from the movie Star Wars... (We have to bridge) the present knowledge gap, not only for O-5s and up, but for all ranks who, for whatever reason, are away from troops today. This gap will continue to widen dramatically as modernization further accelerates with the fielding (of the oncoming weapon systems). The result will be an interactive battlefield, of unprecedented lethality, where night and day operations merge, and effective around-the-clock-combat (will be) a reality. Unfortunately, senior leaders may be misled by the statistical siren song, becoming focused on the added stresses placed upon the support structure (and dealing with numerical indicators of efficient materiel management)... while important to a Commander. (materiel management) is no match for his becoming personally involved in

understanding how to maximize $E = f(W,P,T)$. New equipment Training Teams, markedly better than in the past, are still falling far short of what we need. NETTs focus heavily on W, provide only bare bones for P, and virtually zero for T. Handout materials -- almost exclusively paper based -- routinely consist of (draft maintenance publications). What we need are 3/4" TV tapes, TEC tapes, (etc.), all developed from individual and collective Tasks/Conditions/Standards based software. . . Training and Evaluation Outlines should also be provided so that individual and collective Tasks, Conditions, and Standards can be integrated into unit training from day #1, with accompanying tips for trainers, and identification of support and ammunition requirements."

The Army deserves some credit for having anticipated the Colonel's needs. In 1971, the Chief of Staff, General William C. Westmoreland, convened a board of officers to examine the state of training in units. One of the conclusions of that board highlighted the importance of the service schools for solving Army modernization problems: the staff and faculties of the schools, one of the Army's traditional strengths were presumed to have the expertise, the time, and the equipment to learn how to optimize E with incoming equipment. General Westmoreland, acting on the recommendations of his training board, launched a broadly-based effort to upgrade the ability of schools to assist trainers in units, to communicate into units what the schools know about W,P, and T. This assistance has taken the form of more and better manuals and correspondence courses, but also, importantly, the Training Extension Courses (TEC), a multi-million dollar project which tapped advanced instructional technology and multi-media presentation technique.

Since the mid-1970s, both TRADOC and DARCOM have moved cooperatively to assist unit trainers by upgrading and amplifying the kind and amount of instructional material positioned in units. For example, over the past five years, the Artillery School at Fort Sill, to train soldiers of MOS 13E (Cannon Fire Direction Specialist), has produced and sent to artillery units 46 manuals, 30 correspondence courses, 72 training films, and 160 TEC lessons. Obviously as new artillery materiel enters the force -- TACFIRE, COPPERHEAD, artillery-delivered mines, etc. -- Fire Direction Specialists will have to be trained to use the new equipment, and Fort Sill will have to modify its existing products or issue new ones. Yet 13E production at Fort Sill is but a small part of TRADOC's undertaking, which extends across hundreds of MOS and embraces both active and Reserve Components. In 1979, TRADOC produced about 20,000 separate "training products;" it is programmed to produce some 50,000 in 1983. DARCOM is experiencing a similar strain. Providing technical documentation for novel, complex equipment, targeted on mechanics of the "Johnny can't read or won't read" generation has thus far required issuing evermore voluminous manuals. For example, when the XM-1 tank is issued in USAREUR, 24 linear shelf feet of Skill Performance Aids (SPAS) will accompany the vehicle.

There are those who react to these data by insisting that the Army cut-back production, "discipline the system." But to attempt to do so would be to operate on the inexorable, for a modernizing Army is critically dependent on an assured flow of authoritative information to underwrite the individual training of soldiers and leaders. That information must go where the soldiers are--into the units--and must be accessible when and where they need it.

The answer lies not in constraining the amount of information, but on choosing a more compact form for transmitting information to units, and for storing and retrieving information for soldier use there.

Books--Soldiers Manuals, Field Manuals, SPAS--are the least efficient way to transmit, store, or retrieve information. Microfiche, referring to miniture photographic transparencies, is better. But a more promising technology is videodisc, referring to a phonograph record-like accumulation of video signals.

INFORMATION DENSITY

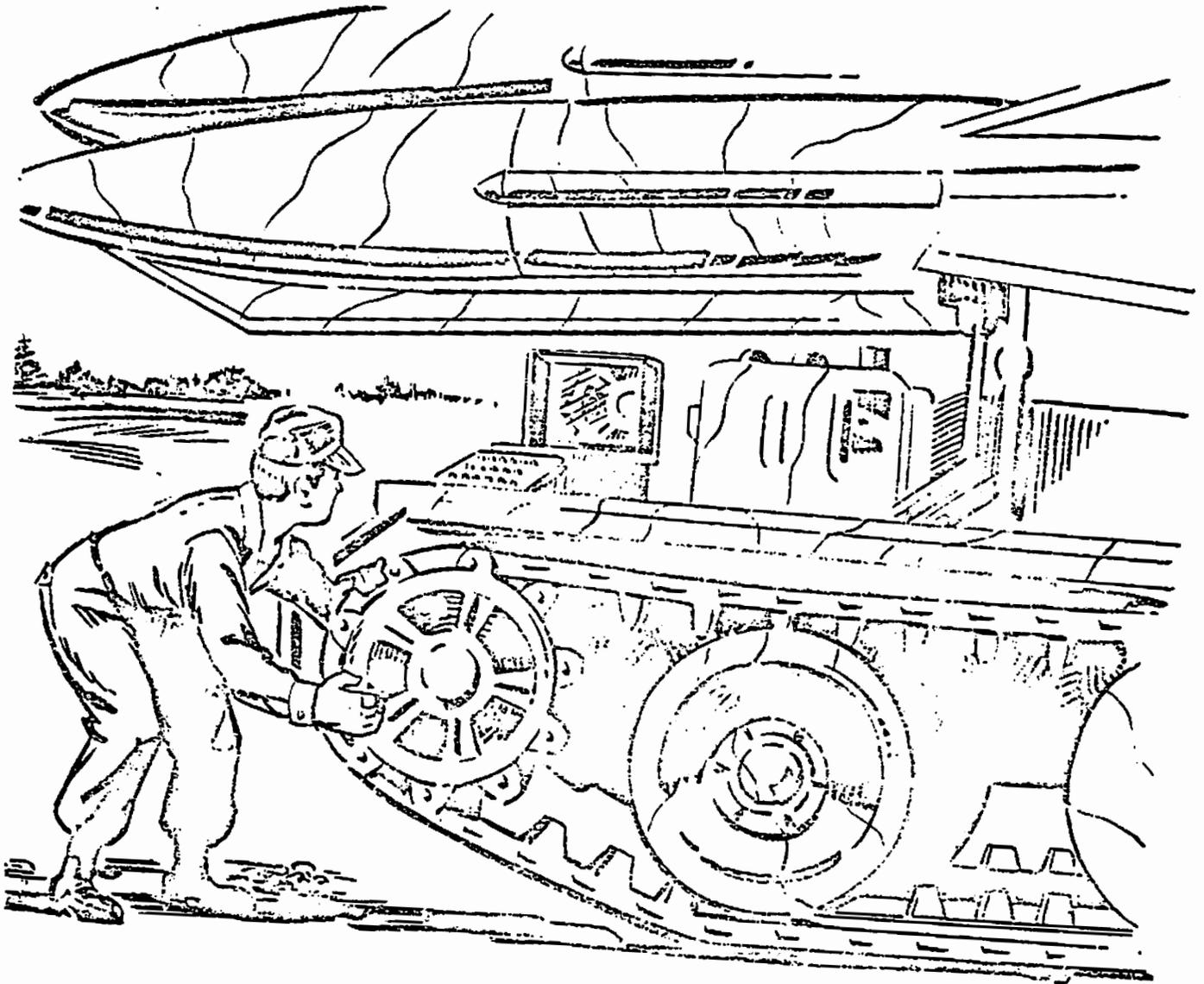
1 Book Page	32 k BITS
1 Microfiche	3,000 k BITS
1 Videodisc	20,000,000 k BITS

Videodisc is more compact and less expensive than microfiche or computer disc or tape:

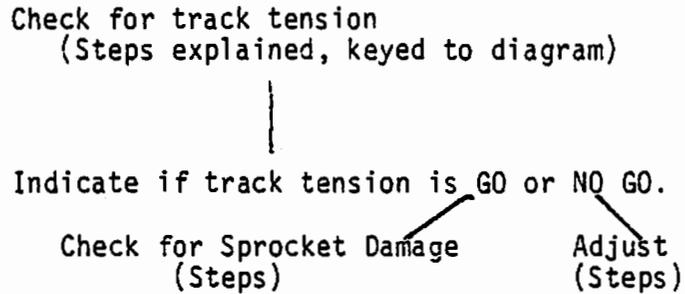
	MAGNETIC DISC	COMPUTER TAPE	MAGNETIC TAPE	MICROFICHE	VIDEODISC
10 ¹¹ BITS Storage	80 Disc-Packs	90 tapes	2,400 ft. of 2" tape	200 fiche 4" x 6"	1 disc 12" diameter
Cost 10 ¹¹ BITS	\$40,000	\$1,350	\$100	\$ 60	\$ 10

The entire 24 feet of XM-1 tank SPAS could be stored on the 4 sides of 2 videodiscs, each the size of a long-playing phono record. Since each page, or frame, has a digital index, it can be individually addressed; any specific "page" could be found in seconds.

Ah, the skeptic will say, this means a TV set in the motor park. And, of course, that's right. But one Army lab is already experimenting with a solid-state, thin, flat TV screen, and the videodisc playback equipment is also potentially compact and rugged. The end product might look like a mechanics tool box, and might be as indispensable.



Because of the digital "page-numbers," this form of SPAS could perform branching diagnostic routines with the soldier:



At each step the soldier would be shown a picture; he would tell the machine when he was ready to proceed, and could interact with the machine to determine the "branches" he should pursue. For some weapon systems, the SPAS storage/presentation might be built-in.

Of course, portable equipment like the one depicted could supplant the present TEC projectors and videotape players in unit Learning Resource Centers, could provide the Orderly Room its set of Army Regulations, the Supply Room or S-4 Section its stocklists, and otherwise eliminate almost all books, pamphlets or papers in the unit, either for peace or war. The videodisc themselves might be of light metal, or of photographic film embedded in plastic. The latter would be advantageous, because reproduction would be easy and inexpensive. Here is one visualization of the possibilities:

1980-1985

**DESK-TOP
INTELLIGENT
VIDEODISC
SYSTEM**



1985-1990

**PORTABLE
INTELLIGENT
VIDEODISC
SYSTEM**



1990-1995

**HAND-HELD
ELECTRONIC
TABLET**



The hand-held electronic tablet shown above would be the lineal descendent of today's pocket calculator, which uses fingernail size silicon chips with integrated circuits. A typical chip today stores 64K BITS, but by 1990, chips storing 500 times as much are in prospect, and chips in the "electronic tablet" might contain the whole XM-1 SPAS, or the entire output of Fort Sill for MOS 13E.

If battle simulation and engagement simulation are near future technologies, videodisc is probably best understood as a mid-range, circa 1986 technology. Up to 1980, the Army has more or less lain back, expecting commercial interests to advance the state of the art. Such an approach is no longer wise. We need videodisc and solid-state displays, and we need them urgently, even if we have to drive development. In the long run, R&D funds for advanced school-to-unit communications may be one of the wisest investments in modernization open to us today.

Such R&D should also explore how better to communicate from units to school. The Army of 1980 is unlike the force studied by General Westmoreland's board in the early 1970's, when the Service schools were clearly conceptually ahead of units. The Service schools of today have more missions, less resources, and have assigned fewer of the Army's best and brightest officers and NCO's. Moreover, items of new equipment often have capabilities which transcend the usual purview of a school, or which are recognized and capitalized upon by units before the school-system is even aware of them. For example, the Colonel quoted above found that the Improved Tow Vehicle, with its thermal sight, proved to be tactically much more important

to the unit than what the ITV NETT represented it to be--not just a better anti-armor weapon, but:

"Clearly, it is equally vital to the Intelligence System since discrimination between friend and foe is absolutely possible using the unique thermal signature of each vehicle type. Thermal will become the workhorse for such operations as passage of lines, screening of flanks, etc. The training challenge is to develop individual and collective tasks/conditions/standards for such tasks as extended ITV employment by pairs to systematically scan areas. N.B. During REAL TRAIN last week, the thermal sight in daylight hours worked effectively 30-40 meters deep in woodlines and often was the first means of detecting the "enemy."

"In addition, the thermal sight has a role to play in the Indirect Fire System and has already successfully adjusted fire."

"The ITV is also being employed in the Direct Fire System, in conjunction with the M60A3 aided by the PP-5 GSR and plotting board, to permit direct fire tank engagements during limited visibility. As you know, thermal employs Mid-IR, and TOW is tied to Near-IR, creating a detection-engagement gap which can partially be filled now by the tank main gun."

"The NETT, while improved over past efforts, did not explore the above capabilities..."

Moreover, the Colonel is convinced that his unit has found out how to train and evaluate key leaders in the tactical employment of new systems, via the Fire Coordination Exercise (FCX) and engagement simulation:

"(In the FCX) the team commander builds cohesion on a 1/10 scale representative battlefield. Here he and his leaders are tested on direct fire, indirect fire integration, fire control, communications, working thru smoke while under chemical and artillery attack. It is extremely realistic, stressful and fatiguing and of such training value that in viewing an FCX After-Action Review one could easily conclude that the action discussed was a full-up live fire exercise. The FCX may also be done at home station."

"The capstone follow-on to the FCX is REALTRAIN where the team commander employs all of his elements in a two sided free maneuver which is the closest we can come to actual combat at this point. What we urgently need for our modern battlefield is MILES where equipment and men can train as they will fight around the clock. My greatest concern is that we must be able to practice effectively at night with the tools at or soon to be at hand. To do this in any coherent fashion cries out for MILES."

TRADOC, aware that its training technology, in some respects at least, lags that in use in some units, has lately emphasized the importance of "feedback." But by this it has often implied a statistical roll-up of ARTEP evaluations, which units are reluctant to provide as much out of conviction that the numbers would be meaningless (lacking understanding of the unit's training methods and the conditions under its evaluations proceeded,) as out of any reluctance to expose shortcomings. And more lengthy written reports for a school describing training or evaluation are not easy for most units to put together, preoccupied as they are with their own mission. On the other hand, most units welcome visitors from the schools, are comfortable with having school or ARI observers at their evaluations, and cheerfully brief their training program, past, present, or future, on request. Since TRADOC is unlikely to obtain resources to monitor by visit all modernizing units, the Army must reach through R&D for communications mechanisms which will permit TRADOC to tap the techniques and ideas in units by means of surrogate visits: some form of teleconferencing, appropriately secure, and capable of graphic transmission and interaction, which could link TRADOC's training developers (and combat developers) with unit training managers like the Colonel quoted above. TRADOC schools need to see and hear frequently what is happening in the units where modernization is not a futurity, not an abstraction, but the main-line work of the force.

But improving school-unit communications is only the most obvious training technology challenge for Army research and development. Battle simulation, engagement simulation, TEC were products of R&D of the early-mid 1970's, the outcome of hard choices to dedicate to the task capable young officers of TRADOC's Combat Arms Training Board, to muster the resources of the Army Research Institute, and to mobilize the energies of the DARCOM for the mission. The decade of the 70's was a period of vigorous growth in Army training technology--the Army has seen nothing like it since World War II. But there is still much we need to discover about training. While we can say that we have opened the frontier of collective training, we plainly have much exploration ahead before we will be able to approach confidently devising a training subsystem for bold-leap materiel like ASSAULT BREAKER. Do the leaders of today's Army have the foresight to invest today in the R&D which will meet for tomorrow's training challenges? Or will they squeeze inquiry into advanced training technology out of constrained R&D budgets, hoping that new materiel will somehow be assimilated into units? The answer will be of profound significance to the Army, and conceivably, to the nation.