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11 November 1986
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General Carl Vuono
Commander
U.S. Army Training and Doctrine Command
Fort Monroe, VA 23651

Dear Carl:

When we last talked, I told you that I was trying to get some thoughts on paper. The results are inclosed.

I have shared these ideas with Ben Covington of the Army Training Board, and Jim Allen of ODCSOPS, DA.

I'd be glad to come down for a further discussion. At your call, sir.

Regards,

Paul F. Gorman

KK30

SOME THOUGHTS ON ARMY TRAINING

for

General Carl Vuono, Commander, TRADOC

from

P. F. Gorman, Cardinal Point

ANNEX A ITEWTALB 86c BDM_ITEWTALB SEP

ANNEX B C³AT 86d BDM_C3AT30FT

An Incoherent Training System

A century ago, the Army was wrestling its way toward a new definition of purpose, fettered conceptually by its experiences in the Civil War and on the western frontier. Emory Upton and others were drawing invidious comparisons between the U.S. Army, spread in its tiny garrisons along the coasts and across the plains, and the armies of Europe, particularly the German victors of the Franco-Prussian War, able to mobilize hundreds of thousands of troops in days, and to maneuver and support field armies with less effort than Americans expended on turning out a few troops and companies for an expedition against an Indian band. Our army which in the '50's and '60's had aped French military dress and terminology, had in the '70's adopted the Pickelhaube for its full dress helmet, and encouraged its officers to participate in Kriegspiel. Fortress Monroe, the Artillery School, was one center of this intellectual discontent with status quo, there being active there a service journal which argued for concentrating the army and training it to fight in large formations, and an officers' club devoted to playing Livermore's war-game based on data from American combats of 1861-1865.

One can draw distinct parallels between that army of one hundred years ago and the army of today which go well beyond the latter's "Fritz" helmet. Strategically, the main issues in both epochs relate to the Army's stationing plan and its training methods. Now as then, there is concern over whether we can prepare senior officers to handle large formations afield, and interest in an advanced form of Kriegspiel as a means to that end. There is doubt that we can mobilize the land forces required for national security. And Fortress Monroe, now as then, is central to the debate. When TRADOC came into being at Fortress Monroe in the early 1970's one of its purposes was to free the Army from the encumberances of the Vietnam era, and to redirect its energies toward the future. And they who put TRADOC together, and who led it in its early years, plainly intended that it serve as the Army's intellectual arsenal --needed now as never before.

Of course, there is no comparing the position and prerogative of the present Commander at Fortress Monroe with his nineteenth century predecessor. He who today commands the U.S. Army Training and Doctrine Command has broad purview over the Army's concept of itself --its mission, its organizations and its materiel. He has at his disposal the Army's Schools and Training Centers, powerful instruments for creating that concensus within the Army as a whole which is the stuff of doctrine. Two concepts from TRADOC's beginnings seem particularly germane to his current problems:

> **Training Developments** is a discipline comparable to that of **Combat developments**, deserving no less command emphasis.
>
> **Evaluation** is important to insure accountability, and thus efficiency, in training, just as is testing in materiel development.

But the new Commander, TRADOC, inherits an organization within which

Training Developers and Training Evaluators --once separately identified, trained and resourced-- have been dispersed, and protagonists for their arts obscured. And where once TRADOC's Deputy Chief of Staff for Training influenced all training, Army-wide, and weighed-in on proposed new doctrine, weapon systems, and structural reforms as a peer of its Deputy Chief of Staff for Combat Developments, the present DCST serves as operations officer of the training base. Decisions taken in years past to decentralize TRADOC, to enhance the role of the Commandants of TRADOC's service schools, and of other subordinate commanders, have, in the absence of strong policy guidance from Fortress Monroe, led to divergences among the several schools and centers severely disfunctional for current AirLand Battle doctrine.

Aside from the Chief of Staff of the Army, and the Vice Chief of Staff, only Commander, TRADOC, has the clout to act upon the Army's training as a whole. Properly, the Department of the Army General Staff divides responsibility for training, e.g., among the Deputy Chief of Staff for Operations and Plans --who has a directorate charged with training policy, including matters pertaining to training ammunition and simulators--, the Deputy Chief of Staff for Personnel --who is chartered to control personnel evaluation and manage careers, exercise proponency for leadership, and govern the Army's "training laboratory," the U.S. Army Research Institute for the Social and Behavioral Sciences--, and the Deputy Chief of Staff for Research Development and Acquisition, who deals with the training subsystems of developing weapons. Four star commanders of the Army other than CG, TRADOC, have regional or other parochial responsibilities which give them a purview over training narrower than his.

That Commander, TRADOC, needs to exercise his clout is evident. The Army, for the foreseeable future, will be in a resource-bind, facing new imperatives to insure that every manpower space and dollar, every item of equipment or round of ammunition, invested in training is efficiently used toward readiness for battle, and that the Army is in a position to show critics that this is the case. But at present there is no such coherence:

-- The propensity within TRADOC is to look for more, not less, institutional training, to propose more student-time and faculty augmentations, resources which it can acquire only at the expense of units. See Appendix 1, Army Training: A Construct.

-- The Army has substantially decoupled evaluations of individual training within units from the overall personnel evaluation system, and has not provided a system for accounting otherwise for individual training in units. Unit commanders confront discontinuities in TRADOC's training publications, and incongruities between these and other directives and guidance they receive. For example, units at the National Training Center are evaluated by, and critiqued against criteria different from both the pertinent Training and Evaluation Outlines (T&EO) of the Army Training and Evaluation Plan (ARTEP), and the ARTEP Mission Evaluation Plan (AMTP). There has been no easy path, or crosswalk,

between an NTC evaluation and the TRADOC documents. Moreover, the consistency among ARTEP and AMTP varies from type-unit to unit. Each TRADOC school offers a different approach in its documentation, and some differences are evident within a given school.

-- Training managers march to different drummers all over the Army. For example, a Bradley battalion commander might elect to plan his weapon training on Department of the Army Circular 350-85-4, Standards in Weapons Training, but if he does, he could be surprised to discover that the guidance from ODCSOP, DA, in the forthcoming Battalion Level Training Model, prescribes a different mix of training events in relating the tempo of his training to his readiness objective. Neither would be tied back to either the ARTEP or the AMTP.

-- Combat developers do not understand the strong trend toward convergence of their sphere with that of Training Developers, and most therefore fail to take advantage of training as a way to refine materiel requirements. The thrust of the President's Blue Ribbon Commission on Defense Management (Packard Commission) toward "early prototyping" is to point, for a prototype can be understood as a simulator of the eventual system fielded to ascertain, among other things, implications of the man-machine interfaces. And all the Army's experience with automating C³I would indicate that an early approximation put into the hands of commanders and staffs for their use in training can produce new insights into requirements, and underwrite evolutionary development. The use of battle simulations is now common enough in the Army that it should mandate provisions for including data on prospective weapon systems in precursor command post exercises with troops both for training and to afford combat developers an understanding of tactical applications. And the day is coming when it will be possible to reconfigure prototypes within hours to accomodate new concepts and subsystems, which can be put promptly to troop test.

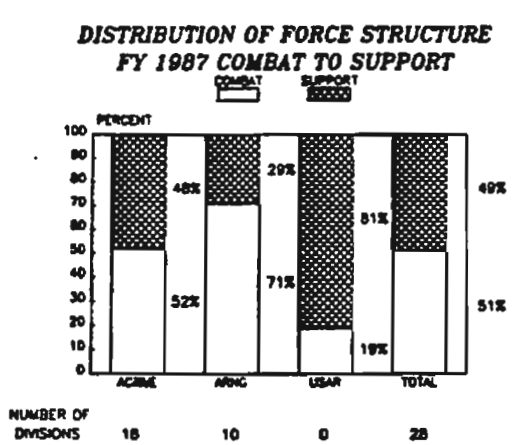
-- Even more damning is the apparent lack of coordination among funded initiatives for training, such as the Electronic Information Delivery System (EIDS), which will not be related to the Integrated Training Management System (ITMS). And ITMS has no interface with SIMNET, and for lack of the aforementioned difficulty in translating NTC into ARTEP/AMTP, no assured input from the ungraded National Training Center instrumentation, nor the Joint Readiness Training Center. Nor does ITMS take into account either its possible use in battle simulation or instrumented tactical exercises without troops, or possible relationships to the contemplated Army Integrated Printing and Publishing Service, or the Comuter Aided Logistic System. See Appendix 2, The Information Explosion.

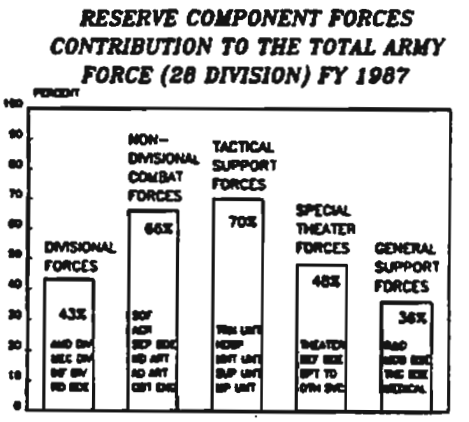
In all the foregoing respects, at least, the intervention of the Commander, TRADOC, is required if there is to be coherence in Army training. Proposals for action will be be presented below.

A Lack of Cohesion

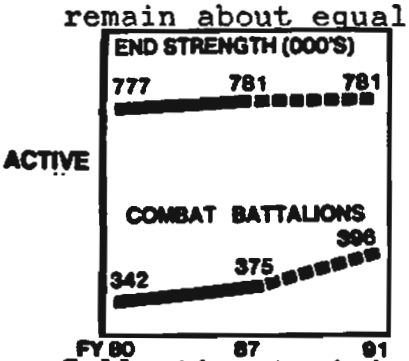
The United States Army consists of four bodies of volunteers: the Active Component, and the three distinct entitites within the Reserve Components: the National Guard, the Selected Reserve, and the Individual Ready Reserve. A system for training these, with their disparate circumstances of available time, facilities, and other resources, has to take into account their role in any prospective mobilization, and provide as well as possible for the fielding of combat-effective units which are both cohesive and sustainable in wartime.

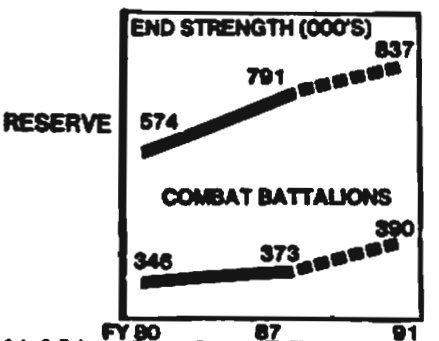
The Army is becoming ever more dependent upon the Reserve Components. Within the Total Army force structure, the RC now provide 49% of strength, including 43% of divisional (combat) forces, 66% of the non-divisional combat forces, and 70% of combat service support elements.





Active strength is projected to remain constant. RC strength will rise. Numbers of combat battalions manned by the AC and RC will remain about equal:





Collective training is inherently difficult for RC combat battalions. Compared with the Active Component counterparts, they have only 1/9th the amount of time available each year to conduct training, and some of that is consumed with movement and other administration. RC battalions are quite likely to produce well trained individuals, crews, and even platoons. But their readiness as battalions and brigades is bound to suffer.

The Army's recent experience with COHORT (Cohesion, Operational Readiness, Training) in the Active Army is instructive, and deserves wider application to the Reserve Components. In particular, exploitation of the Combat Arms Regimental System (CARS) as a focus for unit loyalties, and the use of platoon as the basic unit for overseas replacement suggests some different approaches to Reserve Component organization and unit training.

Plans for using the RC in wartime should also anticipate individual replacement requirements. Some positions are more vulnerable than others, and losses in these predictably higher. For example, casualties within tank crews tend to be a function of height and exposure, so that drivers and tank commanders are more likely to be hit than the loader or gunner. While cross-training within crews can offset many such losses, it may be feasible to create a pool of replacements for critical, high-loss positions, possibly from reservists who are both experienced and trained for currency. But this will require a system of individual records considerably more flexible than that available now, both for peace and war.

Sketched below are some approaches to better integration of the Active and Reserve Components which preserve and enhance unit cohesion.

The USAREUR Dilemma

Of all the Army's field commands, U.S. Army Europe faces particularly daunting challenges. Being on the "front line", troops stationed in Germany have traditionally been among the best trained and highly motivated. Certainly they have had a disproportionate share of available funds for field exercises, and consistently excellent opportunities for range firing and other readiness training. But all that may be coming to an end.

The West Germans have long accepted a degree of militarization which no other members of the Atlantic alliance have been asked to bear. On any given day, there are hundreds of tracked vehicles maneuvering on private land somewhere in the Federal Republic. Low level aircraft flights --jet aircraft and helicopters-- are frequent occurences. And any German who travels the Autobahn expects to be delayed somewhere enroute by military convoys. No doubt, if asked, the majority of Germans would vote to have this presence continued.

But there is in Germany an increasingly vocal and effective minority which is making real inroads into the ability of USAREUR to train. Of 41 recent cases where local opposition to USAREUR's activities had been manifested, the majority, 21, involved objections to training activities. Local opposition to <u>change</u> is expected in USAREUR, since Germans tend to accept disturbances in their routine no more than most Americans. But the recent German dissent seems to have a more general focus upon levels and types of military activities --extensive maneuvers, night firing, aircraft operations-- even where these have had numerous precedents. Environmental protection has become a heated cause at all levels of German politics, and no candidate running for office can afford to be soft on such

issues as "noise molestation". Needless to say, those activities of USAREUR which involve low overflights, explosions, undersoil exposure, tree damage and the like, come in for public condemnation which no amount of environmentally beneficial action or "community action, good-will projects" by U.S. Forces offset. Too, in years past, German local officials customarily buffered USAREUR from complaints from their citizenry, citing to the latter reasons of defense as the larger good, or the economic advantage of the American presence. Such arguments apparently no longer hold water, and in any case, few officials will now take the U.S. side in any controversy. And the prospects are that matters will get worse, not better, in the years to come. It could even be possible that, in the foreseeable future, the presence and activities of U.S. forces could present the sort of issue which German radicals have been seeking for years --one which could attract support from all across the political spectrum, and which strikes at the essence of the Alliance without seeming to be anti-NATO.

The plight of the Bradley battalion commander trying to manage his weapon training, cited above, would be even worse in USAREUR: there he might not even have a range to fire on, since local opposition to USAREUR's Bradley Range at Wildflecken has led to a court injunction which has stopped all construction, with little prospect of early relief.

A Querulous GAO

Whatever the Army thinks it has accomplished with its training initiatives, it has not made a believer out of the General Accounting Office. Two initiatives of which TRADOC is understandably proud --the Extension Training program to improve individual training in units, and the National Training Center for the combined arms training of tank and mechanized infantry battalions-- have repeatedly drawn its fire.

Extension Training is an idea which goes back to before the beginnings of TRADOC, when General Westmoreland's Board For Dynamic Training recommended that means be found to provide better communications between CONARC's service schools and units, so that the expertise of school faculties could be turned to advantage in advancing the proficiency of each soldier, wherever he might be serving. TRADOC's initial thrust toward this objective took the form of the Training Extension Course (TEC) program: performance oriented, mostly audio visual lessons designed to teach basic tasks, employing audio-tape/film-strip players. Most TEC materials were put together by civilian contractors under school supervision, but all had to be validated by soldiers in units. Initial TEC results were encouraging, but unconvincing to the GAO: every report on TEC since its inception (and there has been one about every two years) has reported (1) low usage, or the absence of a system to assess usage factors; (2) lack of a system to ascertain training effectiveness, and (3) failure to provide feedback mechanisms so that the originators could correct errors detected or improve subsequent offerings.

The latest GAO report on Extension Training was dated June, 1985, and entitled: "Improvements Needed in the Army's Program for Developing Extension Training Materials for Use by Soldiers in Field Units." It addresses further reports of low usage in units, what TRADOC ought to be doing to improve the process for developing extension training materials, and a perceived need for TRADOC to reevaluate its decision to field EIDS. GAO read back to TRADOC its own guidance, and recommended that the schools follow same: no extension training materials should be developed unless it were established that there was a need in units. To quote the GAO report:

> "...the Army needs to ensure that lessons learned from the usage of extension training materials are considered before proceeding with its planned large-scale effort to develop new materials, many of which are for new or revised military occupational specialties related to systems under development. In doing this, the Army also needs to obtain user feedback on individual materials and to develop criteria which define acceptable extension taining usage levels. Key indicators are whether the products are used and improve soldier proficiency."

But the GAO's unhappiness with Army training is not confined to Extension Training materials. This past July it sent to the Secretary of the Army a report on the National Training Center acknowledging that the Army had achieved its objective of providing realism in training, but had failed in its objective of informing itself about the efficiency of unit training, and the adequacy of its doctrine and equipment. It noted the same sort of systemic failure that it had found with Extension Training: lack of feedback on effectiveness. While objective data --measurements-- were collected from the instrumentation at the NTC, there seemed to be no mechanisms for using same. In particular, little information flowed into either TRADOC or the troop commands to insure that flaws in doctrine or lacunae in training were corrected. Noting that units in 1985 made many of the same errors reported for units in 1981, the GAO recommended that feedback loops be established so that the training establishment of the Army, and its combat development apparatus as well, could learn from what was transpiring at Fort Irwin.

Army Priorities

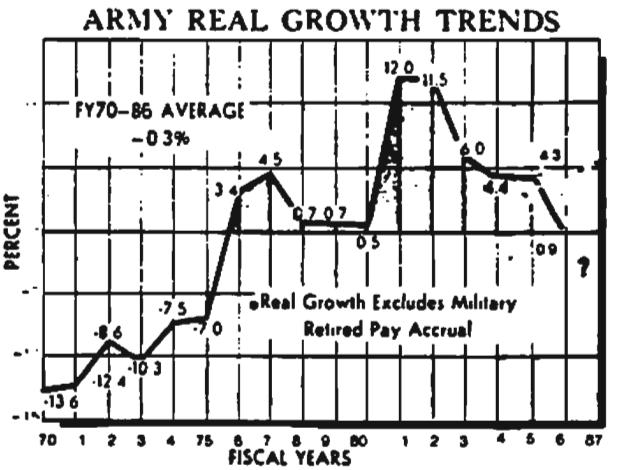
While unfavorable GAO reports scarcely help the Army in obtaining appropriations to support its training, and while Congress has recently legislated strength reductions, these are far less important in the long run than the Army's own internal priorities.

Army budget planning is for zero-growth.

Army Active end-strength is zero-growth.

Army Active strength per division is at a record low.

Army persists with modernization, structural expansion.



MODERNIZATION
(CONGRESSIONAL AUTHORIZATION THRU FY86)

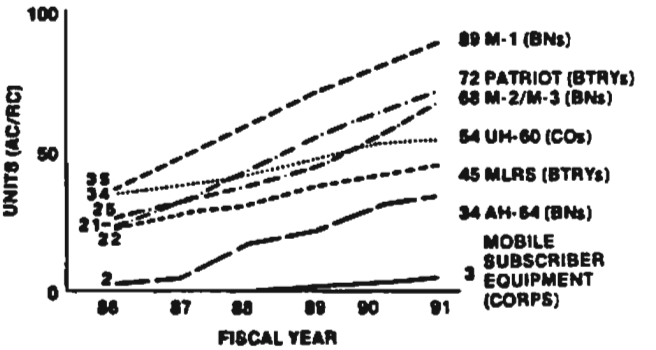
EQUIPMENT

5,000 M1 TANKS
3,700 BRADLEYS
1,600 HELICOPTERS
95,000 TRUCKS
850 HOWITZERS
350 MLRS LAUNCHERS
39,000 NIGHT VISION DEVICES

MODERN MUNITIONS

188,000 MLRS ROCKETS
15,000 STINGER
69,000 TOW II
23,000 COPPERHEAD
21,000 HELLFIRE

UNIT MODERNIZATION



CLOSE COMBAT
(NUMBER OF SYSTEMS)

SYSTEM	PROCURED THROUGH FY 85	FY 86 PROC	FY 87 PROC REQUEST	TOT PROC OBJECTIVE
M1 SERIES	4,168	840	840	7,467
BFV	2,955	716	870	6,882
AH-64 (APACHE)	309	144	144	675
AHIP	60	39	48	578
HELLFIRE	15,082	5,750	0	49,502
TOW	56,883	12,700	12,000	139,866

FIRE SUPPORT
(NUMBER OF SYSTEMS)

SYSTEM	PROCURED THROUGH FY 85	FY 86 PROC	FY 87 PROC REQUEST	TOT PROC OBJECTIVE
FAASV	344	135	141	950
MLRS LAUNCHERS	304	44	44	491
COPPERHEAD	16,187	5,874	220	31,862

AIR DEFENSE
(NUMBER OF SYSTEMS)

SYSTEM	PROCURED THROUGH FY 85	FY 86 PROC	FY 87 PROC REQUEST	TOT PROC OBJECTIVE
PATRIOT FIRE UNITS	68	12	12	103
STINGER MISSILES	11,850	3,439	4,180	50,664

COMBAT SUPPORT AND COMBAT SERVICE SUPPORT
(NUMBER OF SYSTEMS)

SYSTEM	PROCURED THROUGH FY 85	FY 86 PROC	FY 87 PROC REQUEST	TOT PROC OBJECTIVE
HMMWV	16,454	12,132	12,842	101,633
UH-60	699	78	78	1,107
M9 (ACE)	15	22	21	560

Clearly these factors alone portend a resource crunch of some proportion, but they present only a partial picture of the Army's quandry.

> While recent experience with recruiting has been most favorable, the manpower pool is shrinking.
>
> Well-designed new equipment can ease training, but for the foreseeable future the Army will have a mix of new and old equipment, so training requirements increase overall with modernization.
>
> AirLand Battle doctrine is harder to train for than any in the past. Training tasks are more complex, conditions more arduous, standards more exacting, yet OPTEMPO and TRAINING AMMUNITION supported by budgets will almost surely decline, and environmental challenges to training are increasing worldwide.

The Commander, TRADOC, must calculate how he is going to respond to these challenges. Assaults on TRADOC resources and programs are virtually inevitable, but the real issues he must address are Army-wide.

He could roll with the punches, and even counter-punch, buying time, waiting for a break, playing the role of conservator of the Army's "seedcorn."

Or he might reach for Army vice TRADOC solutions, for a long-range strategy calculated to preempt radical surgery on training, and, more importantly, show the Army how to build a training system responsive to the needs of the 'Nineties.

It is, of course, the latter which is proposed here.

Communications to the Rescue

In essence, training is communication: the transferral of skills and knowedge, whether by example, experiential learning, exhortation, exposition, or more Socratic methodologies, or whether by use of electronic means now commonly associated with the word "communication". The latter, aided chiefly by computer developments, become more and more capable for training purposes year by year.

Craig Fields, Chief Scientist for the Defense Advanced Research Projects Agency (DARPA), identifies advances in computers as the most assured technological advance of the next few years. Fields believes that over the next four years there will be increases in speed and power of processors, with proportionate reductions in costs, comparable to the changes which took place in the forty years between 1946 and 1986, what he calls a "step-function increase". In 1946 ENIAC, a house-size computer then the state-of-the-art, could perform 5,000 calculations per second. By 1990, ENIAC-like capability could be available in wristwatch formats. Today's CRAY-2, a commercial cabinet-size 64 bit parallel processor which weighs 5500 pounds and

costs $17 million, functions at 1.6 billion calculations per second. DARPA now has an experimental processor of comparable speed very much more compact, a "giga-flop in a soupcan". Craig Fields opines that the Army's 1990 thinking should anticipate a "Cray in every soldier's pocket", and he is convinced that Army training developers should now be planning, as a matter of urgency, how to exploit such marvels. Software may be a problem, but super-speed, parallel processing makes possible new confidence that even that difficulty could be overcome.

But DARPA spends only about one-half of one percent of its budget on training technology (in FY 1985, some $5 million out of a budget of $750 million), and the Army's recent experience would suggest that its organic institutions and staffs are quite unlikely to perceive or to capitalize upon such opportunity. Rather, extraordinary, outside intervention, such as DARPA might provide, is sine qua non for significant advances in Army training technology.

What could the Army do with DARPA's help? It could set up a coherent training system, based on established performance standards from top to bottom, across all functions, which interlinked the training of every individual soldier with that of his unit, and facilitated collective training at all echelons. Most of the segments of that system are already planned: EIDS, ITMS, SIMNET, JRTC/NTC, JWC and COLSIM-BBBS-JESS/JTLS models. But these are to a coherent training system as lumber is to house. If Army training is to have a dwelling, an architect must show how to relate these building materials one to another, and to soldiers and their missions.

But there is one essential building material not yet planned: a means of tying the soldier to the system, and vice versa. The Army must provide to each soldier, Active and Reserve Components, a **PASSKEY**, an ID card-qualification record which serves, inter-alia, to unlock training support and accreditation for all the individual training requisite for progressive development while in service. The Army has investigated chips embedded in a dog-tag to attach to individuals certain personnel data and medical/dental records, but what is proposed here goes much further: **PASSKEY** would be a means for recording every single individual training transaction, whether in institutions or in units, simultaneously entered on a file on the soldier's **PASSKEY** and on files within the Integrated Training Management System (ITMS). Whether **PASSKEY** is a "dog-tag" or a "wrist-watch", or whether **PASSKEY** uses laser written/read strips, embedded processors, or some other reachable technological solution, is not significant; what is important is that the Army grasp that in the foreseeable future it could broadly distribute interfaces for use by its training evaluators, and/or connected to all its weapon systems and training devices, which can end the accountability problem of which the GAO has been critical over the years. At the same time, **PASSKEY** could provide powerful new incentives to boost individual training in units.

Commander, TRADOC, should propose a jointly funded program to DARPA to develop **PASSKEY** expeditiously, and insure thereafter that **PASSKEY** becomes integral to all training subsystems, devices, and training support arrangements.

For example, the Electronic Information Distribution System (EIDS) would be significantly enhanced were it possible automatically to record and track who used it, when, for what, and to what avail. Each EIDS device could have a **PASSKEY** slot, and each **PASSKEY** could, upon insertion, become part of its training diagnostic/prescription subsystem. In units, EIDS could detect and credit superior performers, and call them to the attention of their unit leaders through ITMS. For reservists, **PASSKEY**+EIDS could become part of readiness assessments, and pay or pension incentives.

But EIDS, currently using videodisk storage, should be upgraded at least to CD/ROM storage, and must be connected into ITMS. EIDS devices should be embedded into emerging weapon systems, and required in all Integrated Logistic Support packages. EIDS should be seen as a fundamental means for communicating with individual soldiers Army-wide for administration and maintenance as well as training, and distribution and update of EIDS "publications" should be incorporated into the Army Integrated Printing and Publishing Service (AIPPS).

Managing individual as well as collective training will require more of ITMS than presently is being planned. ITMS contemplates an Electronic Clipboard as its interface with evaluators of collective training, and its design would have to be expanded to accomodate **PASSKEY** interfaces as well. But the basics are there: ITMS postulates Army-wide communications extending across all four realms of training --Institutions, Units, Individual, Collective (see Appendix 1). What is now missing in ITMS is essentially faster, more powerful, compact, rugged, and cheaper computers, capable of parallel processing --exactly the sort of computers Craig Fields thinks will be in hand by 1990.

But with **PASSKEY** interfaces, ITMS could be significantly enhanced as a means of recording and evaluating training, and hence, of justifying training ammunition expenditures and of assessing readiness. Two examples should suffice: (1)**PASSKEY** would permit the Army to relate its training ammunition allocations not to things --rounds per tank, per howitzer, etc.-- but to soldiers --rounds per gunner, loader, etc. (2) ITMS has poor connectivity with the National Training Center, which **PASSKEY** could ameliorate. At Appendix 3 is a paper prepared by Jack H. Hiller of the Army Research Institute which describes the difficulties inherent in training evaluation at the National Training Center. Note especially pages 4 and 5, in which Hiller discusses weakness in the data and the importance of providing evaluators with automated interfaces with the instrumentation. Field-worthy **PASSKEY** input devices might assist in tracking trainer interventions, such as leader "kills" and "revivals", as well as weapon crew composition, identity of particularly effective or ineffective individuals, and other fine grain details not now observable or recordable.

ITMS should also have gateways into SIMNET. As Hiller observes (App 3, page 6), networked simulators could not only open new training opportunities, but also could provide striking performance data for feedback to TRADOC schools and other originators of doctrine, to combat developers and training developers alike. SIMNET is

computer-based, and its efficiency should increase proportionate to the speed and power of its processors. The numbers of SIMNET devices contemplated for broadcasting throughout the Total Army argue for keeping its costs as low as possible, and again the new processors should contribute.

ITMS must also be interfaced with the emerging --but still largely unconnected-- family of battle simulations, or war games, and each of these should also have **PASSKEY** ports. Neither the recently issued Training Device Requirment (TDR) for the Company/Team Level Training Simulation (COLTSIM), nor the TDR which appeared about the same time for the Brigade/ Battalion Battle Simulation (BBS) call for such external ports, although they clearly recognize the value of the simulations for both training developments and combat developments. COLTSIM does require compatibility, and capability for interface with BBS (referred to in the COLTSIM TDR as CBTSIM), and BBS requires compatibility with computer hardware at Corps and Division. Commander, TRADOC, should insure not only that these are developed together, but also that both fit into models being developed to drive higher echelon battle simulations, like the Joint Exercise Support System (JESS) and the Joint Theater Level Simulation (JTLS), both part of the JCS-sponsored Modern Aids for Planning Program, (MAPP), which are soon to be installed at the Joint Warfare Center (JWC) of the U.S. Readiness Command. Obviously, these also ought to be compatible with the emerging C³ system, especially the prototype Maneuver Control System (MCS). And, as soon as feasible, the battle simulations used at the Warrior Preparation Center by USAREUR and USAFE, and in TACSIM at Fort Hood, should be replaced or integrated for full compatibility.

Commander, TRADOC, should drive hard toward Nested Battle Simulations (NBS) --a coherent family of battle simulations for training leaders and staffs from company through Field Army, designed for interoperability and communications compatibility, and for interfacing with ITMS and **PASSKEY**.

An Instrumented Tactical Exercise Without Troops for AirLand Battle (ITEWTALB) has been proposed to exercise in the field the C³I of formations as large as a Field Army and associated Air Force Command Centers. The four subsystems of ITEWTALB could utilize fully state-of-the-art computers and communications, but are to be designed around existing battle simulations and available communications. Were the communications systems/computers/models proposed above in place, ITEWTALB could function as the capstone event in unit training, and the Army's primary mechanism for training and evaluating Senior-level and Executive-level leaders, per Army Regulation 600-100. The formula for unit training becomes:

PASSKEY+EIDS+ITMS+AIPP+SIMNET+NTC/JRTC+NBS+ITEWTALB= Readiness

This is also a formula for establishing and maintaining standards of performance, horizontally and vertically, thoughout the Army, both Active and Reserve Components.

It may also be a formula for the Army's meeting head-on the

political/environmentalist challenges in Europe and elsewhere with new strategic stationing plans, and new, possibly more realistic roles for the Reserve Components. Here's how it might work:

...The 68th Armor, a CARS tank regiment, has two battalions assigned to the Active Component, one to the National Guard, and one to the Selected Reserve. Of the two Active battalions, the 1st Battalion is stationed in USAREUR, and the 2d Battalion at Fort Hood. 1st Battalion, at Mainz, FRG, has a full TO&E, except that all personnel assigned to the M-1A1 tank platoons are stationed at Fort Hood, in the 2d Battalion. The brigade at Mainz works 1-68 Armor very hard conducting reconnaissance, preparing battle books, participating in terrain walks, and taking part in frequent battle simulations and a semi-annual ITEWTALB. But at least twice a week, the battalion "fights" through a SIMNET exercise in which its platoons at Hood participate. At least once a year there is an Emergency Deployment Readiness Exercise in which these platoons are flown into Rhine-Main aboard Civil Reserve Air Fleet transports, and reunited with 1-68A and their battle gear; the company leaders in Germany know the individuals in those platoons in some ways better than the leaders of 2-68A at Fort Hood, to whom they are attached for day-to-day administration.

The leaders of 2-68 at Fort Hood monitor much more closely the training status of the platoons of 3-68 Armor, New Jersy National Guard, for should they go to war, they and those platoons would rendezvous in Germany at a designated POMCUS site, there to become one of 7th Army's first reinforcing battalions. REFORGER from time to time demonstrates how well this arrangement works. But weekly 2-68A trains with some platoons on SIMNET, and helps train and evaluate all during Annual Active Duty Training.

The cadre of 3-68A has the mission not only of recruiting training, and administering the platoons for 2-68A, but also of being prepared to fall in on the equipment of 2-68A at Fort Hood, conduct a Mobilization Training Program, and prepare for overseas movement. For personnel fillers they would rely principally upon 4-68A, a Chicago-centered Selected Reserve battalion, and a pool of qualified soldiers from the Individual Ready Reserve, with mobilization assignments to 4-68A. 4-68A concentrates on qualifying and keeping current tank commanders and gunners. The IRR pool consists of experienced tankers discharged from the Active Component. Despite its disparate sources of personnel, thanks to **PASSKEY**, the leaders of 3-68A have excellent information available on the status of individual training and POM qualifications for all assigned personnel. Each year its ANACDUTRA consists of a dress rehearsal of the MTP at Fort Hood...

The posture of the 68th Armor is "echeloned back", the obverse of "forward stationing." That posture permits the Army to increase its combat support and combat service support in Germany, without the irritants of firing and FTX. It can train its combat elements better in CONUS. And it can make better use of the 39 days or so which members of 3-68A and 4-68A of the Reserve Components can rely on for training. Upon strategic warning, and within the President's 100,000

Call-up Authority, platoons shift "forward", from 2-68A to 1-68A, from 3 to 2, and from 4 to 3.

Recommendations

The Army needs a plan plan for proceeding toward capabilities implicit in the formula:

PASSKEY+EIDS+ITMS+AIPPS+SIMNET+NTC/JRTC+NBS+ITEWTALB = READINESS

The plan should rest on the principles advanced for ITEWTALB:

Build by evolutionary development. Start with whatever is in place, and upgrade selectively.

Lease --avoid procurement. Put in place a service contract requiring the contractor to furnish the Army state of the art computers and communications, and to perform any function peculiar to peacetime.

Design around function. Avoid specifying hardware, but insist that one function is head-to-toe interoperability.

Commander, TRADOC, should:

Assume proponency for ITMS, and direct its being opened to other systems in the formula, as the central integrator/management system.

Add onto the ITMS contract a task to reexamine ITMS as the formula-integrating element in individual and collective training, and to submit timelines and costs.

Propose to DARPA joint, urgent development of **PASSKEY**. Upgrade EIDS and imbed ports for **PASSKEY**.

Assure an AIPPS/ITMS interface.

Press development of SIMNET toward realizing its full strategic and structural, as well as tactical, potential.

Direct action on compatability between instrumentation and evaluation methods at the NTC/JRTC, and like centers, and ITMS; exploit **PASSKEY** for that purpose.

Direct the fielding of Nested Battle Simulations, internally coherent, adaptable for ITEWTALB, and interfaced with **PASSKEY** and ITMS.

Implement the proposal for ITEWTALB.

ARMY TRAINING: A CONSTRUCT

All Army training --all military training-- can be described with four terms: individual or collective, institutional or unit.

-- **Individual** training refers to undertakings aimed at developing the cognitive and psychomotor skills of one person, as distinguished from teams. Since civil education and training are preponderantly of this sort, and since related pedagogical literature is similarly focused, the services tackle individual training with confidence, and some evident competence, especially in institutional settings.

-- **Collective** training refers to undertakings directed toward developing teamwork, or constructive interpersonal working relationships among several individuals performing a common task. The varieties among individuals, and the permutations and combinations of experience and skills within casual groupings have led educational researchers --civilian and military-- to experiment with and write about collective training mainly of entry-level personnel, where some commonality of background, experience, and age tends toward more homogenous, definitive results. Training of more disparate, and more realistic collectives is largely unexplored.

-- **Institutional** training refers to methods for training either individuals or collectives in which a faculty is established and facilities provided so that groups or classes of trainees may be processed through a fixed curriculum, or set of educational experiences. The school systems established to meet the societal requirements of the 19th, early 20th Century Industrial Revolution provided the model, and have largely conditioned the administrative procedures and forms of instruction used within all the armed services in their training centers and schools. In general, a relatively stable faculty of subject-matter specialists train repetitively changing populations of trainees.

-- **Unit** training refers to that which takes place within battalions, companies, platoons, and detachments, squadrons, or ship's companies, where the "faculty" and the "trainees" are stable, and the "curriculum" varies from day to day, according to mission-needs, or some training management plan laid down by the unit's leaders. The latter bear the primary instructional burden, and are seldom genuine subject-matter experts comparable to those in institutional training. A significant amount of unit training is actually peer training, on the job, with even less expertise or experience brought to bear. **Unit** training, properly a military preserve, has been poorly explored by scholars and experimenters, yet most soldiers, sailors, and airmen are in units most of the time, and their peacetime activities are principally training, more or less structured. Therefore, **unit** training is patently the most expensive kind of training, and the least effective.

The universe of training may be characterized with the following paradigm, or construct, in which there are four distinct regimes,

relating to "who is being trained?" and "where is the training taking place?"

Who trained?	Where trained? INSTITUTION	Where trained? UNIT
INDIVIDUAL	Individual Tng in Insitutions	Individual Tng in Units
COLLECTIVE	Collective Tng in Institutions	Collective Tng in Units

From the point of view of resource allocation, these distinctions are not trivial, for Institutional training managers can assure seemingly efficient utilization of quite expensive facilities and personnel overhead, whereas Unit training managers are notorious for failing to take adequate advantage of classrooms, learning centers, ranges and training areas, let alone more elaborate training mechanisms. For this reason, most of what the services have spent over the years for better means of doing the training job has been spent on Institutional training. This assuredly is true in the Army, for in addition to TRADOC's Program 8 bite out of the Army budget, and the dent it makes in quality manpower, there is the National Training Center, and its upcoming counterpart at the Seventh Army Training Center, in Germany. There is a discernible interest, however, in all the services, the Army included, in better Unit training. The Vice Chief of Staff of the Army, General Thurman, recently indicated that he was willing to forego procuring some of the planned quantitites of new weapon systems if he could be shown that he could resource instead Unit training which would assure that what equipment he did procure could be employed to full potential. For example, he has advocated embedding training aids or simulations into the weapon system itself, and in the interest of defining goals for training developers, he has strongly supported establishing standards of performance horizontally across the various units of the Army, and vertically from the lowest private soldier in any unit to the highest ranking general commanding forces afield.

Still, significant resources are earmarked expressly for training of individuals in the Army's Schools and Training Centers. Our history bids policy-makers and resource-allocators remember that it was the Army school system which prepared the Army for the mobilizations of World War I and World War II, and developed the cadre of leaders from which came Marshall, Eisenhower, Bradley, Patton, Gavin and Taylor --men who played central roles on the national stage from 1941 well into the 1960's, each of whom has acknowledged a debt to the individual training he received in the Army's institutions of his time. But there has always been tension between the needs of the Army of today, whose readiness depends in some large measure on the presence of trained leaders capable in turn of training their units,

and the Army of the future, whose potential can not be realized unless its prospective leaders be pulled from existing units and staffs, and sent off for institutional training or education, where they are unable to contribute to unit training, or otherwise engage in the Army's day-to-day operations. Such tensions are particularly strong during periods of structural expansion, such as is now the case in the Army (and the Navy).

These tensions notwithstanding, the Army can point to some significant advances in Individual-Unit training. It persisted in its fielding of the Training Extension Courses (TEC), which emplaced performance-oriented, troop-validated courseware developed in TRADOC's institutions in units worldwide. While the General Accounting Office has found much fault with TEC --especially since few records were kept in units concerning the degree of its use, and the Army was hard pressed otherwise to demonstrate a payoff for its investment in TEC-- the Army has progressed to the Electronic Information Distribution System (EIDS), a microprocessor-driven video-disc system to continue TEC-like links between its institutional faculties and soldiers in units. Further, the Army's Soldier's Manuals, and skill-qualification evaluations represent an effort on a historically unprecedented scale to guide Individual training, both Institutional and Unit, toward standards uniform throughout the force, and to provide incentives for meeting these standards.

Moreover, to improve Collective-Unit training, the Army has drawn from its institutions a number of battle simulations --computer models of combat designed for command and staff training-- and provided these for collective training in units. And it has fielded the Multiple Integrated Laser Engagement System (MILES), a set of lasers and "smart" detectors which simulate direct fire weapons in engagement simulation --enactments of free-play force-on-force encounters for realistic combined arms training.

MILES has also contributed to Collective-Institutional training, having been used to good advantage as part of the instrumentation at the National Training Center, Fort Irwin, California (NTC). (Instrumented ranges of this sort are here labeled "institutional" because of their permanent faculty who carry the lion's share of instruction at the Center(s), the well-trained, permanent OPFOR, and the relatively limited repertoire of experiences afforded transient participants.) The NTC was strongly influenced by the Air Force's RED FLAG at Nellis Air Force Base nearby, and both have counterparts in the instrumented range to be established by the Seventh Army Training Center, the forthcoming Joint Readiness Center, and instrumented training ranges elsewhere in the Air Force and the Navy. For the Army, at least, these ranges provide advanced simulation for training whole units, approaching vicarious combat, permitting non-lethal learning of deadly lessons.

But much remains to be done, and most Army training today resembles that of yesteryear, with activities like these:

	INSTITUTION	UNIT
INDIVIDUAL	Service Schools Training Centers Correspondence Courses	Continuation Training, Skill Progression Tng, Extension Training Soldier's Manuals Personal Weapon Qual Physical Fitness
COLLECTIVE	Crew Drill Instrumented Ranges	Crew Drill Weapon Crew Qual, Engagement Simulation Battle Simulation Field Training Exercises

SUMMARY. Of these domains, the Army, true to its history, does the most competent job with that in the upper left; its poorest job with that in the upper right --the very proficiency of the schools and training centers encourages unit leaders to assume that these do all that has to be done for individual training, or that, if individual training requirments subsequently materialize, these are to be met by the soldier himself. **Individual training in institutions** is expensive, less for the dollars required annually than for the manpower diverted from units, and hence readiness. **Collective training** is the most expensive, embracing not only the costs of field exercises --POL, parts,maneuver damage-- but also training ammunition for crew proficiency firing --e.g., artillery and tank rounds, and antitank missles.

THE INFORMATION EXPLOSION

In the first decade of the 20th Century, the most powerful man in the United States Army was Major General Fred C. Ainsworth, its Adjutant General. Ainsworth was more influential that the Chief of Staff of the Army, and vastly more important than any of its field commanders. Literally, it was impossible for any other official to move an officer from one post to another without Ainsworth's approval. No major project could be undertaken without his support, and no major policy change was possible without his concurrence. Able, on occasion, to challenge the authority of the Secretary of the Army, well connected with members of Congress, Ainsworth was a truly extraordinary bureaucrat, for the source of his power was his control over Army records.

His personal history is instructive. He rose to the pinnacle of prestige in the Army without ever having heard a shot fired in anger. He had been trained as a physician, had served as a contract surgeon at a peacetime Army garrison, and then had accepted a commission. During the administration of Grover Cleveland, the then Lt. Ainsworth came to Washington, and was assigned to the Bureau of Pensions. At the time, Congress was beseiged by constituents seeking pensions, and the Bureau was inundated with Congressional correspondence demanding documentary support for this or that claimant. When Ainsworth arrived, the Bureau was months in arrears on this correspondence, and Congress was vocally critical. But within a year, Ainsworth had the Bureau turning around correspondence in 48 hours, providing the Congressman not only a reply, but actionable documentation. The Secretary of War in his annual report declared the Bureau of Pensions "the most improved bureau within the Department," and Fred C. Ainsworth's meteoric rise to the top of the Army was assured.

Ainsworth's accomplishments rested on a technological innovation: a card index file, alphabetically arrayed. Once he had pension records indexed, he applied his technique to, and extended his control over medical records, personnel files, financial transactions, and other bodies of papers, until only Ainsworth knew surely where to find information on which to base decisions pertaining to people, installations, materiel, or, for that matter, any of the day-to-day business of the Army. Aided by Elihu Root's desire to have the General Staff concentrate on planning for war, Ainsworth effectively isolated that body from data on the real world, leaving them to hypothetical papers on distant and improbable conflicts, while he managed the Army.

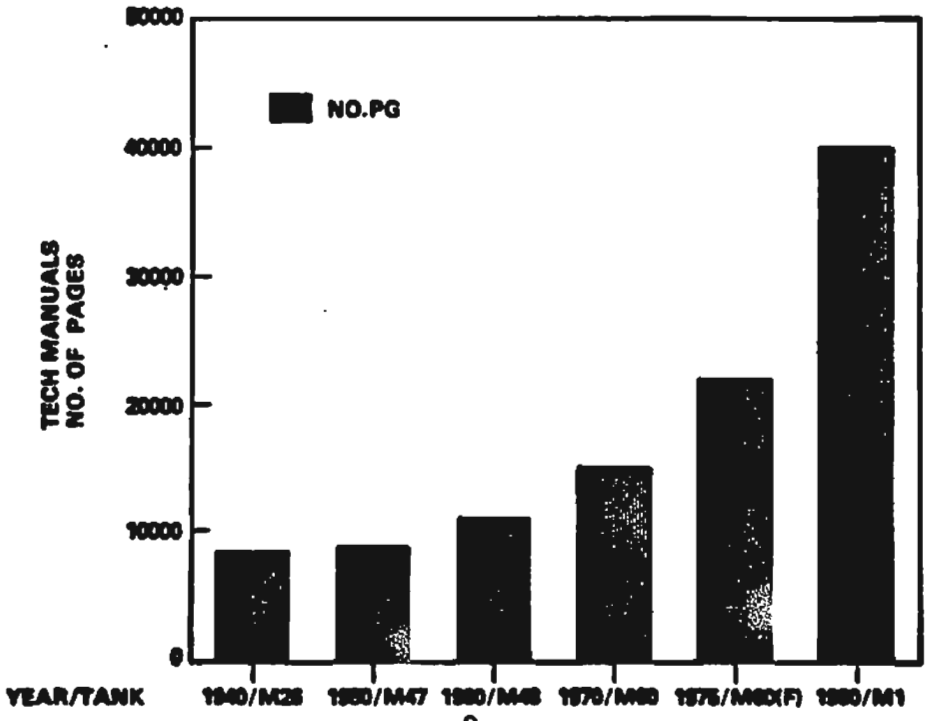
Ainsworth was toppled in a dispute over written records with another doctor-general, Leonard Wood. As war-clouds gathered in Europe, Wood rose to become Chief of Staff, and took office determined to ready the Army for impending war by concentrating its dispersed garrisons so that units could train more efficiently in the large formations in which they would fight, and by freeing his commanders from the burdens of peacetime administration. Convinced that troop leaders should spend more time training their soldiers as opposed to filling out forms for Ainsworth, Wood sought to eliminate some records, and consolidate others. Ainsworth, of course, resisted, for a man who has

built a career around managing records was not likely to welcome such streamlining. He wrote an intemperate letter to the Secretary of War, who reacted by suggesting that he be courtmartialed. Ainsworth resigned, and Wood seemingly won the day.

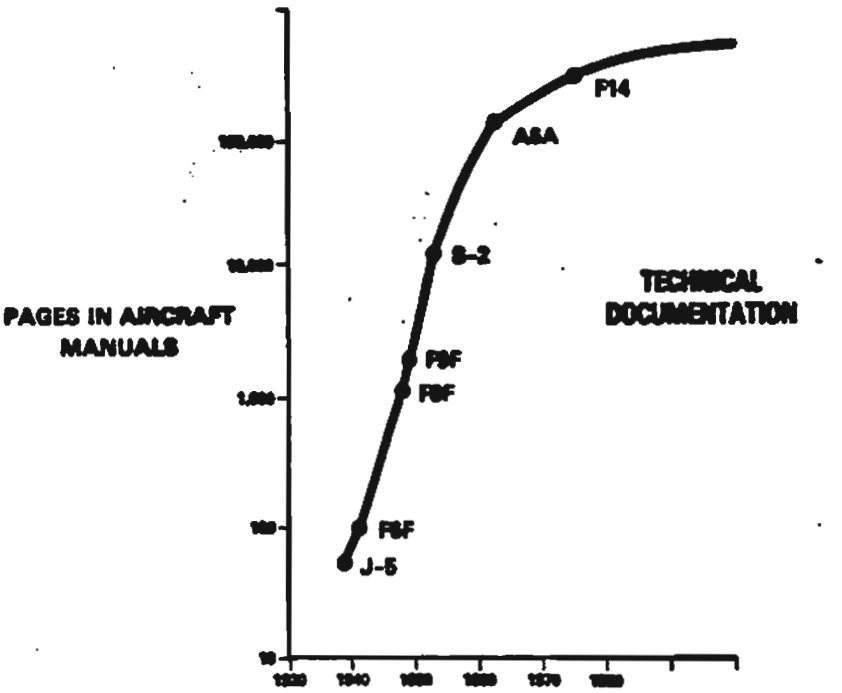
But in the long run, it was the Adjutants General who prevailed. For all his vision, Leonard Wood had no conception of the information requirements for an Army of millions. The Herculean tasks of recording the induction, training, compensation, and discharge of the drafted hosts of World War I and World War II created imperatives for the efficient manipulation of billions of bits of alpha-numeric information. These led to the present day galaxy of computers through which the Army administers itself --largely run by the Adjutant General.

But no Adjutant General to date has devised a means of enabling the Army to deal with those problems of the printed word which arose from fields other than administration, such as education and training. Provide they did for printing and distribution. The Army went into World War I with field manuals printed by private firms, often written by serving officers who derived a profit from their sale. After that war, the Army undertook to produce its own field manuals, but when the nation began mobilizing in 1941, there were less than 50 manuals in print all told to underwrite mobilization of 89 divisions. Today, with an Active Army one-fifth that size, the Army has 1000 times as many field manuals in circulation.

But the real pressure on publication has come from technology, and the requirement to describe ever more complex machines to those who must operate and maintain them. When the Army issued the General Grant tank early in World War II, it was accompanied to the field by one thin pocket-size technical manual of less than 100 pages. The M-1 Abrams tank of today is accompanied by over eight linear feet of documents.



The Army's experience in this respect has been mirrored by that of the other services. The Navy's World War II fighter, the F6F had a manual of 100 pages; the F-14 in the fleet today has 300,000 pages of documents.



For every division in the Army and the Marine Corps, there are at least 1000 manuals in print. For every ship of the Navy, there are some 400 manuals. Each new aircraft of any service has required two to ten times more pages of technical documentation than the aircraft it was intended to replace. More importantly, as new equipment has been fielded, the numbers and complexity of technical documents has grown, generating ever more perplexing problems of timely transmission and relevant, reliable update. Paper-based information distribution systems are patently unequal to the present, and hopelessly inadequate for the foreseeable future.

But burgeoning technical documentation has been accompanied by a proliferation of materials designed to aid training in units, what the Army refers to as extension training or training support materials. Materials designed to train, as opposed to inform or to administer, require special structuring and presentation, and function best if there be arrangements for feedback loops to the originators which can lead to constructive, user-oriented changes. The Army has fielded more than 16,000 different extension training

materials, publications or audio-visual materials, and plans to add to this, over the next five years, 25,000 more. It also plans to buy at least 20,000 videodisc/microcomputer systems with which to establish the Electronic Information Delivery System, (EIDS).

> **EIDS, through interactive videodisc (IVD) technology, provides an effective standard information delivery system with high density storage and rapid access capability for transfer of training, maintenance and other information packages...Inherent in EIDS is the capability to reduce instruction time; to save dollars associated with courseware production, distribution and delivery; simulate actual equipment for hands-on training; reduce meantime between failures of equipment; make available (to reservists), through simulation, training on sophisticated weapon systems not available to them; and increase soldier proficiency levels...EIDS has been type classified as the Information Delivery System AN/GSH-55()...**

Ultimately, the Army expects to have 40,000 EIDS terminals --some of them advanced, miniaturized, "briefcase" models-- throughout the Active and Reserve Components.

Another innovation through which the Army has been attacking its information problems is the **Army Integrated Publishing and Printing Service** (AIPPS), which is designed to eliminate the need to ship quantitites of paper around the world, substituting electronic transmission of words and pictures in for a distributed publishing system handling technical, administrative, doctrinal, and training materials. AIPPS is described as:

> ...a contractor-provided service and associated contractor-owned equipment and software supporting system, geographically distributed among approximately 200 sites worldwide, to manipulate millions of pages of text and pieces of artwork into composed pages, and to eventually print and bind approximately 26 million page impressions every business day from a publishing base of over one trillion bytes...

AIPPS is intended to interlink TRADOC schools and Centers and troop units down to brigades, worldwide, but is presently held up in a major policy debate involving protagonists within the Executive, Legislative, and Judicial branches of government over whether the system proposed belongs jurisdictionally to data processing or to publishing. The Army has also had in view a Technical Information Management System (TIMS), more recently referred to as the Computer Aided Logistic System (CALS), which would service AMC commands expressly. For example, the Communications Electronic Command of the Army Materiel Command, which has had the lead on TIMS, keeps its inventory of technical documents in a warehouse: 800,000 pages in paste-up flats, 25% of which are involved in changes in any given year. Both AIPPS and TIMS/CALS are expected to use EIDS, as well paper, microfiche, and other media. And either system would have implications for any other Army-wide computer communication network, such as the Integrated Training Management System, on which BDM is now working.

The Criterion Problem: A Practical Solution for Research Based on Unit Performance at The National Training Center (NTC)

Jack H. Hiller

Measurement of unit combat performance effectiveness is widely recognized to be of fundamental importance to any efforts seeking to improve tactical doctrine, training, equipment, personnel and organizational systems design. Without measures of performance effectiveness, it is impossible to determine if any changes help, hurt, or have no effects. However, the infinitely variable conditions of actual and simulated combat, combined with the difficulties of observing and measuring unit performance, have thus far frustrated research into unit combat effectiveness measurement. The Army Research Institute is conducting research on this problem for TRADOC's Center for Army Lessons Learned and the Office of the Deputy Chief of Staff for Personnel. The following note is intended to clarify the issues, and to describe a promising research approach.

OBSTACLES TO COMBAT EFFECTIVENESS MEASUREMENT

Lack of Performance Standards. Assessment of the effectiveness of unit combat performance requires that performing units be measured according to established doctrine. However, the translation of doctrine into performance standards is not a simple, straightforward task. In fact, unit training guides typically avoid precise specification of performance standards by substituting task performance procedures. Omission of standards (in the sense of performance success criteria) is understandable given the circumstance that units will conduct training and evaluation with highly variable terrain and weather conditions, time, OPFOR in terms of numbers, skill and motivation, supplies and equipment. Thus, a lack of clearly specified mission standards creates an important measurement problem.

Unit Effectiveness as an Objective Fact. We may intuitively feel that certain units are relatively effective or ineffective, but feel frustrated over our inability to certify these beliefs with hard, precise data. The measurement problem here is analogous to the problem in physics represented by the Heisenberg Uncertainty Principle:

- The process of measurement dynamically affects the object to be measured. Special train-up efforts made to prepare for the NTC and actions that may be taken primarily because the NTC training/controllers are watching may produce performance and measures of performance that do not represent typical unit capability.

- The object of measurement is regarded as having many different potential states of existence. The unstable composition of units based on the occurrence of personnel turbulence/turnover before and after the NTC as well as the simulated casualties during NTC battles, corresponds to this premise of the Uncertainty Principle.

- The object is known only through measurement. Since accurate measurement is impractical to attempt in home station environments, only "snap-shots" taken at special events, such as training at the NTC, would be feasible.

These constraints on the possibility of accurately determining any specific unit's combat effectiveness force a strategy of limiting measurements to units performing sample missions (selected for critical importance) in a relatively controlled, standard environment instead of seeking to establish unit effectiveness in any absolute sense. The eleven missions typically trained by battalion task forces at NTC represent such a selective sample. And this is the key for designing an effectiveness measurement system that would contribute to the development of Lessons Learned.

SOLUTION APPROACH

Unit Performance Standards. The combat simulation provided by the NTC enables different units to be measured while performing essentially the same set of missions. Given the relative constancy of conditions (e.g., time provided, terrain, OPFOR, and material resources) coupled with the ability of the NTC observer/controllers to develop a refined knowledge of doctrinally driven performance requirements, it should be possible to establish performance standards for the eleven missions that military experts would accept as valid. Whether or not the performance conditions are sufficiently stable and the measures sufficiently reliable to generate data capable of yielding statistically significant relationships will be determined empirically; if we eventually obtain significant relationships between NTC performance measures and predictor variables (e.g., home-station training procedures and leadership styles), then we will have succeeded; if we cannot obtain relationships, we may not be able to determine if the failure reflects inability to acquire valid, reliable measures at NTC, at home station, or a true lack of relationships — but time will tell.

The concept for performance standards keyed to measurement of results instead of process/procedures is partially illustrated below for one of the missions trained at the NTC.

The Bn Task Force performing the Delay Mission, will:

- Block penetration of the enemy for at least X hours after the ground assault begins (Passing score), or X^1 hours (High Pass);

- Suffer no more than W casualties (Pass), or W^1 (High Pass);

- Inflict at least Y OPFOR casualties (Pass), or Y^1 (High Pass).

Unit Performance Measures. With Standards patterned on the above example, the derivation of unit performance measures may be directly undertaken (e.g., observation of time and casualty counts). In the example above, it should be noted that the two-point scoring scale used by the current Army Training and Evaluation Program (ARTEP) was expanded one point, and could obviously have been graduated further, consistent with the recommendations of the Summer 1985 Army Science Board Study of Training and Training Technology to expand measurement scales beyond the dichotomous GO/NO GO. In fact, for research purposes, the actual performance data can be rescaled to standard, Z, scores (since the raw percentage scores for OPFOR casualties will likely form a normal distribution) and used directly without prior conversion to GO/NO GO categories, unless required by Subject Matter Expert judgment.

Criterion Variables. Visualize now that the performance of units training at the NTC has been measured and for each unit the effectiveness of its performance has been determined (for research purposes) by using the standards custom tailored for the NTC. Since performance on each mission will generate multiple scores based on its standards (e.g., three standards in the example above) and there are eleven missions, there would be an unwieldy assortment of criterion effectiveness scores. An approach toward reducing these scores is simply to form an index of effectiveness for each mission (e.g., add together raw or weighted scores for the standards from each mission; conversion of raw scores to Z scores for each standard before adding would provide for initial equalization of the contribution of data from each standard to the total score for each mission). Where appropriate, the mission performance effectiveness indices would be added to form an omnibus criterion variable (each mission's index could also be weighted for importance before adding). Predictor variables, such as those relating to unit command climate and leadership dimensions, would use this omnibus criterion variable for research. Predictor variables relating to specific doctrine, training, and equipment issues might, instead, seek to use the performance effectiveness index based only on a specifically relevant mission, or mission standard.

PRACTICAL LIMITATIONS of NTC DATA

The NTC is for Training, Not Testing. The principle purpose established for the NTC is training for combat readiness; in essence, it is designed to provide our units with the first ten "shot-ats" patterned on the findings from research on aerial dogfights and the pre-combat training programs that were subsequently developed. Data are collected -- on a non-interference basis -- for the purpose of identifying patterns of strength or weakness in training, personnel and organization, tactics/

operations, equipment, and logistics (often generically termed Lessons Learned). These data are initially used by the NTC trainers to support the conduct of the After Action Reviews (a Socratic-like procedure held immediately after engagements that most experts credit as the primary source of learning from experience), then used as a source of performance information in the Take Home Packages for units to improve their home-station training programs, and finally made available for research. A limited amount of data may also be collected on an issue specific basis. Since NTC data are not collected in a controlled, test-like environment, multiple problems are posed for the research applications of these data. The most severe current limitations of NTC data are described below.

NTC Data Weaknesses. Certain data are collected but contain errors, certain key events are not observed/recorded, and the interventions of NTC training staff affect battle outcomes. Each of these three sources of data problems are explained below:

a. Missing Data. A principal problem relates to the most important technique for motivating effective training and generating objective data, namely, the Multiple Integrated Laser System, MILES, that simulates weapons firing effects (i.e., laser beams are substituted for ammunition, and laser sensors provide feedback on hits and near misses). The laser beams of the MILES may not penetrate the smoke and dust of the simulated battlefield as would ammunition, so that the accuracy of direct fire weapons simulation is degraded. Since radio signals from vehicles carrying information on position and firing activity may be blocked by terrain features, critical data may be lost. Furthermore, indirect fire and air defense artillery are not yet simulated with any MILES, but instead the older form of evaluator guesswork is used. In addition, not all direct fire weapons systems are instrumented, and neither are most individual soldiers. Thus, objective data from the NTC instrumentation system may be incomplete or non-existent.

b. Data Not Routinely Collected. There are a wide variety of data that would need to be collected for researching specific issues. Examples of such data needs relate to battlefield casualties, leadership styles/behaviors, sleep patterns of soldiers and leaders, leader knowledge of events, plans made and the reasons, visibility during specific points in a battle, radio communication patterns, etc.

c. Active NTC Trainer Interventions. The NTC trainers who manage the conduct of the exercises actively influence battle outcomes as they manipulate training conditions to achieve good training. If the trainers judge that actions have bogged down so that valuable training time is being lost, then they may direct the OPFOR (the units simulating the enemy) to change their behavior, or they may invoke a nominal enemy to change friendly force behavior, or they may simply direct the friendly forces to stimulate action. Perhaps the single greatest effect the trainers have comes from their actions in "reviving" dead leaders/soldiers during battles, and "killing" others for the purpose of maximizing the

value of NTC training. A junior leader could be revived "six or seven" times during a battle to provide the opportunity to learn how to perform. It is obvious that the final outcome of any battle can be significantly affected by the actions of the trainers. Thus, interpretation of battle outcome data is greatly complicated by trainer activities -- this is not to argue against trainer interventions, but to caution against simplistic application of battle outcome data.

COMPONENT PROCESS DATA

Performance criterion measures based directly on objective battle outcome data (e.g., casualty counts) are essential for avoiding invalid subjective conclusions about the performance effectiveness of any units engaged in simulated combat. However, battle outcome measures do not easily translate into explanations of performance, even if there were no data problems as described above. In contrast, data collected to describe the actual task performance of units and their leaders, as well as equipment, should be directly meaningful and thus relatively easy to interpret. Although such data are not now collected because of the burden that would impose on the NTC trainers, a technological innovation will make such data collection feasible. Specifically, during 1985, the Army Research Institute developed and tested a prototype "Electronic Clipboard" with funding provided by TRADOC's Training Technology Agency. The Electronic Clipboard is a field-portable, hand held computer device that simplifies the scoring of performance by presenting checklists, selected by menu, and recording the scores for each checklist item. Scores are entered simply by use of a touch-screen display. The scoring data in the Electronic Clipboard may be off-loaded directly into a computer or this data may be transmitted by radio. With the use of the Clipboard, it would be possible to have trainers and other observers in the field collect data on general and selected topics (e.g., tactical performance, sleep and rest behaviors, etc.). Observer data reflecting actual performance of tasks should prove extremely helpful for deriving Lessons Learned, particularly when the observations are related to and supported by available battle outcome measures.

EXPERT JUDGEMENT

The accuracy of estimates for any given unit's performance effectiveness, using component process measures, will be limited by the ability of observers to see unit activity on the simulated battlefield; given the limited number of observers available, and the difficulty of seeing covered/concealed vehicles and soldiers cloaked by darkness and smoke, the process measures will often be incomplete. Furthermore, variations in performance conditions will affect how units act and how closely their actions conform to tactical doctrine, as described in the Army Training and Evaluation Programs (and Army Mission Training Plans). Likewise, uncontrolled or random variations in performance conditions for the same missions may significantly affect the battle outcome measures (e.g., based on luck or good intelligence, the OPFOR may successfully attack a weak point, or the weather may be atypical and thereby affect unit effec-

tiveness). Therefore, as a supplement to the objective estimation of unit performance effectiveness, it will be desirable to allow military experts to rate unit performance effectiveness taking into account variations in the battlefield conditions.

Research plans call for having experts (experienced commanders) rate unit effectiveness according to the combat operating systems (i.e., maneuver, fire support, intelligence, air defense, mobility/countermobility, combat service support, command and control, as well as nuclear/biological/and chemical), and thereafter to provide an overall effectiveness rating. The experts are to provide explanations whenever their ratings depart from a neutral or mid-range value. Ratings would be given using two frames of reference. First, the experts would be asked to rate units on a relative scale in terms of their own experience (e.g., the high end of the rating scale could be, "one of the best performances," and the low end, "one of the worst.") In as much as any given expert's experience may relate to generally very good or very poor units, a second frame of reference would be in terms of ideal proficiency for combat (e.g., the high end of the rating scale could be, "completely effective performance," and the low, "completely ineffective.") The basis for making these ratings would be review of the mission orders, the digital data tapes fed though the computer system that displays vehicle positions and firing events, synchronized radio-net audio tapes, plus map overlays, and documented comments from the NTC staff that indicate any special conditions. Ordinarily, differences between experts would be treated by averaging their ratings. Where ratings are extremely different, their comments would be used to decide on how to handle their data. The use of such expert ratings of unit performance, and the associated explanations, may overcome any incompleteness in the NTC data and avoid false conclusions being drawn mechanically.

FUTURE PROSPECTS

The requirement for producing a realistic combat simulation at the NTC necessarily constrains opportunities for acquiring high fidelity measures of unit performance, as has been explained above. There is, however, a new kind of combat simulation now under development by the Defense Advanced Research Projects Agency (DARPA) and the Army, SIMNET (for Simulator Network) in which precise measurement can be achieved without any intrusiveness from data collectors. SIMNET will provide for the networking together of hundreds of combat simulators representing, eventually, all of the major weapons systems. Each simulator uses a digitized terrain representation in conjunction with wide area networking communications to keep track of every other simulator. Each simulated weapons system and its firing effects are realistically displayed within simulated systems (e.g., M1 and M2) using computer generated imagery (CGI) and battlefield sound effects. Force on force engagements may thus be performed on the scale of battalion task force training at the NTC, or on an even larger scale. Since all of the information used to conduct the simulated battles exists in the SIMNET computer system as the battles are fought, that in-

formation may be stored for later systematic analysis. The data from SIMNET may thus be collected without any intrusion from data collectors and made precise and comprehensive.

Research plans call for using NTC-like mission scenarios in SIMNET along with the NTC performance measurement system now being developed by ARI and the Combined Arms Training Activity. Because of the potentially high fidelity of SIMNET data, it should be feasible to conduct research on the performance measurement system itself. For example, how consistent are expert judgments when an exact, comprehensive history of each battle is available for convenient retrieval and replay; what leads to consensus or disagreement? What is the consistency among:

1) objective performance outcome measures (e.g., casualty exchange ratios),

2) behavioral performance measures (e.g., conformity with ARTEP task procedures as scored with GO/NOGO), and

3) expert ratings of unit performance effectiveness ?

Furthermore, how may any measurement inconsistencies be resolved?. This research to improve the performance measurement system itself should lead to improvements in home station training/evaluation techniques, improved NTC training and performance feedback, and greater certainty and precision in Lessons Learned.

CONCLUSION

The NTC is capable of producing data that describe the performance of units, their leaders and equipment, during realistically simulated combat missions. Although the NTC data have limitations as described above, the combination of objective data produced automatically by MILES and position locating electronic equipment with the data to be produced by the NTC trainer/controllers as they observe the battles, as well as with expert ratings for unit performance effectiveness, may create an enormously valuable source of information for improving the Army across all of its major systems. The NTC offers the potential for a new kind of *data --data* that picture the interactive performance of complex weapons systems as employed by a variety of typical units on a variety of critical missions. Given that care is taken to avoid overgeneralizing from training at the NTC to actual combat, NTC data have a high potential for generating Army Lessons Learned.