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PFG

ORSA & TRAINING

10 Dec 74

THE SYSTEMS APPROACH

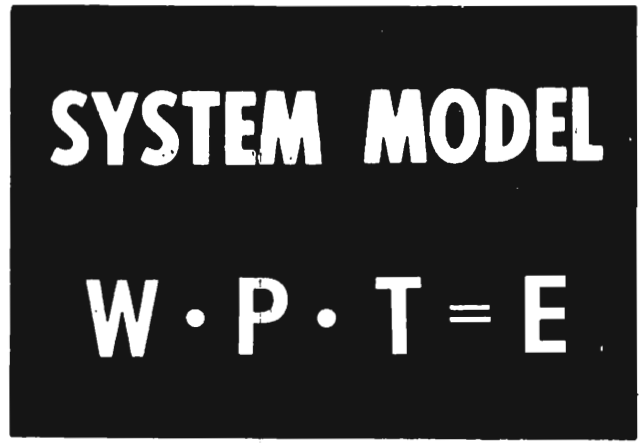
The purpose of this presentation is to explain the need for a new approach to training, a systems approach. The systems approach is a method which ensures that each component of the system is examined in detail in order to develop knowledge about the components, their interrelationships and dependencies. The systematic investigation of all its parameters will lead to the ability to measure quantitatively a systems' worth and its limitations. Through these measurings, information is developed which forms the basis of decisions about the system: "Is is worth its cost (actual or proposed)? How can it be improved? Should it be replaced? Is it operating at its designed effeciency and if not, why?"

SYSTEMS APPROACH TO TRAINING

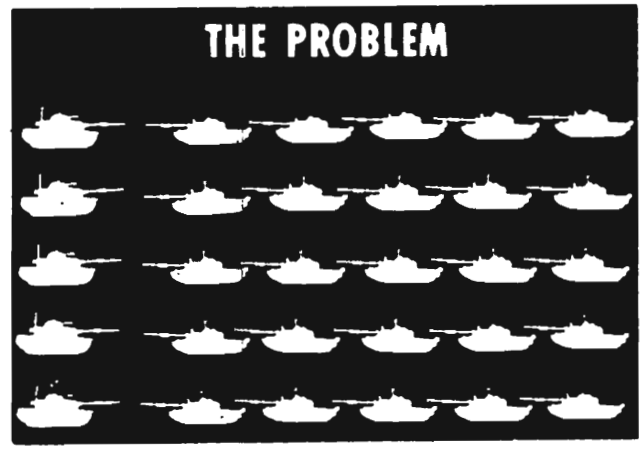
The correct answers to these questions are absolutely essential not only to managers of the TRADOC training base, but also to commanders throughout the Army and to those who manage the Department of Defense Budget. The justification for all systems, including weapons and associated simulations systems must be stated in terms that allow those who control the allocation of resources to evaluate comparatively operating or proposed systems. Where systems have training impact, that too must be measured and explicitly quantified.

The analysis of training in the past has not had the benefit of this systematic approach. It is necessary for the present as well as the future, to consider seriously systematic analysis as the only way to proceed in determining what is being done right or wrong with training, and what direction should be taken in the future. Presented here are two rather homely examples to illustrate what is meant by systematic analysis.

Shown on this slide is a model for systems effectiveness. It is a good model because it is specific enough to describe its components and their interrelationships, yet sufficiently general to permit an investigation of the system as a whole, preventing sub-optimization of its component parts.



Weapons systems effectiveness, "E" is a function of the capability of the weapon, "W", the proficiency of the individual or crew that mans the weapon, "P", and the tactics and techniques by which the commander employs the weapon, "T". So efficiency, or E, is a function of all three of these factors and any analysis of training efficiency has got to lead us through an assessment of the weapon, the proficiency of the individual's handling of the weapon, its role in the tactical scheme directed by the commander, and the interrelationships among the three factors.



The problem addressed here at the outset can be simply stated in terms of our facing on the first battlefield of the next war, enemy tanks that will outnumber ours by a factor of something like 5 to 1.

That's the problem; how to win that first battle of the next war, though outnumbered. We've been outnumbered in tanks for a long time. And it's been apparent since at least the early fifties, that our productive capacity to turn out tanks will not bring us to parity in the number of tank systems. Ergo, we have placed emphasis on the development of anti-tank systems.

This is a chronology of the introduction of anti-tank systems into the Army inventory. It should be pointed out that this is active Army inventory. For example, in 1974 the New Jersey National Guard is still equipped with the 3.5 inch rocket launcher, and trains with it.

The first weapons system that we will track through the model is the lightest and least pretentious of all of the anti-tank systems that the United States has in its inventory at the present time: the M72 LAW. We've had a very bad track record with light anti-tank weapons. We were the first nation to recognize the need for such a weapon; that is to say, a weapon which in the hands of an individual soldier would reliably kill an attacking tank. The "bazooka", the 2.36 inch rocket launcher, was produced in the United States in 1942 and was probably the first such weapon developed by any nation in the world. Difficulties with this weapons system began almost immediately. There were two errors: the bazooka was handled as a secret weapon, literally, and it was vastly oversold. It was represented to the field forces as being capable of penetrating any known tank.

In the fall of 1942, while the 505th Parachute Infantry was training at Fort Benning, the 2.36 inch bazooka was being tested there, under deep security wraps. GEN Jim Gavin, then a colonel commanding the 505th, one day noticed some curious explosions on a nearby range. He went over to determine the nature of the weapon that was causing the explosions, and there found a supersilious Research and Development officer who, even though Gavin represented himself as commanding a regiment about to go into combat, declined to discuss the weapon with Colonel Gavin beyond stating it could kill any tank. He did allow Colonel Gavin, however, to feel the bazooka which was sitting on top of a field table under an Army blanket. Colonel Gavin, then just six months away from his parachute landing in Sicily acquired as much knowledge of the 2.36 inch rocket launcher as one could acquire through the folds of an Army blanket.

The 505th was issued the bazooka en route to North Africa and had a few days of practice with the system prior to being parachuted into Sicily. The regiment had not been warned that the Herman Goering Division and one other Panzer Division was in the area of the drop and shortly after landing, all elements of the regiment found themselves under tank attack. The 505th discovered to their dismay that the 2.36 inch rocket launcher would not penetrate the TIGER tank. One of the battalion commanders, Colonel Gorham was, in fact, killed firing a bazooka at an attacking TIGER. The 2.36 would either bounce off or get about an inch penetration in the frontal armor of the TIGER tank.

Despite our signal lack of success with the bazooka in its first combat experience, the 2.36 inch remained the Army standard light anti-tank weapon through 1950. In that year, we sent Task Force Smith against a North Korean force which was well-equipped with T-34 tanks. The experience of Gavin's 505th was repeated in Korea. The 2.36 inch rocket would not penetrate; it bounced off. General Gavin, then in the Weapons Systems Evaluation Group, went to General Ridgeway who was then Vice Chief of Staff. He had been both a Regimental and then Division Commander in the Sicily operation. Together they made a decision to fly the new 3.5 inch rocket launcher literally from factory doors to combat in Korea. The 3.5 inch rocket launcher was deployed in time to have it weigh as one factor in the Eighth US Army's success in stemming the Korean onslaught and turning that war around. The 3.5 inch remained in the inventory up until the mid-60's, when it was replaced by the light anti-tank weapon, M72 LAW. The new anti-tank weapon was of somewhat different design in that is was packaged as a round of ammunition and issued to other than an assigned gunner.

Our history with the 2.36, however, was repeated when in 1965 the 82nd Airborne was again sent into action, this time in Santo Domingo. It is literally true that the troops upon unloading at the arrival airfield were informed that the insurgents possessed armor; whereupon there was a crash training program at the end of the airstrip at Santo Domingo in which the paratroopers fired their LAWs for the first time. They went into action hours thereafter. The same experience was repeated in the Easter Offensive of 1972. Although the LAW had been in Vietnam for some years, it had not been used by either the American or South Vietnamese forces to any extent. When large numbers of tanks

materialized on the battlefield there, the LAW was virtually the only anti-tank resource immediately available to the South Vietnamese Army. Then again, a crash training program was necessary. The LAW quickly became one of the favorite weapons of the South Vietnamese. Its price on the Black Market is reported to have increased 20-fold within a month of the first tank attacks. In a MACV examination of 105 tank hulks in the vicinity of An Loc and Pleiku, 49 were discovered to have been penetrated by LAWS, as opposed to any other weapon. But the Vietnamese Army, as our Army, had to learn to use it in combat. That experience was repeated again one year ago in 1973 when the LAW was delivered in large numbers to the Israelis. The initial reports were that the Israelis didn't like the LAW; they preferred other anti-tank weapon systems to it. Subsequent investigation disclosed that most of their dislike was associated with its arrival at the 11th hour. Many of them never saw the LAW until they were literally in the front lines with enemy tanks just over the nearest hill. Their repeated assertion to us was that it's too late to learn to use a weapon system when in the midst of combat. Confidence in the weapon system must be achieved before it's put in the hands of a trooper on the battlefield. Otherwise, he won't use it. Such was the Israeli assertion.

On 6 December 1974, General Gorman, TRADOC's Deputy Chief of Staff for Training, assembled a group of about 20 company grade officers at Fort Benning and asked them what they knew about the LAW. These officers were all students at the Advanced Course and were assigned to a training analysis project, so presumably, had their minds focused on matters related to weapons systems and training. He asked them to tell him what the US Army doctrine on the LAW was. They came up with a list such as you see here. Doctrine can be

LAW DOCTRINE
(50%+ OF USA BELIEVES)

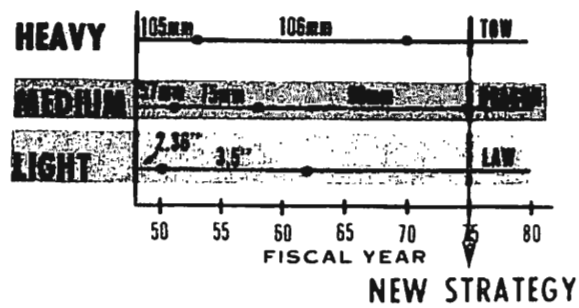
- INDIVIDUAL WEAPON
  (1 EA CARRIED BY 2 MEN/SQUAD)
- EASY TO TRAIN
  (NO TRAIN)
- BACK BLAST DANGER
- EFFECTIVE TO 400 METERS

defined in various ways. GEN DePuy defines doctrine as is shown on the last slide. If the majority of the United States Army believes something, then it's doctrine. You ought to understand that that's a pretty accurate description of what most officers in the United States Army believe about the LAW. The presumption is that a soldier upon being issued this weapon or round of ammunition, can, by reading the instructions printed on the side, put it in action against a Soviet T62 tank and reliably hit that tank out to 400 meters. As will be seen in this discussion, each of these doctrinal points has implications for the battle effectiveness of the system, and each point will be addressed to some extent as the analysis proceeds.

In 1975, the United States adopted a new strategy in the deployment of anti-tank systems. That strategy is reflected by the density of U.S. anti-armor weapons that can be brought to bear on any given battlefield. This strategy was adopted because of the availability of the DRAGON and the TOW systems as well as the LAW and can be described as a saturation of the battlefield with anti-tank weapons.

The basis of this new strategy is shown on this slide. We have more than doubled the number of available anti-armor systems within the infantry battalion which means that tactically, we can address the problem of anti-tank defense dramatically differently.

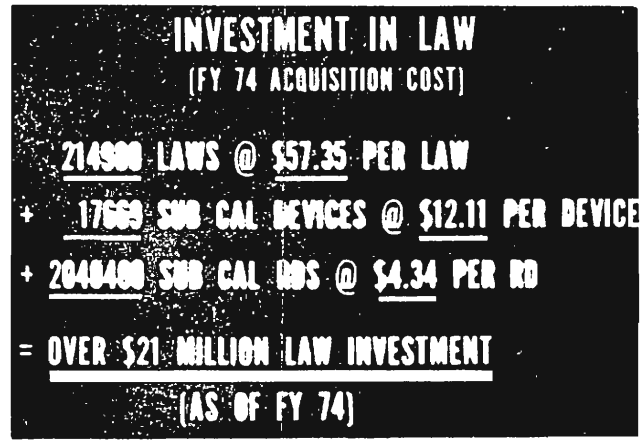
U S ANTITANK WEAPONS



ANTITANK WEAPONS
ORGANIC TO INFANTRY BATTALION

WEAPON	1965	1975
LIGHT	19	66
MEDIUM	18	27
HEAVY	11	18
TOTAL	48	111

Now, focusing on the light anti-tank weapon, we should be aware that the United States has a very substantial investment in the weapon system, as shown on this slide. At the end of FY 74 we had nearly a quarter of a million LAWS which cost nearly $60 each. In addition to the weapon, the Army purchased a simulation system - a subcaliber device consisting of a 35mm insert that is placed in the tube of an expended LAW and a small subcaliber rocket, which is fired through the 35mm tube. It is so constructed that it ballistically simulates the flight of the 66mm service rocket. So, overall the Army had over a $21 million investment in the weapons system.

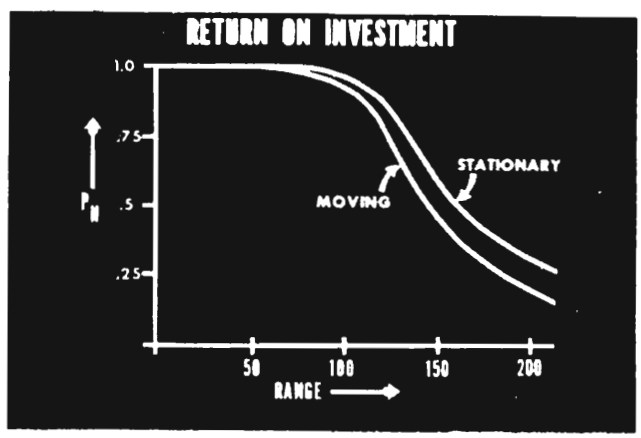


This system is of interest in a training sense because it is one of the few weapons systems in the United States Army where a decision was made at the time the system was developed to provide a simulator to the field for use in lieu of service practice ammunition. Service practice firing with the LAW system, had it been conducted in the ten years we were just discussing, 1965-1975, would have required an expenditure of over $50 million worth of ammunition. Those figures are based upon a presumption that we would have trained 30% of all active Army infantrymen on the standard LAW qualification course over the last 10 years. Had we invested the same amount of firing in subcaliber devices, we would have spent in that period only $400,000. That's a substantial savings through the use of simulation.

What is truly significant is that we didn't train with either. We didn't train with the service round because nobody considered it important. The presumption of most commanders, as will be shown in a moment, is that the LAW is an easy weapon to fire; therefore no training is required. And the simulator, although built into the original design of the weapon and part of the original buy, didn't become available to troops until 1971. So it has been in the system for less than

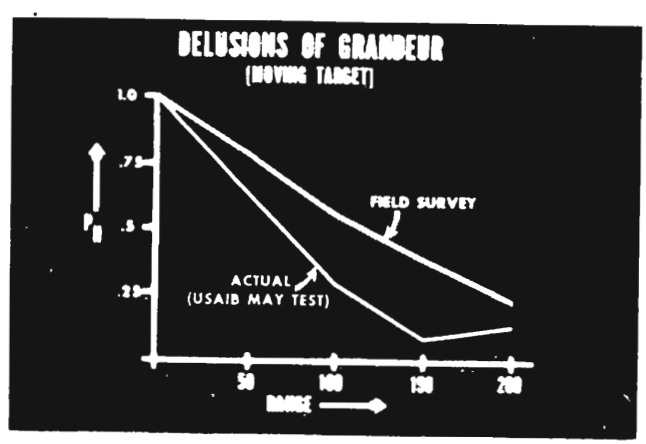
three years. Factually, when the 82nd Airborne was put on alert in October of 1973 for possible deployment to the Middle East, there was a frantic scurrying around Fort Bragg, North Carolina, in search of these rounds. The 82nd simply had not trained with the only weapon system that most of their troopers would have at their disposal to defend against Egyptian, or whoever's, tanks they would have to go up against. In any event, we have a large investment in this system, so let's see what it's worth; let's look at our return on investment.

These are curves that were developed by the Army Materiel System Analysis Agency of the Army Materiel Command for the light anti-tank weapon. They represent the probability of first round hit over range against moving and stationary targets. The significance of such curves is precisely that this is the way that data is organized by AMSAA and is therefore the sort of data that figures in weapons systems acquisitions. It is the way that systems analysts and weapons procurement officers evaluate a weapons system. They want to know when they invest $21 million in LAW, for example, what these curves would look like for that system.

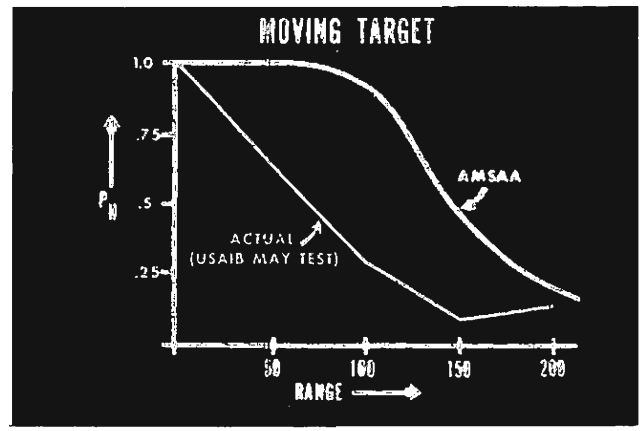


Now the next question is, "Is this what we really get for our investment?"

The Combat Arms Training Board asked that question by conducting a field survey in four CONUS divisions to determine how 24 commanders of Brigades and Battalions rated the operational capabilities of the LAW when fired by their gunners. They were asked to plot on a graph the probability of a first round hit over range. The results of that survey for moving targets are shown on this slide. Also shown for comparison is the actual return on investment; that is, how well troops trained with the LAW by the Army's best trainers can shoot.



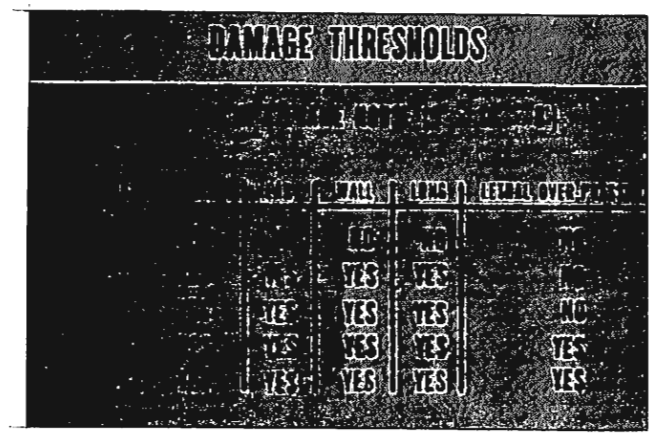
In the month of May, the Infantry School took a sampling of soldiers from the 197th Brigade and put them through the Army's standard 4-hour program of instruction on the light anti-tank weapon. The results reported here in the line labelled "actual" indicate that the soldiers selected in this sample performed significantly less well than the Army Materiel Systems Analysis Agency had been showing American soldiers capable of performing against moving targets.

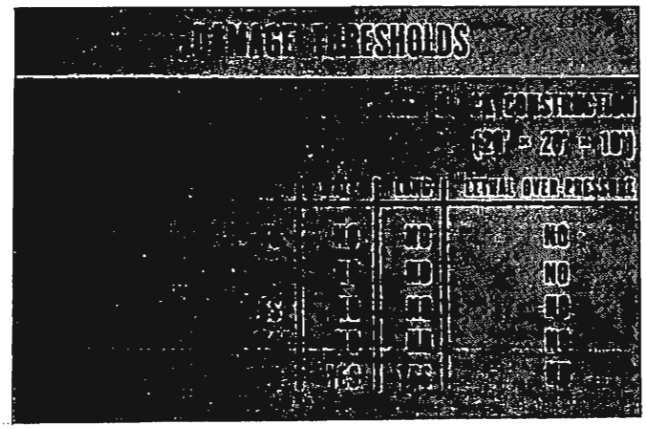


Some remarks about the sample. First of all, it's considered statistically significant. Secondly, half of the randomly selected soldiers had never fired the weapon at any time in their career. Thirdly, the training was conducted by Infantry School experts, so presumably it was the best that the Army could provide. Therefore, it probably represents an optimistic, rather than a pessimistic, view of soldier capabilities. Finally, although their performance against stationary targets was relatively better, we accept the fact that over the ranges that we are discussing, the problem in combat is going to be a moving target. The moving target was identified as the significant training deficiency, and is the one that we're going to focus on here as we attempt to figure out what we can do about the gap between expected and actual performances.

It's interesting that commanders were significantly overoptimistic about the LAW system. For example, they would have gauged their soldiers twice as effective at 100 meters against a moving tank than the results of actual firings at Benning suggested. And, of course, this sort of expectation in the minds of these commanders could lead to deployments or tactical plays in defense, delay, ambush, etc., which greatly exceed the capability of their soldiers to deliver hits in action.

Let's next examine the proposition that the LAW is dangerous to use in city fighting because of the back blast. There is on the rear of the LAW a painted enjoinder to beware of the danger in the back blast area. And, as we have seen, it is the conclusion or the presumption of most infantry officers familiar with the weapon system that the back blast is so dangerous that the weapon could not be fired inside a house. At right are shown results of studies of the Biomedical Lab of the Edgewood Arsenal, which demonstrate that the LAW will do no physical damage to a soldier who fires it in a room of the size indicated. There is a danger from flying glass, but that could be guarded against fairly simply. Other weapons systems examined did reveal potentially dangerous overpressures, but not the LAW. The data pertaining to cinder block construction reveals even higher damage thresholds and suggests that the LAW, contrary to popular impressions, is a weapons system that is applicable for combat in cities. This is an important point because the most lethal profile presented by a tank is its top. If you can fire down onto the top of an enemy tank, you are firing into its thinest armor, and your chances of a kill given a hit go up dramatically.

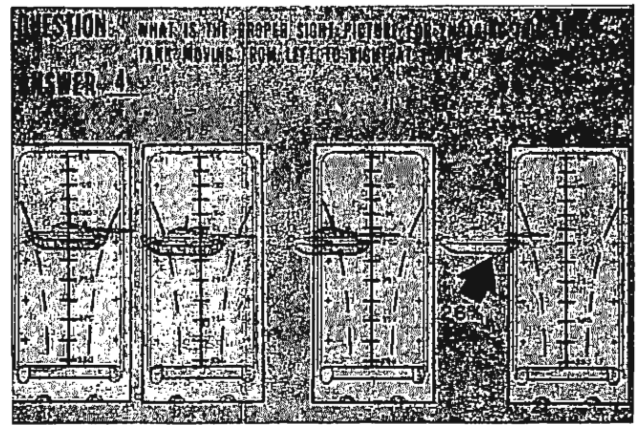


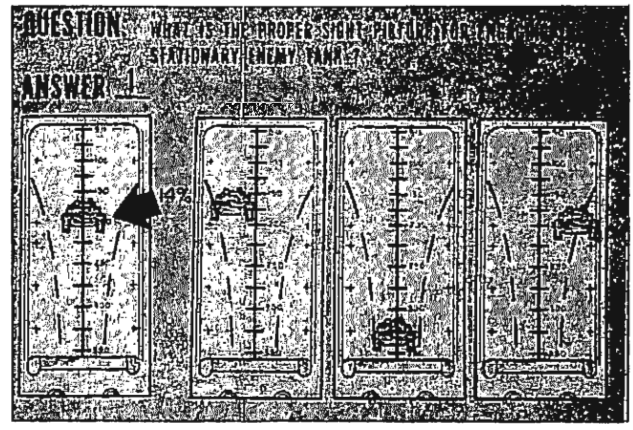


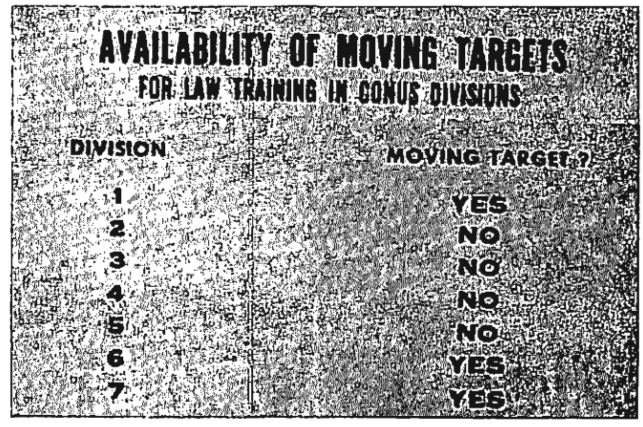
The systematic approach to the investigation of this system, has led to the discovery of gaps between what is possible (AMSAA), what is assumed (field survey), and actual capability (Benning test). The next logical questions to be answered are, "What causes these inconsistencies, and what can be done about them?"

The 1973 11B (infantry) MOS test included two test events related to the use of the LAW stadia sight. Those same questions were asked of a sample of 100 infantrymen in four CONUS divisions. The

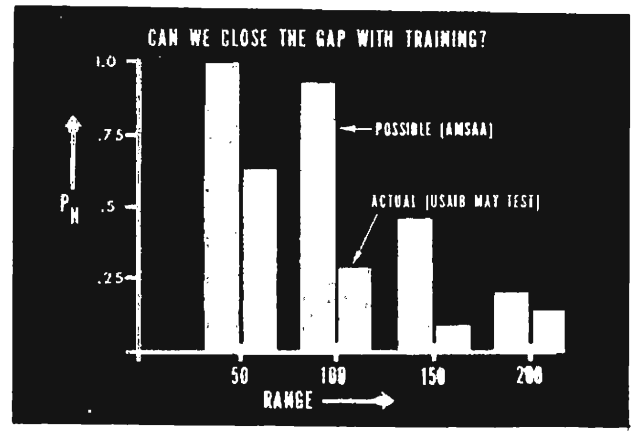
questions and statistics on the response are shown on these two slides. The same test was given to the advanced course students at Fort Benning, and the results of that poll were very much statistically like the results of the Army at large in MOS 11B. Only 26 percent of the respondents: 1 in 4 - selected the correct sight picture for engaging the T-62 that is moving from left to right at 15 miles per hour, by setting up the 15 miles an hour lead indicator on the LAW sight. That is no better than random chance. The responses to the second question, both among the soldiers taking the MOS test and their commanders, was less than random chance. Only 14% correctly identified a proper sight picture for engaging the stationary enemy tank. Soldiers do not understand the stadia feature of the sight. They set up a choking target which only works when the tank is presented broadside. The round would have landed substantially over the tank. Now, of course, what this shows is that throughout the Army at all echelons, there is a lack of understanding of how to engage targets. As we shall see shortly, the use of the stadia sight is one of the primary reasons for the poor performance with the light anti-tank weapon. Commanders do not understand it. Soldiers do not understand it. Sergeants do not understand it. And therefore, the weapons system is ineffective. Now interestingly, when TRADOC looked in the field for facilities which made it possible to practice engagement of moving targets, it was found that only 3 of 7 CONUS divisions had these facilities. If high priority National Guard units were surveyed, it would undoubtedly show that no facilities for moving targets exist, except for the rare circumstance in which they could avail themselves of the facilities of one of the three active divisional posts. The evidence is pretty strong that most of the Army doesn't understand how to engage moving targets and rarely practices it.



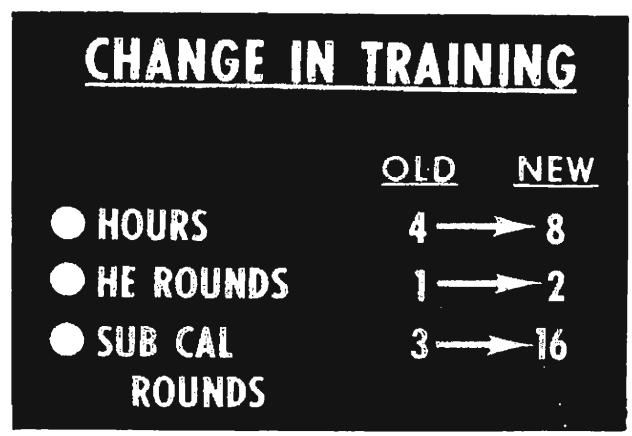




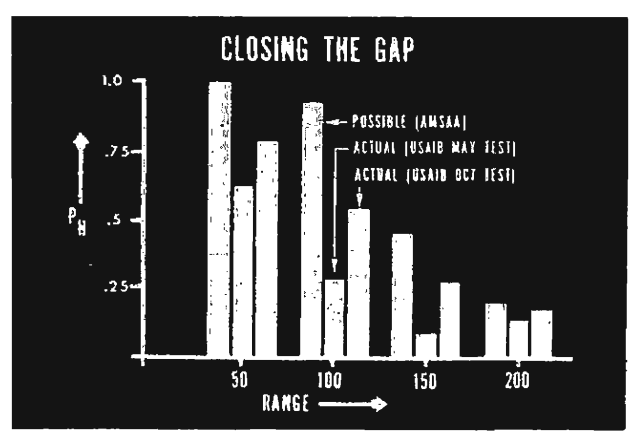
Now, let's see what can be done about closing the gap between these AMSAA expectations and actual firings. This slide shows a range band analysis where the probability of first round hit at Benning was compared with the AMSAA curve for the same range for moving targets. It graphically illustrates the magnitude of the gap.



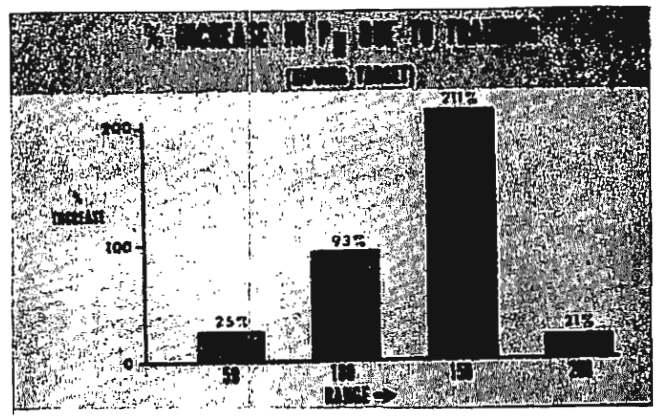
Up to this point the systems approach has led to the discovery of the effectiveness gap, a measurement of it, and now logically leads to an attempt at establishing the causative factors which in turn should provide information on how to close the gap. TRADOC, therefore, asked the Infantry School to conduct a second test. It was necessary to collect empirical data in order to yield information on the effect of training on the equation. The Infantry School devised a new training program roughly double the length of the old. One more HE round was fired, and there was a substantial increase in the number of simulators that were fired. Significantly, this new program of instruction was optimized for moving targets. The performance test for graduation from the program was based on being able to hit an actual moving tank with the subcaliber rocket.



The new tests just completed this October produced the results shown on this slide. For moving targets there was a substantial increase at all range bands in the new test, presumably as a result of the training system.



This slide summarizes the information on the last and displays a direct comparison of the two test results.



The next question in the systems approach is to ask whether it's worthwhile to go for that statistically significant increase in probability of hit.

The measure of effectiveness against which the cost effectiveness of the new training program was compared was a .9 probability of hitting a moving tank within 200 meters. Using FY 75 procurement cost of $68 per LAW and $4 per subcaliber round, the calculated cost per firer was as shown on this slide. To get the .9 probability of hit under the old training program, 10 independent firings or 10 men would be required, while 4 men would be required under the new training program. So the return derived from the new training program more than offsets the additional per-firer expenditure on ammunition. In effect, the new program increases return on inventory investment by a factor of 2.5.

IS △ TRAINING COST EFFECTIVE?

M.E. IS .90 P_H AT MOVING TANK WITHIN 200M

RESOURCE PER FIRER	OLD	NEW
TRAINING TIME	4 HOURS	8 HOURS
AMMO COST	$80	$200
P_H	.22	.45
FIRERS REQUIRED	10	4
TOTAL COST	40 HOURS $800 10 MEN	32 HOURS $800 4 MEN

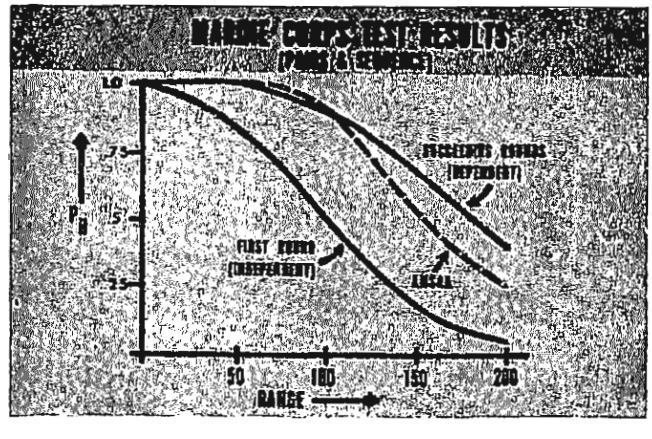
Now let's look at "T" in our model. Independent firings are discreet independent engagements. They are like flipping a coin; every flip has the same probability of turning up heads no matter how many flips are made. There is no "learning" effect. But, it is not true that a probability of hit for a weapons system like the LAW remains constant in combat if the events are interconnected or made interdependent through the tactic

of the commander. It is possible in tank gunnery to use the results of the first round to inform the gunner and the tank commander what to do about the second round; that is, apply burst on target. It is equally possible when firing the LAW to use the results of the first round to develop range and lead data which the firer can use better to engage the target with the second round, so that events are no longer independent, but, in fact, become dependent. The employment techniques for dependent engagements are termed sequence and pair firing. Sequence firing occurs when one man shoots multiple LAWs at a given target in rapid succession, taking up his second and succeeding sight pictures based on sensing of his previous rounds. Pair firing is a technique whereby two men side by side within voice range of one another consult as to the proper range and lead. The first man fires, then the second man observes the outcome and adjusts accordingly. The October test at Fort Benning tested the pair and sequence firing technique and results are as shown on this slide.

TACTICAL IMPLICATIONS

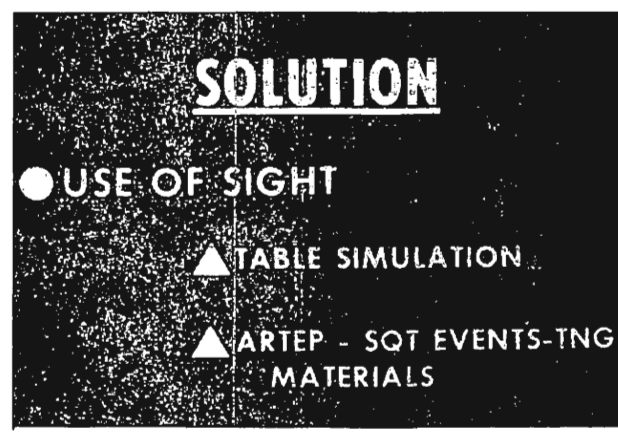
	EMPLOYMENT TECHNIQUE		
	INDEPENDENT	SEQUENCE	PAIRS
PROBABILITY OF AT LEAST ONE HIT IN TWO SHOTS (USAIB OCT TEST)	.58	.70	1.00

A few years ago the Marine Corps conducted experiments firing LAWs at a variety of targets over range and produced these data. Their first round experience was substantially below the AMSAA curve. But, by training their soldiers to fire in pairs or sequence they brought their capability out beyond the AMSAA curve, which suggests the standard tactic for using this weapon should be to train soldiers to fire in pair or where the circumstances permit, both in pair and in sequence. In defense and delay there is no reason why soldiers could not have at their positions 2, 3, or more LAWs and be prepared to fire in pair and/or in sequence.



Most of the bad shots observed in both the Infantry Board tests and the Marine tests can be attributed to the inability of the gunner to estimate accurately the range to the target. Employment of pair or sequence firing addresses directly and efficiently the problem of range estimation with the LAW. None of the doctrinal publications of training literature of the Army make a sufficient point of the criticality of range estimation to the performance of the weapons system. In defense and delay in particular, it is possible for commanders to take steps to cut down the range estimation error. Knowledge and use of the stadia sight can be far more efficiently transmitted to commanders, noncommissioned officers, and soldiers as well. The solution is to put into the training literature, to make part of the doctrine for the employment of the weapon system, these findings. The Army will shortly be deploying laser range finders, and a variety of other means, including the binoculars of the artillery forward observer, will be available to aid in range determination. Map data, ranging and pacing to terrain references, particularly in situations such as shown on this slide, should become a routine part of the employment of the weapons systems.

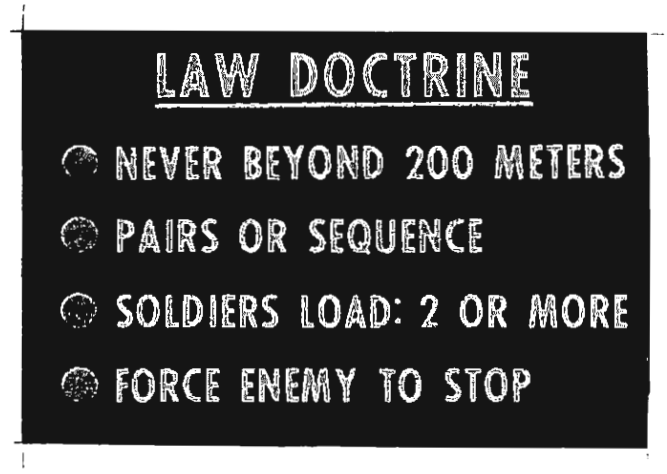
The sight training problem can be alleviated partially by simulation training at a desk or table. The table simulation is a far more effective training method than has been used in the past. Two inexpensive items are required for this simulation: a sheet of paper with various tank outlines to serve as targets, and a clear plastic overlay (or an actual LAW sight) for placing over the target profile. Unlike the multiple choice MOS test questions, this process requires the soldier actually to take up a sight picture just as he would when engaging targets in combat. These devices should be made more generally available to the field and should be used in the Army's testing programs which will provide the motivation necessary for learning stadia sight use. The soldier must repetitively practice the use of the stadia sight. Its use does not come naturally, and it's the only stadia sight on a weapons system in the infantry today.



The systematic analysis of the W·P·T = E model has resulted in an examination of each of the doctrinal beliefs of 50% plus of the Army. Although TRADOC did not address "W" directly, the analysis did identify the stadia sight as a problem, and development of any future advanced or improved LAW should include the development of a new type sight. The "P" in the equation has been addressed directly in the discussion of training methods, table simulation, and training problems such as range estimation. Tactical implications produced by the analysis included techniques of fire and range determination.

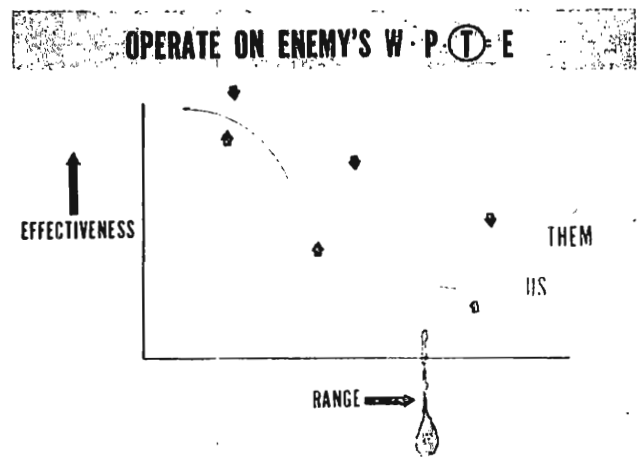
What should be LAW doctrine as a result of the analysis is a drastic modification of that which was doctrine because of majority belief. Unfortunately, it won't become operational doctrine until it meets the criteria that 50% plus of the Army believes it.

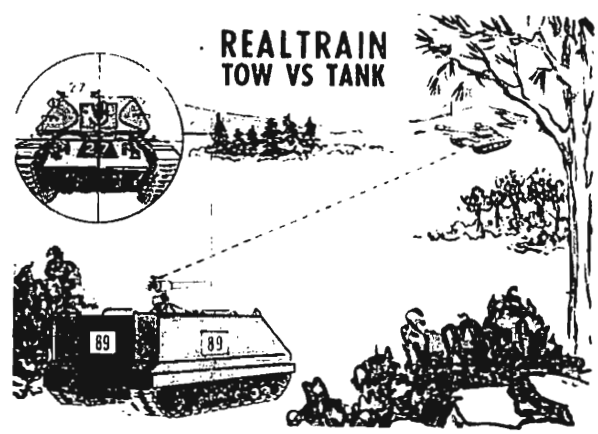
Let's now address each of the points listed on this slide because that will lead us to a better understanding of what it is that we ought to be teaching in the service schools or wherever there is training with the LAW weapon system. It is merely academic whether the LAW can be fired effectively up to 200 meters, or 250 meters, as the Marines concluded in their studies; however, it is clearly a weapon that is ineffective beyond the range band 200 - 250 meters, and tactics should take that into account. We should fire habitually in pairs or in sequence because of the substantially increased probabilities of hit whether at moving or stationary targets. We should reconsider our proposition on how to allocate LAWs in the field.



In any circumstance where it is possible to do so, the soldier's load, if he's going to carry the LAW, should be two or more. This would be particularly effective in defense, delay, rear area security, and ambush situations where it's possible to, in effect, stockpile the weapons on position. Finally, since the probability of hit against an enemy that is stationary is substantially greater than the probability of hit against moving targets, regardless of what technique one uses in firing, we should use tactics which force the enemy to stop. Whether it is simply mines placed on top of the ground, or employment of any other form of hasty obstacles, it will give the LAW gunner a much better opportunity to bring his weapon to effect.

To give a further illustration of "T" factors, let's look at another system. From an analytical point of view the enemy has a problem like ours in that his battle effectiveness is also a function of W, P, and T. We can operate so as to degrade the effectiveness of his system through our tactics and training so that, in effect, our strategy in approaching training should be to upgrade our P and T and operate so as to degrade the enemy's P and T. The net total of E is really an interaction between enemy and our own capabilities. Now we'll look at a series of analyses directed toward the tank system in order to show how this is done. A T62 firing at an M60A1 that is fully exposed and stationary has a very good chance of killing the M60A1. If the M60A1, though fully exposed, keeps moving, that probability of kill is reduced. If the M60A1 goes in to hull defilade, however, he drops his vulnerability to the T62 dramatically. TRADOC has devised training techniques designed to teach tankers this lesson in vulnerability. The system that we're presently using is an optical simulation called REALTRAIN and depends upon telescopes affixed to weapons systems which enable participants to read numbers affixed to the vehicles of the





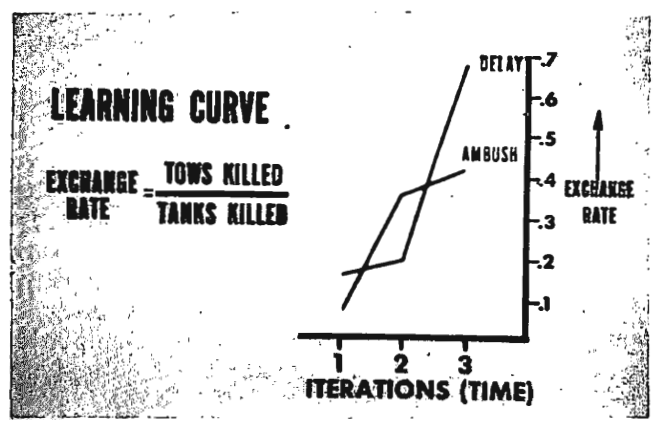
opposing force. The theory is that the ability to read numbers degrades over range like the decline of hit probability over range in the AMSAA curves, so that the ability of the TOW gunner to read the number on the attacking tank at any given range is a rough approximation of the ability of that TOW weapon system to get a kill at that particular range.

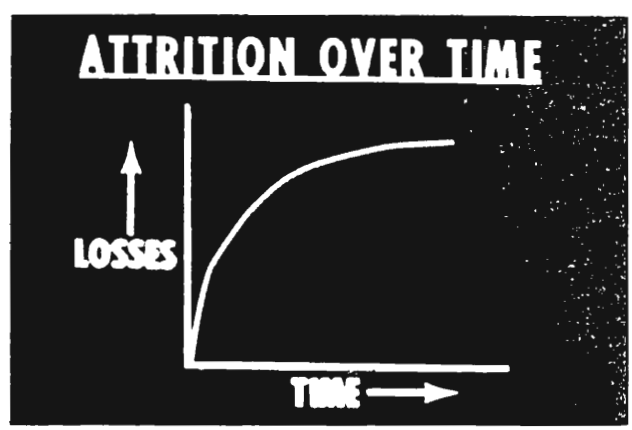
Last summer in Wildflecken, a company of the 3rd Division equipped with the TOW was trained to combat an attacking tank force in order to test REALTRAIN effectiveness. There were three record runs in which the infantry trained with TOW was committed in two scenarios against a tank company from the 11th Armored Cav Regiment. The soldiers in the Cav Regiment had not received any training in this sort of simulation other than acquainting them with the rules for getting kills and giving them some practice in doing that. The results of the Wildflecken experiment in June of last year for both the ambush and the delay scenario are shown here. The tanks learned how to take better advantage of the terrain. They were learning lessons about vulnerability through REALTRAIN. The learning effect is graphically shown for each scenario by plotting the exchange rate versus iterations.

So this simulation called REALTRAIN teaches tankers something about the advantage of the proper use of terrain. This is a very important lesson to learn, for the experience in the Middle East illustrated that the attrition-over-time curve is initially very steep as it is displayed here. In a very short time more tanks were lost in the Middle East than we have deployed in Europe right now.

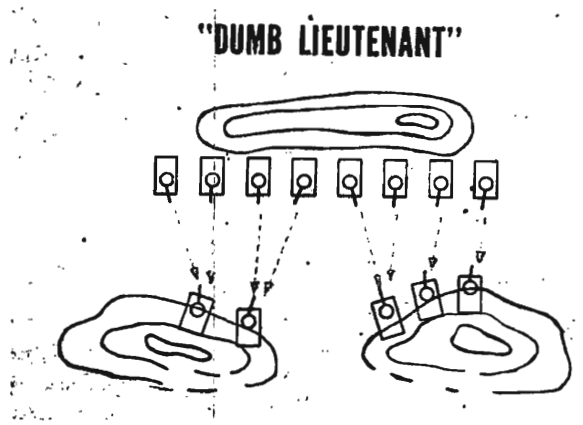
REALTRAIN RESULTS
(WILDFLECKEN 6-74)

	TANKS KILLED (%)	TOWS KILLED (%)
● AMBUSH		
1ST RUN	73	4
2ND RUN	50	18
3RD RUN	36	15
● DELAY		
1ST RUN	100	17
2ND RUN	83	17
3RD RUN	73	50

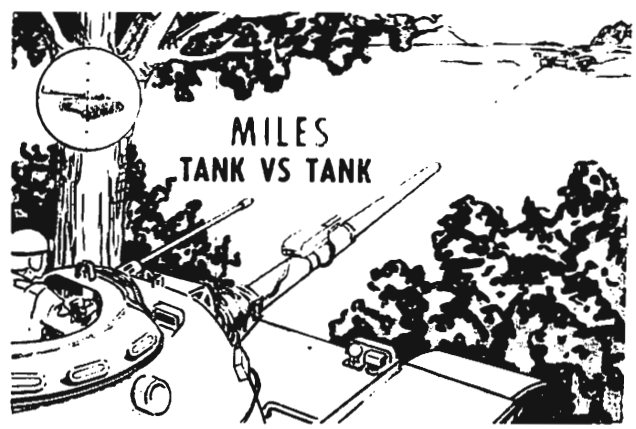




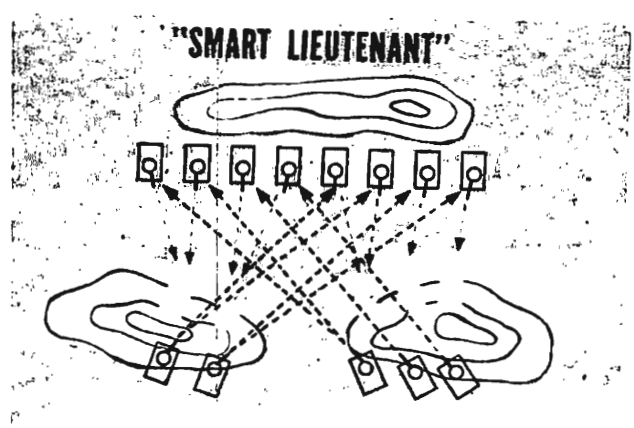
The ability to communicate effectively to our lieutenants the vacuity of a tactic like the one on this slide, where an attempt is made to engage a tank force of roughly comparable weapon systems efficiency but in greater numbers from the front slope, becomes not only important but indeed crucial, for the very survival of the United States Army's armor on any future battlefield. General Talbott, TRADOC DCG, wrote a letter to Europe summarizing the results of his examination of the Israeli War and stressed that no point was more crucial than the one illustrated here. He asked cooperation of the command in Europe in teaching lieutenants not to be so dumb as to adopt this tactic.



TRADOC has scheduled for operational tests in February a simulation system which we hope will help to teach the lieutenant what is right or wrong about the selection of any given tactical position. The system, called MILES, mounts a small coded laser on the tank which when fired and a hit scored will, set off a smoke grenade and/or give an audible signal to the target tank that has been hit. It will be integrated with other lasers which can play the part of TOW, the LAW, the machine gun, etc., so that we ought to be able in training, to set up an effective simulation of the modern battlefield. In effect, we will make REALTRAIN a more efficient simulation than is attainable with the present system of reading numbers.



What we hope to get from simulation exercises like REALTRAIN and MILES is a generation of armor lieutenants who understand that there is a preferred tactic and they discover it in their training. When they use that preferred tactic they will kill more of the attacking force and suffer fewer losses than they would if they did what the "dumb lieutenant" did.



There is in the FY 76 and 77 budget a line item of some $25 million for the MILES system. There are many in Washington to whom such a large number gives pause. It is encumbent on TRADOC, therefore, to give some measure of the effectiveness of the MILES system. Since there is no hard data now available on training effectiveness of this system, a detailed cost effectiveness analysis at this point cannot be made. If the assumption is made, however, that MILES training is at least as effective as REALTRAIN, and then because crew effectiveness increased by about 1/3 in the long run, three MILES trained crews may save one tank. If then, the cost of MILES can be compared to the cost of tanks, a return on investment could be calculated. This of course will be accomplished after MILES effectiveness is precisely measured.

Further systematic analysis through the W·P·T = E model leads to a strategy for capitalizing on the potential training benefit of these simulations systems which can be outlined through the use of learning curves. This slide shows a theoretical compared with what we call a realistic learning curve. Most soldiers initially learn at a comparatively slower rate because of having to absorb basic ideas and fundamentals. As they become more familiar with the subject they reach a point in time where the learning process "takes off" and proficiency or learning increases at an accelerating rate. Then, at some later time in the process, the rate of learning slows to a point of diminishing return as the soldier's learning capacity is approached. At that point a "forgetting" curve may take over unless something is done to cause the soldier to retain his newly developed skill or knowledge.

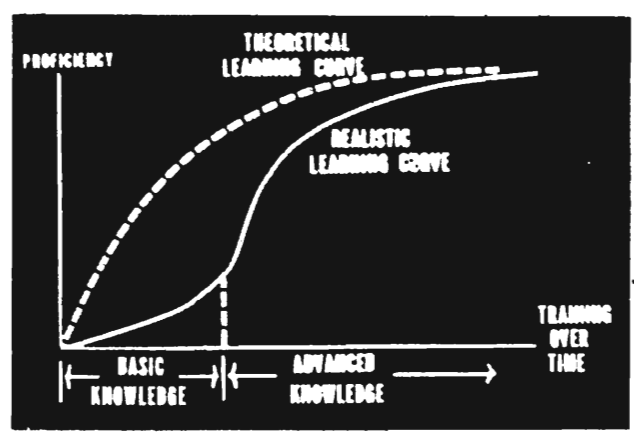
IS MILES COST EFFECTIVE

MILES COST PER TANK: $810
M60A1 COST PER TANK: $400,000
} $\frac{1}{500}$

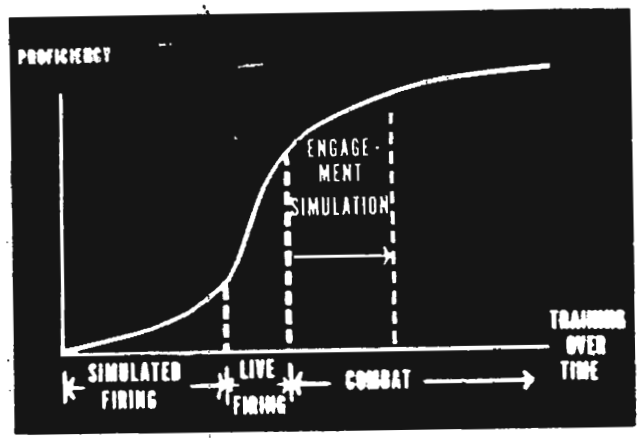
IF MILES IS AT LEAST AS EFFECTIVE AS REALTRAIN

THEN

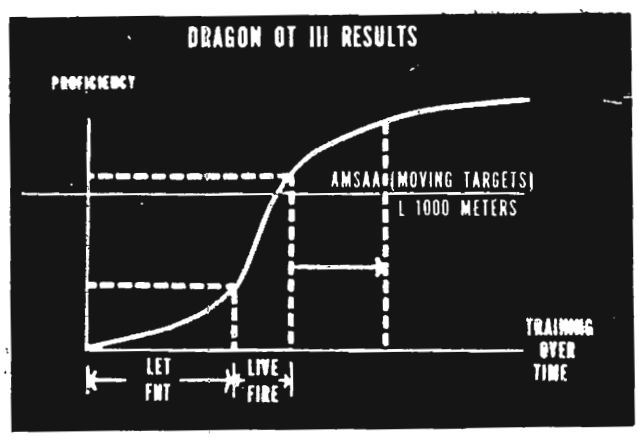
3 MILES SAVES 1 TANK



To get the maximum return on investment in training time and ammunition dollars, we can take advantage of the characteristics of the actual learning curve. To do this optimally it makes sense to save our live firing for that time when learning is taking place at the fastest rate. This maximizes the marginal return on ammunition investment. Simulation is scheduled at the two ends of the curve. Initially, we use simulation during the basic knowledge phase since simulation costs less and can therefore be practiced repetitively more cheaply. Again at the top end of the curve we use engagement simulation to prevent a forgetting curve; that is, to maintain the proficiency or knowledge gained to this point.



This training program of integrated and phased live fire and simulation was demonstrated in the DRAGON OT III. Soldiers were initially trained using only DRAGON training devices. After initial training they fired a live round and achieved a low hit probability when compared to the AMSAA projected probability. Since these trainees were in the steep area of the learning curve, they achieved a much higher probability of hit on their second round. In fact, the second round hit probability was higher than the projected AMSAA probability. Had the training program relied on live firing rather than simulation during the early learning process, many more live rounds would have to have been expended before reaching the AMSAA probability of hit. Of course there would have been an attendant increase in ammunition cost. The test also showed that simulation alone produced a gunner who had a low probability of hitting targets, but one trained with simulation and one live round upped his hit percentage dramatically. Thus demonstrated is the utility of employing both simulation and live firing in the right proportions and in the right order.



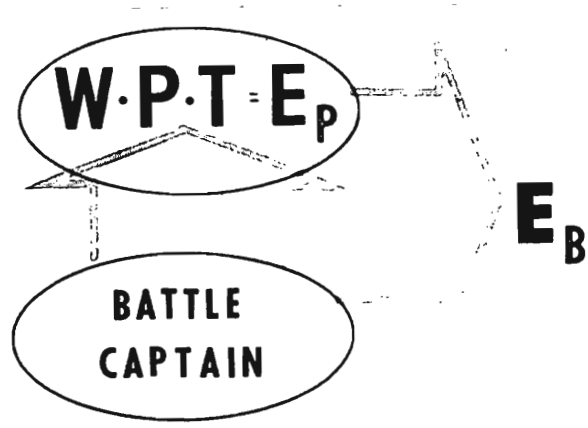
Those two examples, the LAW and the tank, have served to demonstrate how a systems analysis can both expose problem areas and point a way toward their solution. The system model for weapons effectiveness, $W \cdot P \cdot T = E$, has served as the framework for the analysis, and each of its components were investigated to determine both their isolated and interactive functional relationship to effectiveness. At this point, it is important to realize that effectiveness as discussed so far is only a potential effectiveness. That is why the subscript "P" for potential was added to the equation.

SYSTEM MODEL

$$W \cdot P \cdot T = E_P$$

Of course, the objective is to realize this potential effectiveness on the battlefield. But the factors of leadership, management, and operational integration of the components of the equation, add to it another dimension. This new dimension takes the form of what General DePuy calls a "Battle Captain." The combined efforts of TRADOC and tactical units will be required to develop a Battle Captain, and some productive approaches to that end are listed on this slide.

SYSTEM APPROACHES

- DOCTRINE (TNG LIT)
- ENGAGEMENT SIMULATION TECHNIQUES (REALTRAIN, MILES)
- GAMES
- ARTEP

The Battle Captain, armed with expert knowledge of the weapons system capability, the most productive training techniques, and the optimum tactical employment, all of which the systems approach has developed for him, will be able to convert potential to battlefield effectiveness and win the first battle of the next war.