PRODUCTIVITY FOR DEFENSE

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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." While that wry Yankee observation may have been as true in the age of Moses or Shakespeare, it has particular poignance today, when in industry after industry managers puzzle over why, despite broad recourse to the most modern forms of enlightened management and extensive automation, they have to hire more and more people to perform added work caused by inept maintenance, labor turnover, absenteeism, flawed quality control, bottlenecks and shortages. We in national defense are peculiarly vulnerable to the contemporary productivity paradox. This is so not only because the manufacturers of our weapon systems have encountered cost-overruns from procurement delays and extraordinary inflation in costs of labor, materials, and parts, but also because of the military manpower policies of four Administrations which have thrust the Armed Services into the marketplace as key competitors for the nation's marginal manpower, with all that connotes for increased military personnel costs, and for the real capability of the men and women in uniform for using or servicing modern high-technology weapon systems. Like industry, then, we too have begun to pay serious attention to personnel and training factors, to selection, preparation, motiviation, and man-management: in short, to productivity.

The Chairman of the Defense Science Board, Norman R. Augustine, is about to bring out a 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. In it, the author observes 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

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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 completed staff actions by sections of the Joint Staff last year.

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? What are we to believe concerning today's media spewings about the Armed Services having costly, gold-plated, too-complicated weapon systems manned by overpaid, illiterate duds? Can Defense cope with its manpower albatross?

First of all, in the macrocosm it seems evident to me that the Department of Defense is indeed operating conscious of the fact that personnel-related costs consume about half the budget, and that the Services have in fact been pursuing policies intended to provide maximum defense per man in uniform. Not many Americans grasp what has been happening with modern weapon systems and force structure over the two years, and the media have not been receptive to representations, such as I am about to make, that you are 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 inherently much more flexible and mobile.

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 its 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 at risk--better a Sheffield cost than a Belgrano cost. Secretary 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 Aegis 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 requires 15% fewer maintenance personnel per squadron per ship than the F-4, and 20% fewer per squadron 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.

But, of course, while such historical perspective is useful, much more needs to be said about the personnel efficiency of modern weapon systems. I suggest to you, as I have officially to the Army, that the productivity of any system--referring to its bottom-line effectiveness, considering all that goes into fielding, manning, maintaining, sustaining, or using it operationally--is a function of three factors: (1) the inherent capabilities built into the materiel; (2) the proficiency of its operators or maintainers; and (3) the tactics or techniques by which it is employed. The weapon, its crew, and how it is used or managed in battle, all figure prominantly in its productivity.

For example, take these factors as they apply to modern fighter aircraft. To understand how technology has been boosting performance of systems, let me remind you that an F-16 fighter-bomber has a crew of one, compared with B-17 flying fortress, which had a crew of 10. But an F-16 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 98K 24-bit word memory and a speed of 100 million operations per second. That computer occupies one cubic foot. Just 20 years ago, a comparable computational capability could not have flown in a fighter: it would have occupied 2000 cubic feet--and, incidentally, cost at least eight times as much.

In fact, no weapon system has been so extensively and expensively engineered to diminish human influence on battle outcome as the modern fighter aircraft. Yet, beginning with World War I, and in every war to

date, about 4 percent of all pilots have accounted for 40 percent of air-to-air kills. Augustine's data on the RAF is less dramatic than that for all aces. USAF experience over North Vietnam was comparable to that in Korea and the World Wars: pilot skill remained a primary factor in combat results. An ace indeed soars like an eagle, and an ace is a rare bird. The average pilot is a turkey. The price of fighter pilot mediocrity in war has been so high, through all those wars, that less than one in five pilots had better than a 50-50 chance of surviving his first decisive combat. One analyst,* upon examining these data concluded that:

> "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 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."

The Arab:Israeli fighter ratio was 2.5:1 at the outset of the Yom Kippur war; the air-to-air loss ratio was 56:1.

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

*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 Materiel," unpublished.

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 missiles from over the horizon at ranges of up to 60 nautical miles. When the Tomahawk cruise missile enters service this summer, that strike range will increase to 250 nautical miles--a far cry from the 8 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 melee 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

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Weiss, op.cit.

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, were outnumbered overall better than 2½:1. Rather, it seems reasonable to impute this disparity in Israeli versus Arab productivity to intangibles: to better Israeli personnel selection and training, to deft Israeli leaders.

To generalize, land forces exist to gain or maintain control over territory and the inhabitants thereof; hence, one important measure of productivity is area controlled. If you go back to the time of the War Between the States, you 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 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 and part from a technological leap--the greatly improved mobility, sensors, and communications available to the modern battalion.

Now it is sometimes misunderstood that increases in firepower such as I have just described occasion greater costs in terms of casualties. In the U.S. Army experience, this has not yet been the case. Our casualties as a precent of combat troops per year were approximately the same in 1964 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 the amount of area that a battalion is expected to control suggests, 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 on each soldier and magnified the importance of soldier initiative and energy, and leader skill and adaptability. We must 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 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. . ."
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> "The willing riflemen, grenadiers, and bazooka men who had led the attack and worked the detail of destruction upon the enemy on a Monday would carry the attack when the fight was renewed. . . on Wednesday. The hand that pulled the trigger was the same hand that was most likely to be found tossing a grenade, setting a satchel charge, or leading a sortie in the next round."
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> "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 work of the others the efforts of the firers would have been unaviling. 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 scouts 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 on to earn posthumously a Medal of Honor in Korea.

How are we to find the Randy Joes, the Brillos, the Lesters for tomorrow's battles? A modern line battalion is a complex nexus of weapon systems. How should we identify and train weapon-system crewmen for modern weapon systems? Or more accurately, how should we coach unit leaders to do this, and to usethem well in battle?

To quote "SLAM" Marshall again:

"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. . ."

"How much then does training have to do with it? Probably this--that it enables the willing soldier, the man who will fight when he gets the chance, to recognize the breadth of each opportunity and to know when and where to use his fire to full advantage and with regard for his own need of protection. It may also stimulate and inform the man who is already fixed with a high sense of duty so that in him the initiative becomes simply a form of obedience."

"But more than that it is not likely to do under present methods and until the principles by which we attempt to establish fire disciplines are squared with human nature. We are on infirm ground when we hold to the belief that the routine of marksmanship training and of giving the soldier an easy familiarity with his weapon will automatically prompt the desire to use the weapon when he comes under fire."

"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 along for the ride. Discipline is not the key. Perfection in drill is not the key."

Remember now Slam Marshall wrote the foregoing in the aftermath of World War II. I wish he were alive today, because I believe the Army could show him a feature of training now known to many line commanders which enables leaders better to determine prior to combat which of their men are likely to carry the fight, or at least who are more able to contribute to unit productivity on the battlefield. This training is a 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 eye-safe lasers and laser detectors designed to simulate direct fire weapons of various types. Instead of firing a projectile, the weapon shoots a blank, acoustically activating the laser, which sends a pulse of energy downrange. Each pulse is coded for type weapon. Detectors, 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. Used by all participants in a tactical exercise, MILES permits two-sided battle, in which the interactions among direct fire weapons--rifles, machine guns, tank and anti-tank weapons--can be experienced with verisimilitude. Incidentally, the MILES design goes back to 1971 and General Jim Gavin's A. D. Little intervention on behalf of dynamic Army training. With MILES I believe that the Army has at last fielded a way to train for both weapon proficiency, and for tactical finesse.

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 training 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. Repetitive "battles" using

MILES than reinforce the lessons of these experiences, and facilitate rapid individual and collective learning.

The superiority of engagement simulation over other more traditional forms of tactical training has been well documented in carefully structured Army Research Institute tests which compared units who 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 similation is 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."

Let me also quote from the report of a division, stationed in Germany, which conducted extensive tests using the MILES engagement simulation devices:

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

"The actions and reactions of the leaders and individual soldiers resembles seasoned combat soldiers who have learned their lessons on the battlefield...the value of MILES goes far beyond tactical proficiency. Our observations indicated that it enhanced individual motivation, job satisfaction, and unit morale. The secondary effect of this phenomena resulted in improved maintenance and weapons proficiency: the soldiers wanted their equipment to work so that they could get out to the MILES training. . ."

This US Army-Europe Division, which at the time (1979) had perhaps broader experience with engagement simulation than any other division in the Army, and with extensive live firing under its belt as well, saw in MILES not only better training, but new opportunity:

--To train at night with passive and thermal sites against realistic targets.

--To extend range "firing" times at night and weekends beyond the German-noise imposed curfews at major training areas.

--To train on farm land or at home station in ways never before possible.

--To reward tactics of engaging from flank or rear.

That division became convinced that engagement simulation stimulates productivity both in terms of operator proficiency and leader skill in small units.

For you in industry, recognize that MILES is a strap-on system, literally an after-thought to weapon system development, but significant in that it offers los-cost, high effectiveness leverage which could have had even lower cost embedded in the system itself. For you in the military, note that it is a tactical integrator which boasts readiness directly, and should therefore offer important advantages for both RDT&E and O&M funding.

There remains, however, the problem of tactical leadership at the battalion or brigade, or even division echelon. I believe that it is true that even very

proficient companies can be compromised by maladroitness on the part of their battalion task force command, and even very good battalions can be undone by clumsy brigade or division command. In the summer of 1978, when I was in command of that division in Germany earlier referred to, we overlayed an experiment in productivity assessment on some very earnest readiness training for the commander and staff of 12 of my line battalions--armor and infantry units, plus a cavalry squadron. 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 putative Soviet onslaught out of France and performing reconnaissance and other troop-leading procedures on the ground. They were required to cope in the command posts with the time-stress involved in devising plans and issuing orders, in shifting forces and fires to meet a wiley and aggressive enemy, and in sustaining their units logistically. We controlled the pace to feed them successively more complex situations, ever faster. The assessment outcomes were surprising. 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.

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 assessment against a second set of criteria, termed "competence scores" which measured 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 were measured using these criteria, were 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 effective battalions were also rated strongest 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 effectiveness can be used directly to address productivity for combat, or combat readiness, and I submit that the Army would be well advised thus to identify and promote upper-half producers among its battalions well in advance of its next battles.

Let me sum up: I suspect, but can adduce no conclusive evidence to prove, that quality fighters dominate the land battle as thoroughly as fighter aces do the sky, or attack subskippers their watery domain. As the cost of raising, equipping, and training units for land warfare rises, it is imperative that we search for ways to identify and to train those quality fighters so as to assure optimum productivity for those more expensive units. The simulations that I have just described offer very powerful approaches to achieving that productivity. What is required now is a determined effort by the Army's leadership to apply these training techniques broadly within the force, extending them in depth and in breadth through the medium of groups such as are represented here today.