

## PRODUCTIVITY FOR DEFENSE

Remarks by LtGen. P. F. Gorman, USA  
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I am a fugitive here today from ongoing meetings of the Defense Resources Board, the management mechanism presently in use by Secretary of Defense Weinberger and Deputy Secretary of Defense Carlucci for laying out the prospective budget for FY 1984 and the program for the four succeeding years 1985 through 1988. The Defense Resources Board consists of the Secretaries and their principal civilian deputies and assistants, plus the Secretaries of the Army, Navy, and Air Force, and the Chairman of the Joint Chiefs of Staff. The Board sits around a long table covered with notebooks documenting issues of resource allocation. Back-benching the Board members are the Chiefs of the Armed Services and yours truly, the Assistant to the Chairman, JCS. Framed on the wall at the foot of the table are these words, attributed to William Thomson, Baron Kelvin, dated 1854, words we might take as a motto for this conference:

"Large increases in cost with questionable increases in performance can be tolerated only for race horses and fancy women."

The context of this quotation is a discussion of public intolerance for inefficient new cannon and warships. Whether the reminder on the wall helps the Defense Resources Board I cannot say, but I can assure you that its members meet keenly conscious of the problems which will be central to your proceedings. Like many of you, the men around that table are deeply troubled by the fact that in industry after industry, despite broad recourse to the most modern forms of enlightened management and to extensive automation, firms have to hire more and more expensive labor to compensate for inept maintenance, turnover, absenteeism, flawed quality control, bottlenecks, and shortages. Indeed, American companies supporting national defense seem peculiarly vulnerable to the contemporary productivity paradox, encountering cost-overruns from delays among subcontractors, and extraordinary inflation in costs of manpower, materials, and parts. But the DRB also knows that the productivity of the Armed Forces is under question. The military manpower policies of the last four Administrations have thrust the Armed Services into the market place as prominent competitors for the nation's marginal manpower, with all that competition connotes for increased military personnel costs, and for the capability of men and women in uniform to use or to service high-technology weapon systems. And so, like you, senior executives in the Department of Defense have begun to pay very serious attention to human factors, to the payoff from personnel selection, preparation, motivation, and management; in short, to productivity.

The New England Poet, Robert Frost, once noted that the world is full of willing people: "...some willing to work, the rest willing to let them." Anent Frost's point on the paucity of producers, the Chairman of the Defense Science Board, Norman R. Augustine, observes in his new book entitled Augustine's Laws and Major System Development Programs (which should be required

reading in the nation's war colleges and business schools, and which I commend to this audience) that:

"The contribution made by a group of people working in a common endeavor tends to be highly concentrated in the achievement of a few members of that group. The degree of this concentration is observed to obey a fundamental law, as indicated by the data (graph provided). It is seen that the great predominance of output is produced by a disproportionately small segment of the participants, with the same law seeming to apply whether one is addressing authors, pilots, engineers, policemen, or football players. As one digs deeper into the barrel to increase the manpower assigned to a given task, the average output is merely driven downward and ultimately, large numbers of participants are added with hardly any increase in productivity at all (unless, of course, changes in work methods are also introduced). Conversely, substantial reductions in manning--eliminating the least productive contributions--can be made with little impact on overall output. In fact, the least productive half of all participants seems to generate no more than 20 percent of the total output."

The data referred to is an elegant scattergram which arrays touchdowns by rushing backs of the National Football League, patents by industrial firms, authors contributing to an engineering journal, and arrests by the Washington, D.C. police. The data points establish a neat straight line function and do indeed show that one-third of inputers produce two-thirds of output, or that one-half of the participants are largely unproductive. Interestingly from the military perspective, plotted in the same continuum on Augustine's chart are Royal Air Force victors in air-to-air dog fights During World War II, and staff actions completed by sections by the Joint Staff over the year 1981.

These data are probably understated, since they record only contributors who score, when in reality many actual participants may have produced nothing measurable. And as Augustine points out:

"...there are unquestionably those who produce negative output, such as the worker who makes so many mistakes that a great deal of the time of other potentially productive workers is consumed in rectifying the problems the former has created. Only one-third of the workers typically achieve a level of contribution equal to the average of all those who contribute. In a moment of frustration a second-string National Football League quarterback summed up the problem: 'It's hard to soar like an eagle if you are surrounded by turkeys.'"

But how about the average soldier, sailor, or airman? What do we know about the productivity of men-at-arms discharging their responsibilities for national security?

First of all, I want to assure you again that the managers of the Department of Defense are indeed conscious that personnel-related costs consume about half their budget, and that the Armed Services have been pursuing policies intended to provide maximum defense per person in uniform. Not many Americans grasp what has been happening with modern weapon systems and force structure over recent years, and neither the anti-defense lobby nor the media have been receptive to representations, such as I am about to make, that the nation is buying efficient defenses.

Your Army is manpower lean: Today there are fewer soldiers in the Army for each combat division than at any time since before World War II. And the division of today has ten times the firepower of a World War II division and is proportionately much more flexible and mobile; I will return to these relationships in a moment.

Your Navy is building ships which are not only more powerful than their predecessors, but far more manpower efficient. I am aware of the argument that the Navy has simply shifted manpower from ship to shore, but I submit that even if this be so, it is no mean accomplishment: better put expensive manpower ashore than in harms way at sea. The Secretary of the Navy, John Lehman, for one, points out that over the past 20 years his department has significantly reduced crew size and increased ship maintainability. He notes that in that period manpower, as a share of the Navy budget, has dropped from 20 percent to 18 percent, and he cites the case of the new anti-missile cruisers, which have both highly sophisticated weapons of long-range and probability of kill plus much improved reliability and which are manned by a crew of 319 compared with the cruisers they replace which had crews of 1600. As far as naval air is concerned, the new F-18 fighter, now replacing F-4s and A-7s, requires 15 percent fewer maintenance personnel per squadron per ship than the F-4, and 20 percent fewer per squaderon than the A-7.

As for the Air Force, the leverage on manpower efficiency exerted by its modern aircraft and ordnance is equally impressive. During August 1944, as Allied Forces broke out of Normandy, 3000 heavy bombers of the 8th Air Force flew more than 18,000 sorties. Something like 30,000 aircrew members were required for this effort. Today, 800 F-16 fighters, manned by just 800 pilots, could deliver the same tonnage of bombs over comparable distances, but much more accurately. To illustrate the last point, take the Thanh Hoa Bridge in North Vietnam, which up to the spring of 1972 had survived 872 bombing attacks during which 11 aircraft were lost. On 27 April 1972 eight sorties were flown using laser-guided bombs. The bridge was destroyed, and no aircraft were lost. High technology is productive in war--as the Syrians and Argentineans found out this year.

But, of course, however comforting such representations may be to you as fellow taxpayers, they are probably irrelevant to your own business pursuits. Let me offer, therefore, three guidelines toward increased productivity which I would lay down were this an audience of military professionals. I have chosen these guidelines with hope that the training or management techniques I describe will be of interest, and conceivably of some utility to you. And I want to be quick to say that were I conducting such a military conference, I

could ask for no better agenda than to have Dr. Worth Scanland and Dr. Ed Shriver, whom we in the services recognize as experts in these matters, to follow me as they will here this afternoon and Friday afternoon respectively. But to my first guideline:

Guideline One: Look for High Performers

Augustine writes with his tongue well out in his cheek, but militarily he is basically right about producers. I would offer a corollary to his law: the higher the technology in a given productive process, the more dominant the man in the loop. For example, no weapon system has been so extensively and expensively engineered to diminish the human role in battle as the modern fighter aircraft. The latest USAF fighter-bomber, the F-16, with its crew of one, compared to a B-17 Flying Fortress, with its crew of 10, can carry twice the bomb load, twice as fast, and act as its own fighter escort. Or take the F-15 air superiority fighter, which is fitted with a computer, a signal processor for its radar, with a 90K 24-bit memory and a speed of 100 million operations per second. That computer occupies just one cubic foot. Twenty years ago, a comparable computational capability could not have been fitted inside a fighter; it would have occupied 2000 cubic feet--and, incidentally, cost at least eight times as much.

Yet, you should understand that beginning with World War I and in every war to date, about 4 percent of all fighter pilots have accounted for 40 percent of air-to-air kills. In fact, Augustine's data on the RAF is less dramatic than that for all aces. In World War II, the top ten aces of England, Germany, and the US--just 30 flyers--shot down 3176 aircraft in air-to-air combat: better than 100 kills apiece on the average. USAF experience over North Vietnam was comparable to that in Korea and the two World Wars: pilot skill remained the primary factor in combat results. An ace indeed soars like an eagle, and an ace is a rare bird. But the average pilot is a turkey. The price of fighter pilot mediocrity has been so high, through all those wars, that less than one out of five pilots had better than a 50-50 chance of surviving his first decisive combat. One analyst, upon examining these data drew these conclusions regarding productivity:

"Any realistic assessment of the capabilities of projected equipment must properly account for the variability of individual performance, and allow the selection and maximum exploitation of the rare capabilities of the best operators, while raising to a maximum the performance of the less skilled."\*

Another analysis of these figures written in the mid-'60's, held that:

"With intensive pilot training and selection, an air force could develop a pilot group capable of sustained 5:1 to 10:1 exchange ratios against any air force that simply produces pilots on a standardized production line curriculum."\*\*

\*Herbert K. Weiss, "Systems Analysis Problems and Limited War," Conference 18-20 Jul 66, Annals of Reliability and Maintainability, New York, NY, 1966, V5.  
\*\*COL J. N. Merritt and P. M. Sprey, "Money for Men or Material," unpublished.

In 1973, at the outset of the Yom Kippur War, the Arab:Israeli fighter ratio was 2.5:1, the air-to-air loss ratio was 56 Arabs shot down for every Israeli. The recent fighting over Lebanon produced similar lopsided results.

A naval weapon system which exhibits similar characteristics is the attack submarine. Over the last two decades the Navy has upgraded its sub fleet from diesel-electric types to nuclear powered boats and fitted the latter with powerful suites of hunter-killer devices. The new subs do have larger crews--about 20 percent more men. But a modern Los Angeles class nuclear attack submarine can search through 10,000 square miles of ocean in a 24-hour period, nearly 10 times what predecessor craft could cover, detecting enemy six times further out, attacking with homing torpedoes from three times as far, or with anti-ship missiles from over the horizon at ranges of up to 60 nautical miles. The Tomahawk cruise missile, just entering service, extends that strike range to 250 nautical miles--a far cry from the eight mile maximum-reach of the old subs.

But again, history tells us that the productivity of attack submarines is a direct function of the aggressiveness and skill of the submarine commander. We have to go back to World War II for extensive data, but from US experience of that vintage, the productivity of submarines seems to depend directly on who is in command--successful commanders transferred to crews with mediocre combat records took their "luck" with them and built on their record. Like fighter pilots, submariners, by the act of engaging an enemy, often precipitated a deadly duel. And like fighter pilots, a novice commander's chances of surviving his first decisive combat were not inviting. The data shows that once a commander scored his first kill his chances of surviving for further kills improved by a factor of three.\*

Probably similar relationships exist among land combat weapon systems, but land battles are often less duels than melees on which all records are suspect. We can draw some inferences. For example, we know of four tank battles of the Yom Kippur War of 1973 involving altogether nearly 2000 tanks. Half of all the participating tanks were destroyed or damaged--a good measure of the intensity of modern battle. But of those tank casualties, the Arab share was more than 90 percent. Materiel cannot account for this lopsided result, because in many cases the Israelis were using captured Soviet-made tanks identical to those in use by the Arabs; and, in any event, the Israelis were outnumbered overall better than 2-1/2:1. Rather, it seems reasonable to impute this disparity in Israeli versus Arab productivity to higher human performance: to more skilled Israeli personnel managers, more adroit Israeli trainers, and more deft Israeli tacticians.

To generalize, land forces exist to gain or maintain control over territory; hence, one important measure of force productivity is extent of area controlled. If one goes back to the time of the War Between the States, one would find that an infantry organization proximate in size to the present day battalion--say 600 to 800 men--would be expected to control with its organic and supporting direct fire weapons an area perhaps 20 acres in extent. In World War I a battalion was expected to control some 160 acres, a very substantial increase

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\*Weiss, op.cit.

over its Civil War predecessor, reflecting the prowess of the Springfield Rifle, the Browning Machine Gun, and the very much more formidable indirect fire support available in 1918. In 1945, a battalion on defense, because of yet more firepower, would be expected to control something like 400 acres, perhaps two and a half times the area held by the World War I battalion. But in 1980, in Germany today we expect a battalion to control as much as 18,000 acres--that's 40 or 50 times as much as 1945. Part of this productivity expectation arises from gross increases in firepower--over ten times as much, measured in projectile throw-weight alone--and part from the greatly improved mobility, sensors, and communications available to the modern battalion.

Parenthetically, it is sometimes mistakenly believed that increases in area controlled and firepower such as I have just described occasion greater costs in terms of casualties. In the US Army experience, this has not yet been the case. Our casualties as a percent of combat troops per year were approximately the same in 1864 as they were in 1918, and the numbers for 1918 are very similar to the numbers for 1945, and, indeed, for Vietnam in 1968. Our experience in Korea, incidentally, was somewhat lower than either World War II or Vietnam in 1968.

The reason casualties have not risen proportionate to the increase in firepower is dispersion. As the figures on expansion of the area of control suggest, we have over the years endowed our units with the technological means to operate while spread out, and the very process of spreading out has reduced their vulnerability. In fact, reckoning from the slice of men behind a given frontage, one can demonstrate that we have reduced the density of manpower at risk on the battlefield nearly one-hundredfold since 1918. But we have also thereby multiplied the demand for productive effort from each soldier, and magnified the importance of soldier initiative and energy, and leader skill and adaptability. We expect that man-density on the battlefield will continue to go down. Hence, no matter how elegant the technologies we bring to bear, each soldier and leader in future battle is likely to count for more than ever before toward accomplishing the unit's basic mission; and selection, training, and motivation of soldiers and leaders will weigh the heavier on the scales of battle.

Conclusions that such human factors dominate unit productivity in land warfare seem well borne out by my own personal observations in Korea and Vietnam and by the research of S.L.A. Marshall and others in World War II. "SLAM" Marshall in his seminal work, Men Against Fire, recorded the results of painstaking after-action interviews:

"In an average experienced infantry company in an average stern day's action, the number engaging with any and all weapons was approximately 15 percent of total strength. In the most aggressive infantry companies, under the most intense local pressure, the figure rarely rose above 25 percent of total strength from the opening to the close of action. . ."

"Of course there were many other active files doing yeoman service in supply, communications, and other missions. Men do not progress in battle by fire alone, and without the others the efforts of the firers would have been unavailing. But the point is that . . . the same names continued to reappear as having taken the initiative and relatively few fresh names were added to the list on any day. . ."

I have personally watched infantry units in two wars succeed under fire because of the initiative of a very few doer-leaders, who were often not in the command hierarchy at all, or lowly therein, whose individual initiative, energy, and courage cleared resistance and emboldened the herd. I see in my mind's eye men I knew in Vietnam only by sobriquets like "Randy Joe" or "Brillo" who were lead scots for their outfit, thriving in that position of gravest hazard, secure in their own savvy, basking in the special thrust and confidence which their leaders and their comrades reposed in them, but otherwise disdainful of rank or recognition. I see Corporal Lester, from whom I learned as a lieutenant to know, love, and fire expertly the Browning Automatic Rifle and to use TNT as casually as pistol ammunition--Lester whom I bailed out of jail in Columbus, Georgia, for trying to blow the bridge to Phenix City; Lester who went to earn posthumously a Medal of Honor in Korea.

Across all the Armed Services, such high-performers seem central to productivity. But how do we identify and develop these? One answer is explicit in my second suggestion:

Guideline Two: Use Experiential Learning

SLAM Marshall, writing in 1947 despaired of finding high-performers outside of combat itself. To quote him once more:

"We had better face the facts of life. Fire wins wars, it wins the skirmishes of which war is composed. . . Company by company we found in our work that there were men who had been consistently bad actors in the training period, marked by the faults of laziness, unruliness, and disorderliness, who just as consistently became lions on the battlefield, with all the virtues of sustained aggressiveness, warm obedience, and thoughtfully planned action. . ."

"Did these earlier signs of indiscipline then provide light in the search for men who would probably act well in battle? Not at all! Fighting alongside the rough characters and taking an equally heroic part in the actions were an even greater number of men whose preliminary conduct had marked them as good soldiers. In the heat of battle these forceful individuals gravitated toward each other. The battle was the pay-off. . ."

"There is no feature of training known to any company commander I have met which enabled him to determine, prior to combat, which of his men would carry the fight for and which would simply go along for the ride. Discipline is not the key. Perfection in drill is not the key."

But were SLAM Marshall alive today he would be pleased to discover that all the Armed Services are working with forms of training or drills unknown in World War II which can find high performers, develop their skills and thus lead to much higher productivity.

The US Navy in its aviation training, for example, has made excellent use of techniques which pit learner pilots against skilled adversaries flying planes whose size and agility approximate those they would be likely to face in combat. During the Vietnam War, from 1965 to 1968 the Navy's kill ratio in Southeast Asia was a little better than two for one. Disappointed at this showing, in 1968 the Navy shifted to teaching its flyers how to fight North Vietnamese MiGs by simulating MiG's in dogfights. In 1969 the first Navy and Marine graduates of this training reached the fleet; shortly thereafter, air-to-air combat productivity went up six-fold. The Navy-Marine kill ratio from 1970 to 1973 was 12 to 1.

The US Air Force, meanwhile, flying in many cases the very same aircraft, never got much better than two for one throughout the Vietnam War. In 1974, however, they borrowed a leaf from the Navy's book and set up so-called Aggressor Squadrons, equipped and trained to fight like Soviet MiGs. These were then put to use on well instrumented combat ranges--chunks of reserved air space where all the maneuvers and simulated firing during a dog fight could be recorded for use in critiquing the performance of participants.

The Air Force, in explaining why they had recourse to such expensive training, cites historical data which illustrate that if pilot survives his first combat (in which, as I have remarked, his probability of being shot down is very high) and then goes on through as many as ten combats, he reduces his vulnerability to loss by a factor of three. Therefore, the Air Force reasoned, 10 vicarious combats, through experiential learning, might leap pilots ahead on the curve of declining expectation of loss, with the net effect being one-third more expensively trained pilots available, and the avoidance of risk to a corresponding number of very costly aircraft.

I spoke earlier of attack submarines. The US Navy has built into its modern attack boats a computer-simulator which generates the cues to put the commander and his whole crew through their paces in tactical situations ranging from quite simple to very intricate attacks, and which measures and records their responsiveness for subsequent evaluation and remedial action.

The land force analogue is a relatively new type drill which the Army refers to as "engagement simulation." In its most advanced form, engagement simulation employs MILES devices. The acronym, which stands for Multiple Integrated Laser

Engagement System, was chosen for congruence with the Latin for "soldier." It describes a family of small, light-weight eye-safe lasers and laser detectors designed to simulate direct fire projectiles of various types. A participant's weapon shoots a blank, acoustically activating a laser, which sends a pulse of energy downrange. Each pulse is coded for type weapon. Detectors, worn by all participants, built with a logic-chip specific for type targets, can discriminate incoming signals as lethal or non-lethal, determine whether there was a hit or a near miss, and signal the target accordingly. MILES permits two-sided battle, in which the interactions among direct fire weapons--rifles, machine guns, tanks and anti-tank weapons--can be experienced with verisimilitude. Incidentally, the Army adopted the MILES hardware on the recommendation of the management consulting firm Arthur D. Little, and one of the chief contributors to development of the associated training technique was Dr. Ed Shriver, of Kinton, Incorporated, from whom you will hear in Session VI.

Properly employed, MILES is used in conjunction with motivational techniques borrowed from organizational development, or organizational effectiveness as it is known in the Army. Pivotal to the mock battle is an after-action review in which the lessons from each "casualty" inflicted during each battle are reviewed with each party to the casualty before the assembled unit, and tactics germane to the overall outcome are criticized. This technique stimulates very American "win" and "succeed" urges, and evokes genuine enthusiasm among participants. Repetitive "battles" using MILES then reinforce the lessons of these experiences and facilitate rapid individual and collective learning.

The superiority of engagement simulation over more traditional forms of tactical training has been well documented in carefully structured tests, by Ed Shriver and others, which compared units trained via engagement simulation with like organizations intensively but conventionally trained. One of the US Army Research Institute scientists\* who participated noted not only that engagement simulation proved to be a dramatically superior way to train line units, but also that the tests disclosed a deplorable lack of tactical proficiency throughout the whole tested population. To quote from one of his comments:

"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 weapon systems. Ill-prepared tactical units can only weaken the deterrent effect of US ground combat forces . . . engagement simulation training methods can provide one means for making much-needed improvements in the proficiency of small combat units."

But productivity in this sense is looking up. Just last week I received a copy of a letter to General Jim Gavin--former Chairman of the Board of A.D.L.--from the commander of our 24th Division inviting Gen Gavin to watch MILES training at Fort Stewart, Georgia. I'll quote from that letter:

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\*Scott, T.D., "Tactical Training for Ground Combat Forces," Armed Forces and Society, UNC Press, Vol. 6, No. 2, Winter, 1980.

"We feel that we have made truly exciting progress in small unit training as a result of the laser engagement system, in combination with battle drills. Soldier skills and junior leadership are well on the way to a startling improvement. MILES allows soldiers and leaders to learn things that up to now could be purchased only with the sacrifice of lives on the battlefield."

Engagement simulation with MILES has the advantages of showing the "bottom line" for training: for the whole tactical team there is, as in real combat, a winner and a loser, and the outcome is the sum of the interactions among all participants. Let me resort at this juncture to the inevitable quote from Clausewitz On War:

". . . just as in commerce the merchant cannot set apart and place in security gains from one single transaction, so in war a single advantage cannot be separated from the result of the whole. Just as the former must always operate with the whole sum of his means, so in war only the final total will decide whether any particular item is profit or loss."

Commanders need to know whether their units can, as our kids say it, "put it all together" to produce a win under conditions approximating battle.

But MILES also shows leaders the stuff of which their followers are made. And, as importantly, the after-action review subjects leaders to the frank appraisal of those followers--as you can readily imagine, private soldiers and junior non-coms are devastatingly frank and invariably accurate in pointing out maladroit tactics. I believe that with MILES we can build a new generation of tactically savvy units--vicarious combat will save us lives and win battles. That is good news indeed. I can vividly recall accompanying the Chief of Staff of the Army to an after-action review of a mock battle just concluded, a critique which was, of course, entirely unstructured and unrehearsed. What we heard was an inspiring blow-by-blow account of a tank company team's attack on a hill in which the team commander and all his officer platoon leaders were knocked out of the fight in the first bursts of fire from the defenders. But the artillery forward observer, a second lieutenant not one week in Germany, fresh from the Artillery School, took command and skillfully used fire and maneuver to win the objective. Needless to say, in that outfit the young gold-bar then and there won his spurs. And I can tell you that he was no more elated than the Chief of Staff, who declared that with just a few hundred lieutenants like him, the U.S. Seventh Army would be unbeatable.

This leads to my next recommendation:

#### Guideline Three: Train from the Top Down

Usually, productivity is taken to mean providing against incompetence at the bottom of an organization, to improve the skills and motivation of operators and maintainers, or to upgrade their first-line supervisors. But in military

organizations the finesse of those wearing stripes or bars is readily overwhelmed by bungling on the part of those wearing the stars--generals' mistakes can be costly indeed. I believe it is true that even very proficient companies can be compromised by clumsiness or procrastination by their battalion task force command, and even very good battalions can be undone by fumbles at brigade, division or higher command. In the summer of 1978, when I was in command of a division in Germany, I cooperated with the Army Research Institute to overlay an experiment in productivity assessment on some very earnest readiness training for the commander and staff of 12 of my line battalions. We tried to keep the assessment transparent to the participants, and I think that in a large measure we succeeded. From their point of view, they "fought" four battles in the Saarland over four days, "defending" a sector in the Old Germany Westwall against a hypothetical Soviet onslaught out of France, and performing reconnaissance and other troop-leading procedures on the ground. They were required to cope in their command posts with the time-stress involved in devising plans and issuing orders, in shifting forces and fires to meet a wily and aggressive enemy, and in sustaining their units logistically. We controlled the pace to feed them successively more complex situations, ever faster.

Two comments may help in generalizing on this sort of training. First, it is driven by two-sided competition, that is, participating commanders and staffs are pitted against a putative enemy commander and his staff, composed of intelligence professionals. The outcome of the contest between the two forces is adjudicated by a battle simulation, a war game of sufficiently fine grain that the siting of principal weapons can figure individually in the calculus, and of sufficient speed that game time can be real time whenever control chooses, and for whatever duration desired. Before the advent of computers, this sort of training was manpower intensive and very difficult. Today microprocessors with flexible software permit these games to serve not only assessment and enhancement of readiness, such as I have described, but also to serve as tutorials in new doctrine, weapon systems, or standard operating procedures.

Second, the assessment results invariably confound supervisors. While as a general rule a higher commander will be able accurately to predict which subordinate will perform well or poorly, surprises will occur in both directions. The taxonomy of such miscalls shows on the one hand bright, capable, articulate commanders who have not formed a staff team, and who try to fight the battle single-handedly, and on the other hand lackluster commanders whose personal deficiencies are well compensated for by a very competent staff. The former burns himself out very quickly under stress. The latter can produce steadily and well in crisis.

The assessment outcomes in Germany were surprising to me. The battalion commanders and their staffs were all professionals with very similar backgrounds, and the commanders themselves had been selected for command by an Army-wide board. All were in units with virtually identical readiness ratings, and all were equipped with the same mix of weapon systems. One might have reasonably estimated going in that the units performance or productivity would be as like as peas in a pod. But it turned out that some were much better producers than others, and it was possible to group the 12 units into two quite distinct

productivity groups of six each, as measured by timely accomplishment of unit mission, by the area of land controlled, by resources remaining post-battle, and by enemy versus friendly exchange ratios. I can tell you that the experience convinced me to look hard at my own criteria for evaluating subordinates lest I weigh too heavily purely personal capability, garrison flourish or commander's conference virtuosity, and thereby be party to boosting into higher rank a rabbit of our profession over an ultimately more productive turtle.

In devising this assessment, once again we had broad recourse to organizational development technique. Trained organizational effectiveness consultants were stationed as observers in each of the participating battalion command posts, where they made detailed notes on the team work among the commander and his staff members. These notes were used to prepare an independent assessment against a second set of criteria, termed "competence scores," which measured behavioral factors like sensing, communicating information, decision making, stabilizing, communicating implementation, coping actions, and feedback. After each battle the OE consultant counseled the battalion commander on what was transpiring within his command group relating to each of these criteria. Disparities among the participating battalions, when measured using these behavioral criteria, proved to be identical to differential rankings derived from the more traditional military measures of effectiveness. From the first to the fourth battle, moreover, whether measured by military or OE MOE, we demonstrated that we could drive productivity upward. In the Army Research Institute report, the authors noted that the largest differences among participants in any battle were scores on mission accomplishment and force exchange ratios:

"The latter is particularly noteworthy in view of current U.S. 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 score (the organizational effectiveness measures of effectiveness) had better loss exchange ratios (military measure of effectiveness)."

The ARI researchers further noted that these more productive battalions were also rated strongest in the OE MOE related to "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). I consider the results of this experiment a remarkable confirmation that organizational development techniques can be used directly to address productivity for combat, or combat readiness.

The urgency of finding ways and means of training our senior executives is directly proportional to rank. I earlier discussed the exponential growth in area controlled by land forces, in firepower and in force mobility. These factors have multiplied exponentially the information which must be mastered by

command, and correspondingly reduced the time available for command decision. And comparable developments have occurred in air and naval war. Whereas an officer of my age and rank might once have contemplated waging war from a posh chateau or a commandeered hotel, insulated from the battle by an elaborate staff and cushioned from events by hours, even days, today he must visualize himself as the hub of a 24 hour per day information network, testing for reality, coping, and communicating the while. I think most of you are aware of the heavy investments in formal professional training we in the military have been willing to make: the usual general will have spent 10-15% of his post-commissioning service as a student. In my own case, in 32 years as an officer I have spent 6 actually in school, 4 assigned to a school faculty, and 4 serving as a training manager: over 40% of my career. Yet little if any of that training or education has directly prepared me for the exercise of command in modern battle as I have just described it. I personally advocate, in the interests of productivity, continuing education for generals, exploiting inter alia battle simulation, to prepare them for the rigors of command in battle today.

Let me summarize. I have reported that the armed services have found it useful, in promoting productivity for the grim business of war, to seek out high performers, to use experiential learning both as a means of identifying these and of developing teamwork, and to train top down as well as bottom up, I have mentioned applications of organizational development to these ends. You will have recognized that these three approaches are not only complementary, but overlapping. In closing, I want you to know that there is much else going on within the Department of Defense conducive to productivity that time precludes my mentioning, such as improved individual skill training and job aids, but of these you will hear more later.

I invite your comments or your questions.