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DA Training Ammunition Authorization Committee
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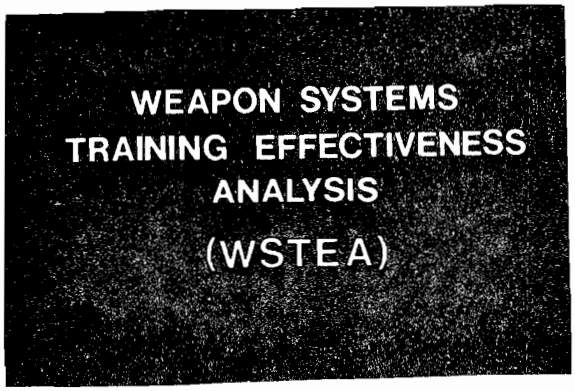
# TRAINING EFFECTIVENESS: ANALYSIS OF WEAPONS AND AMMUNITION

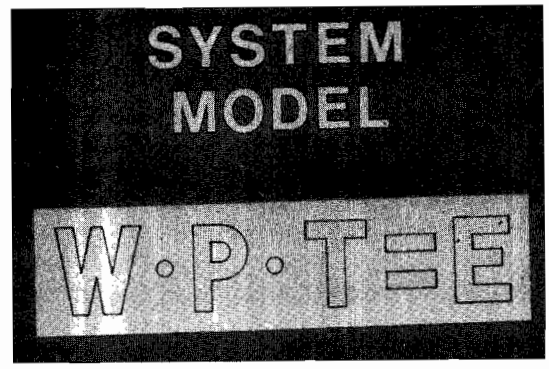
## PART I - INTRODUCTION

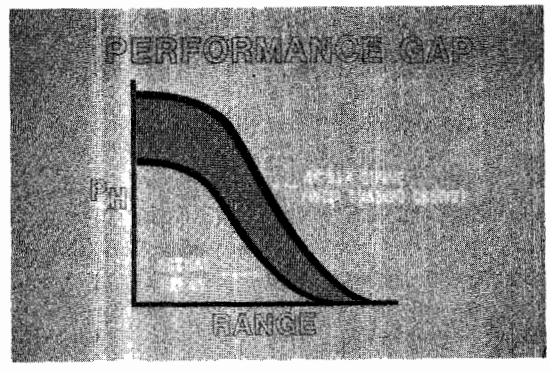
In FY77 alone, the US Army will expend over 400 millions of dollars for training ammunition. About a quarter of that amount will be expended to develop proficiency in the armor corps of the US Army. Surprisingly almost the same amount will go towards developing proficiency with small arms. A similar amount to developing the proficiency of our artillery units throughout the world.

Early in December, General Officers representing all of the major commands of the Army--the troop commands, the TRADOC, the DARCOM and the Department of the Army, met in Washington to consider the policies of the Army for the procurement of ammunition, and training ammunition was a prominent topic in that general officers' meeting. I made a presentation to that group which I want to share with you today so that those of you within TRADOC who are working with problems of this genre will be advantaged by what I told that group, and those of you in other commands who are interested in this particular pursuit of the TRADOC will be better informed on what it is that we're up to. I'm going to present to you the briefing in five portions. First an overview of what we would term weapons systems training effectiveness analysis. Then I'm going to talk about a specific example of such an analysis using the armor system as my case in point. Then we're going to look at some work on-going with the M16 rifle and with artillery as a training system. Finally I'll summarize all of the foregoing for you. Turning first to what we term weapons systems training effectiveness analyses--you should understand that the TRADOC, as part of its work of preparing for the future of the US Army, has underway in several of its schools--the Ordnance delivering schools, analyses of the weapons systems for which the school is proponent which probes deeply into the effectiveness of training devices and training ammunition as part of the analysis. We use a general approach to the problem



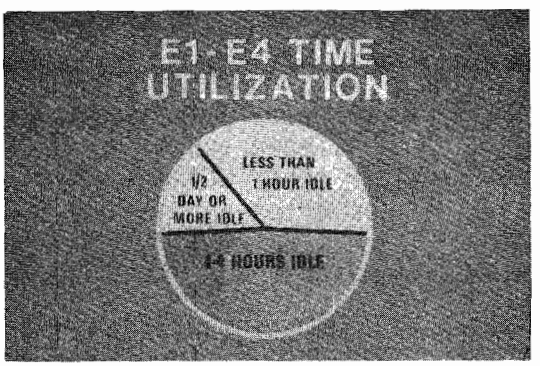
of analyzing the weapons systems which is represented here--this is a simple construct or paradigm which says that the effectiveness of the weapons system is a product of the weapons systems capability or W - that is the inherent capability of the material of the proficiency of the man or crew who mans the weapons system, and finally the tactics or techniques by which the weapon is employed, so that you can see that W is pretty much a given--that's what we bought when we bought the weapons system; but P, the proficiency of the crew, and T, the tactic or technique of the leader, are both matters we can address importantly with training techniques and in which the expenditures of training ammunition and training devices play a major role. Generically, whenever we examine a particular weapons system--we find a situation like this. There will be a set of data-hard data--produced by the Army Material Systems Analysis Agency in the usual event, which represents what the capability of the weapon is in the hands of well trained crews. This is an expression here on this chart of probability of hit over range and it produces mathematically an expression of P for particular weapons system. When we, however, look in the TRADOC at any particular weapons system, we will find almost invariably that in the hands of actual crews, the weapons do not measure up to the capabilities of which they are capable with well-trained crews. And the shaded area is what we refer to as a training gap representing the difference between what we could get out of the weapon, and what we are actually getting as a result of our present training technique personnel policies or other factors. One specific purpose of weapons systems training effectiveness analyses is to close that training gap--to find ways and means of developing crews that can exact from any weapon its full measure of potential on the battlefield. And I want to be very clear that the purpose is not to save ammunition--the purpose is to develop P or high proficiency.



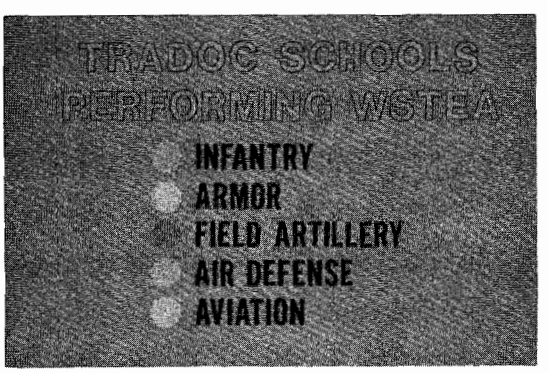



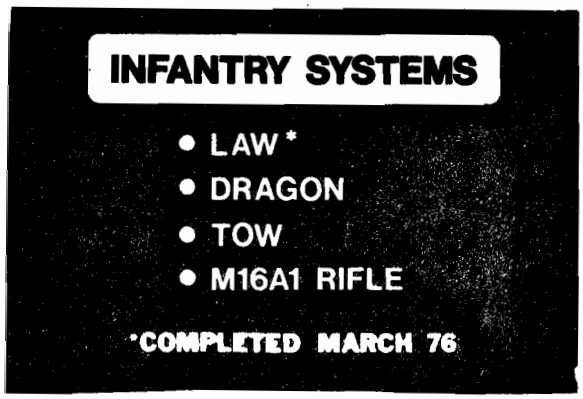

There are those who will tell you that it is impossible given the training environment of the US Army to do much about developing more weapons systems proficiency. They will asert that soldier time is completely committed to that job at the moment. Well, two observations--one here--first, institu-

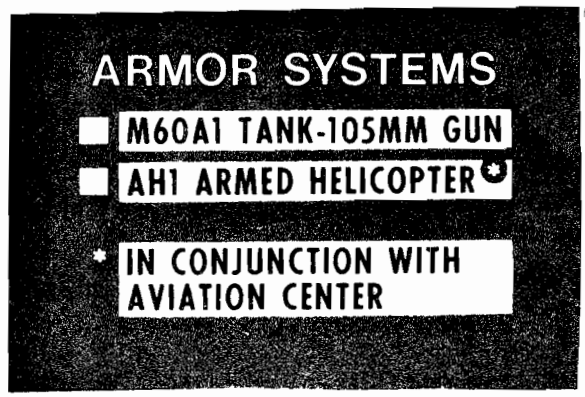
ional training is an important part of weapons systems proficiency and no doubt the service schools and training centers play an important role in developing P for the Army. But note that most soldiers spend only three to six months in institutions. Ninety percent of their service in the United States Army will be spent over in the units, the large circular area here, and when one examines the typical training year you'll discover that time in the major training area, access to major ranges and facilities for training, is confined at best two months out of the year, that access to local training areas occupies at best about four months of the year, and that fully half of the year is spent in the garrison environment. That tells our weapons systems training effectiveness analyzers that principle opportunities for improving P may lie in improving the effectiveness of our approach to garrison training or in local training areas, as opposed to continued emphasis on those experiences that occur in major training areas. We know from actual surveys of the force as a matter of fact, that most soldiers have idle time during the day. This is the results of a survey conducted in October 1976 which established that soldiers E1 through E4 have on the average, at least half of them, 1 to 4 hours in which they are wholly idle and that means that there are major opportunities for intervening in that time to teach weapons systems proficiency to them, occupy them gainfully in a matter which they recognize as central to their business of being a soldier, and involving them in an activity which is almost universally regarded as interesting. Job satisfaction depends upon our performing these weapons systems training effectiveness analyses well and efficiently.

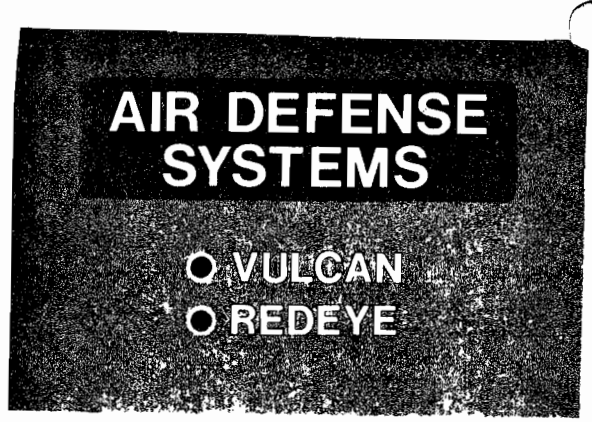

Here are the schools that are involved in these analyses. The Infantry School has already completed one such analysis for the light antitank weapon, M72A2, and that analysis in turn has been used to develop the follow-on system--the VIPER. Underway are the analyses of DRAGON, TOW, and M16A1 Rifle. We'll come back to the latter study in a moment. At the Armor School,





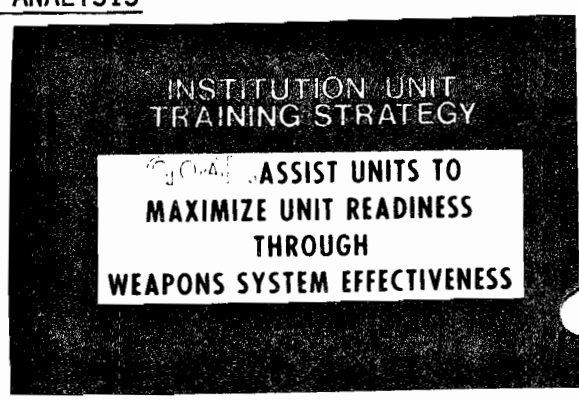

they are looking into these systems, and again we'll have a better look at the M60A1 study in a moment. At the Field Artillery we're looking into the Observed Fire System but we are concentrating on the Forward Observer because our initial scoping of the problem established the fact that the forward observer contributed some fifty percent to the system error, and if we can improve his performance then we exert enormous leverage on the overall efficiency of the artillery system. And finally at the Air Defense School, we're looking at these systems. And our interest here, as was the case with the LAW, is less to develop efficiency in training with these systems (important though that is) than to find out what it is that we must put into the Combat Developments of the follow-on gun and missile systems that will be coming into the force in the next few years.


PART II

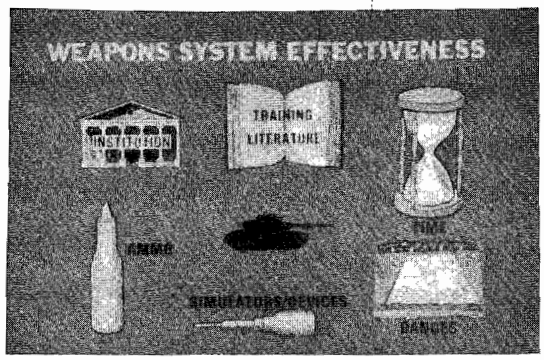
ARMOR TRAINING EFFECTIVENESS ANALYSIS

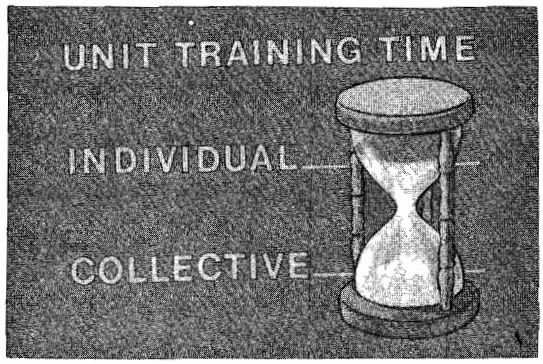
We're further along with training effectiveness analyses for the tank than we are with almost any other major weapon system. The Armor School at Fort Knox has developed a training strategy for the Armor force for the years from the present out through 1985. The objective of that strategy is as shown here. It

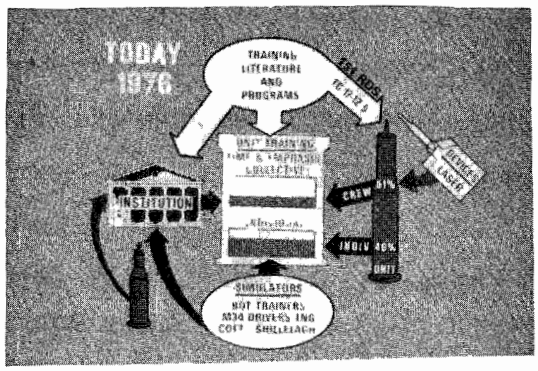


applies to both training that we conduct within the TRADOC and the training that we recommend be conducted in units serving throughout the world.

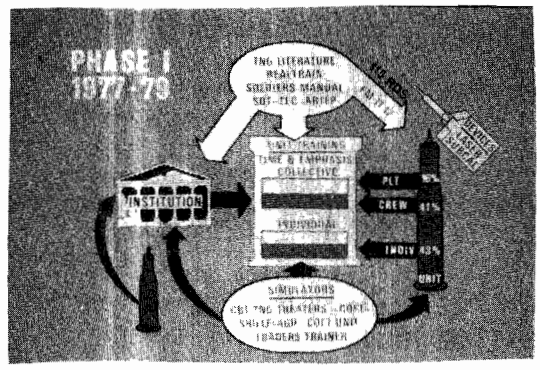
Now the ingredients of a training effectiveness analyses are shown here. Obviously what we're interested in is producing effective platoons and companies of tanks. But in order to do that we have to operate on institutional training, on the training ammunition that is expended in producing proficiencies of those crews on the simulators or devices or facilities that figure in either institutional or unit training including mini-ranges, laser devices, etc. Training literature, part of our training support system, obviously plays a role; and as the hour glass in the upper right indicates, it is vital that we consider time since time is the key training resource. In the past most of the time that we have devoted to tank training in units throughout the world has been devoted to individual training. That may sound strange, but a moment's consideration of what the purpose of the several tank tables of the eight that have been prescribed in years past really was, will convince you that that is an accurate observation. Not until we get to table 7 and 8 do we begin to develop crew proficiency. Overall what we're interested in doing is to develop better collective proficiency because we know from analysis of battles, notably those which took place in Israel in October 1973, that tank duels (that is one tank vs another tank) are rare in battle; that the more frequent occurence is the engagement of enemy targets by platoons and companies of tanks. And that being what it is that tanks do in battle, that is what tanks should do in training. The Army must train as it fights. Now here is a depiction of the present state of training in the armor force. By and large we are spending about 151 rounds of main gun ammunition for a tank crew per year in accordance with the gunnery which is prescribed in this training circular, 17-12-5. This training circular embodies a lot of improvements over the system which had governed tank training up until 1974-1975 and it is a real step forward in producing proficient crews and units. But you'll notice here that it is still true that under this training circular that under this training circular that over 49% of those main gun rounds



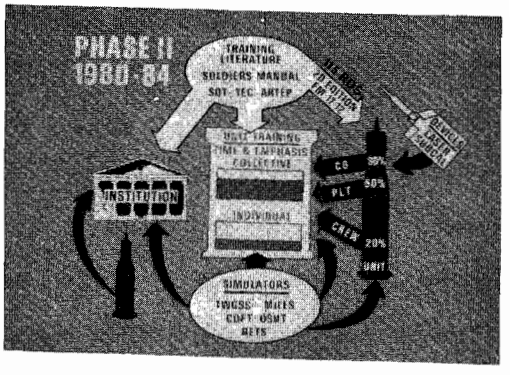



goes to developing individual proficiency and only 51% toward developing crew proficiency on Table 8. There are in existence,as the chart indicates on the bottom, a certain number of trainers and devices. These impact at the moment principally on institutional training, and we would like to see more of them available to assist training in units. And up on the top you can see other items available to the TRADOC to act as levers on tank training throughout the world: the Training Extension Course program, TEC; the Army Training and Evaluation Program (ARTEP); the Skill Qualification Tests (SQT); the Soldier's Manual; etc. All of the elements of the TRADOC Training Support System come into play in our present approach to training. Now we want to change this approach and there are some important changes pending. In 1977, by June, we will have published a new Field Manual 17-12 prescribing a change in tank gunnery training. Note that one of the important changes is a reduction in the amount of main gun ammunition which will be expended to train each crew from 151 rounds per tank to 115 rounds per tank. Note also that the ammunition will be spent towards different training objectives whereas nearly half of the ammunition under the present training circular was spent for individual training--under Field Manual 17-12, 43% will go for individual training, 41% for crew training and some 16% will be expended to develop platoon collective firing proficiency. You will note also that we envisage a much richer mix of simulators and training devices being in the field to support the training under Field Manual 17-12 including notably the combat training theaters such as presently constructed in Europe or their counterpart in the US, an improved conduct of fire trainer or the Shillelagh, a much broader issue of the laser training devices Mark 55 and of other devices and ranges which will be prescribed or recommended in the field manuals. This field manual will authorize unit commanders to develop a mix of these ranges and devices which is appropriate to his training circumstance. This will be particularly useful to commanders of the reserve components whose garrison or armory training situation is radically different from that of the active force and whose local training areas and major training area opportunities are significantly more circumscribed. Field Manual 17-12 will permit a very much more flexible approach to developing crew and collective proficiency. In November 1976 USAREUR hosted with TRADOC a training conference at Grafenwohr in Germany which we call TRAINCON '76. Here is some footage from the television tapes which were made at that conference and which are now generally available throughout the Army. These sequences show the training devices that were presented to the attendees in order to demonstrate improved methods of training the tank force which are germaine for the local training area environment in Europe.



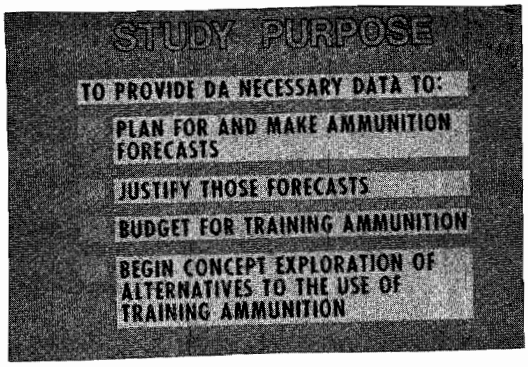

(Tank Devices Film Footage)

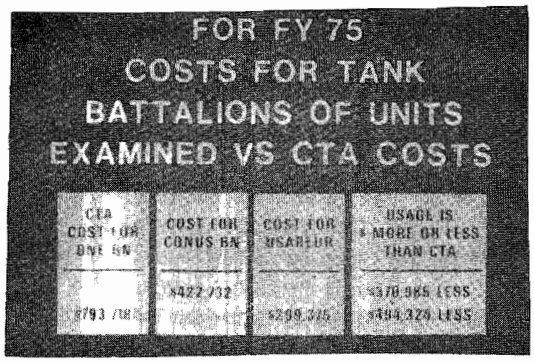
TRADOC expects to be able to field with DARCOM assistance even better training devices in the very near future. Here is an artist's concept of one such device. To the right you see a man who is manipulating the gun sights for M60 tanks. To the left an instructor who has a console in which he can set up the gunnery problem for that gunner on the right. The instructor can pose any kind of a problem for the gunner imaginable. He can present targets up to 3,000 meters away. He can have the target move at various speeds relative to the gunner. In brief, he can make it just as easy or tough as the gunner's proficiency will tolerate. As you can see, this micro-processor or computer provides a printout record of just how well that gunner handles the fire missions that are set up for him. Here you have a device, in brief, which can train and evaluate gunner proficiency in a garrison environment. Here is a device which could be used to administer Skill Qualification Tests. Here is a device in which we could practice tank gunners on critical tank gunning tasks every day of the year. Now, we don't intend to stop our development that was foreshadowed by Field Manual 17-12 published in 1977. We'll go on to bring out a new edition further on downstream as this chart suggests and that new edition will carry the movement or emphasis further from individual to collective training. As you can see here under the version of FM 17-12 that we see coming out in this time frame, we will have fielded much better simulators and training devices. The TWGSS shown on the bottom (Tank Weapons Gunnery Simulation System) which we hope will be a full crew simulator which will enable us to get at all the individual training of the crew and to do so in a garrison environment. We would hope that the Multiple Integrated Laser Engagement System (MILES) is available in this time frame and we see other devices that will be coming into the inventory before then. Equipped with those devices it is our expectation that tank units will be able to accomplish all of their individual training in the garrison environment, permitting us to concentrate our main gun expenditures on crew training and as you can see here we would envisage about 20% of main gun firings to go for that purposes; 50% for developing platoon proficiency and 30% to developing proficiency in live fire as a company -- an undertaking with which the US Army has heretofore had very little experience but one which we feel is central to being able to fight our future tanks in the kind of battle that we anticipate for the time frame shown.

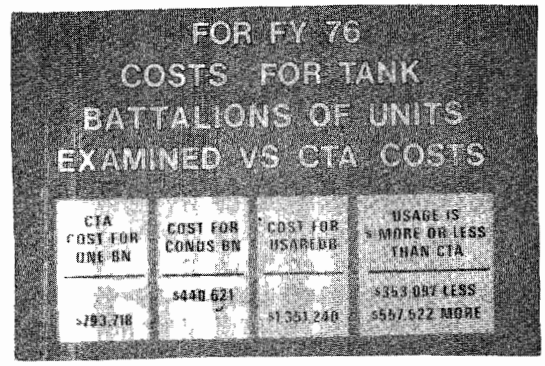

## Engagement Simulation Ammunition Study

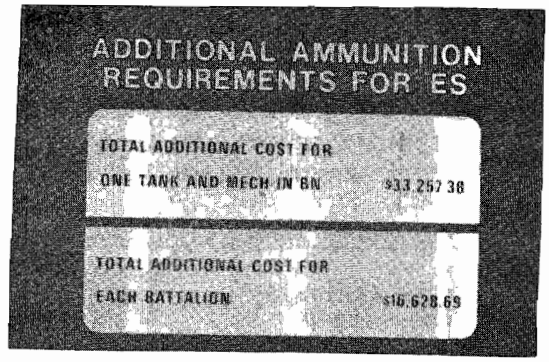
Now we have undertaken as part of this analysis a number of sub-studies...here is one--its a published report just in. It inquired into what ammunition requirements we needed to support



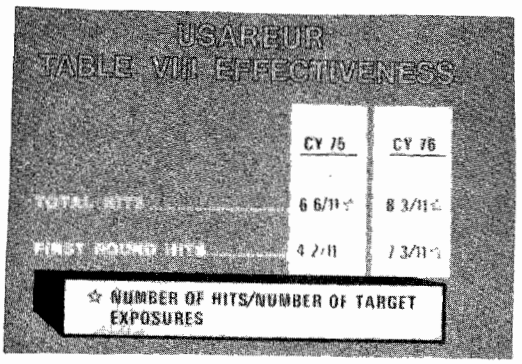

REALTRAIN which is out principle engagement simulation undertaking. The results of this study indicated it is possible to inquire into costs and effectiveness and all of these purposes were met. Here for example is some of the data from that study. This chart compares on the left what is authorized by the present common table of allowances. As you can see--in 1975 CONUS battalions spent about 400 thousand dollars worth of ammunition and that was significantly less than that authorized by the common table of allowances. Note that USAREUR in that year spent per battalion only about 300 thousand dollars which again is significantly less than the CTA and less than the amount spent in CONUS. But look at what happened here in fiscal '76. CONUS costs are about the same and remain below that authorized in the common table of allowances, but USAREUR costs have quadrupled and here you're looking at a million three thousand dollars - ($1,300,000) of expenditures? First, let me make the point that the study established, as this chart shows--that the cost of training a tank battalion in either CONUS or USAREUR -- some 16,000 dollars ($16,000) per annum.

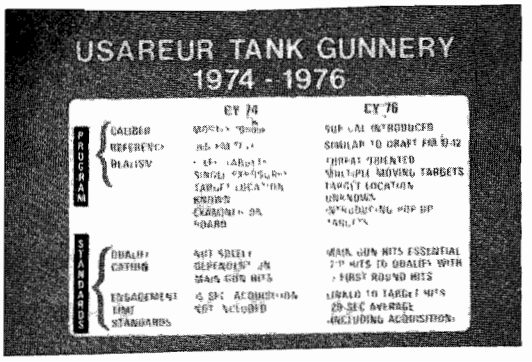


## USAREUR Tank Gunnery

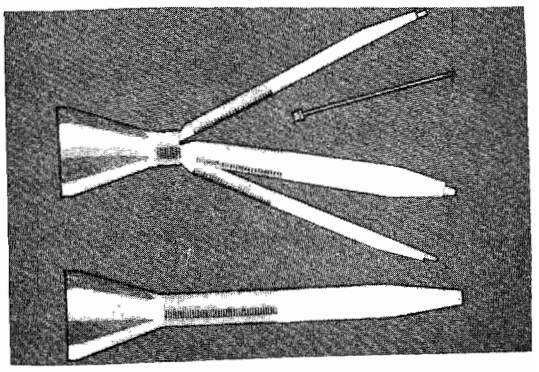
Now let's look at this cost vs effectiveness in Europe. As this chart illustrates, there are substantial differences in the way tank gunnery was conducted in 1974-75 and the way it was conducted in 1976. Europe had in 1976 substantially altered its tank training to demand of participants much higher standards in terms of first round hits and in terms of time to engage; whereas in 1974 and 1975, for example, time to engage was measured from the time that the man had acquired the target--in 1976 the scoring measured is total time to engage including the acquisition time--a very different proposition. Now the results are shown here. There was a substantial improvement in USAREUR tank gunnery from 1975 to 1976 and although costs went up by a factor of 4--effectiveness went up by the same factor and these results demonstrate conclusively that the 7th Army in 1976 was a very much more potent force on the battlefield than it was in 1975.



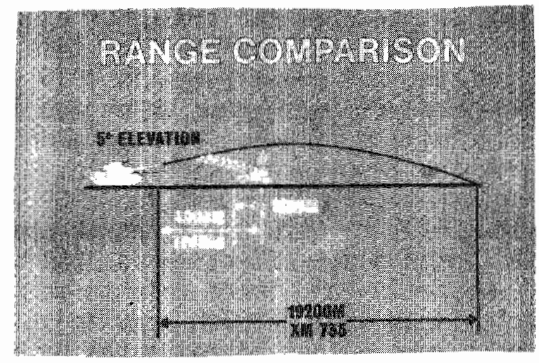



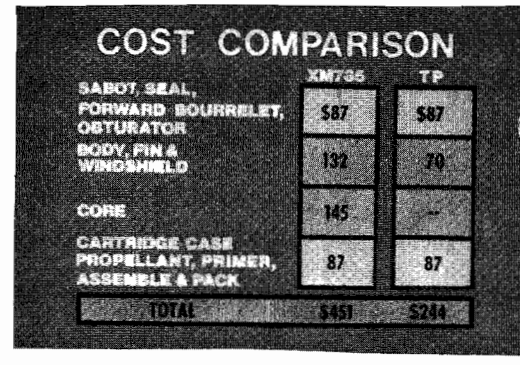

## M735 APFSDS Tank Round

One important function of Weapons Systems Training Effectiveness Analyses is to anticipate problems coming up in the future. Prominent among those which will effect tank training are the problems which will be induced by the new ammunitions which are being developed for issue to the tank force beginning in 1978. Here for example is the Mark 735 tank round. This is an armor piercing discarding sabot round, which like the main gun round for the Soviet T-62, has been stablized. This brown outer portion is the sabot that is discarded as the round goes down range, and what actually travels to the target is this long L over D penetrator. Now in developing this penetrator, we encountered a significant engineering problem. It travels so fast that this nose cone up here tends to oblate or melt away. By developing harder metals, we were able to solve that problem ~~in training~~. It is illustrated on this slide. This round travels with a very flat trajectory. This means that gunnery with it is a very different proposition from gunnery from any other round that has been in our inventory. It means that we'll be able to shoot battle sights out beyond 2,000 meters. It means that problems of super-elevation and lead will be significantly less than it has been with any other munition in our inventory.



But it also means that we're going to need very very long tank gunnery ranges. At five degrees of elevation this round will travel out some 18,000 meters. Confronted with the problem of developing a training round for this munition, the engineers took advantage of the problem that they had encountered with the nose cone. They went back and selected a metal that would melt away at about 3,000 meters. Further, they cut the round into four quadrants or sections and you can see the sectioning here. The round is actually divided into four parts so that after that nose cone melts away, these four quadrants will fly apart and the round will begin to tumble in the air. So, in effect we have produced a round that will fly exactly like the service round will fly up until the point that the nose cone melts away, and that will occur somewhere out beyond 3,000 meters. The result in effect is shown here on this slide. There you see the trajectory that the round would pursue if allowed to fly its full normal trajectory. As the broken up round indicates with the fix that I have just demonstrated the oblating nose cone and the quadranted training round, we ought to be able to get controlled decomposition of the round in the range band--4,000 meters or so out from the firing point. Here are some data on its cost. On the left the Mark 735 which is the service round--the round that will be used in combat and on the right the training round--the round that will permit us to practice this gunnery on any range that we have in operation today.

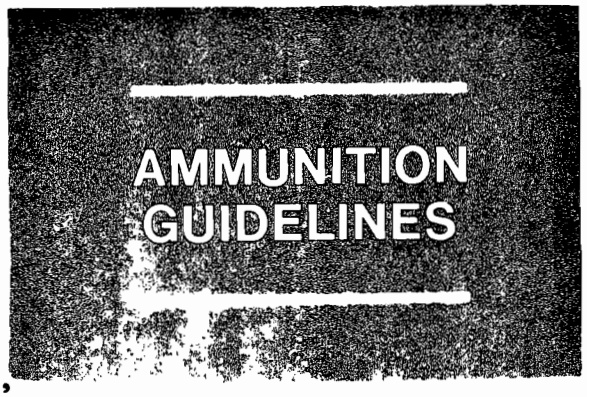



## Ammunition Guidelines

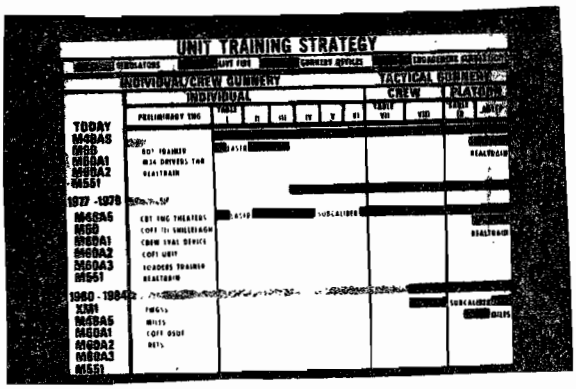
TRADOC officers who are performing weapons systems training effectiveness analyses must understand that in the course of their work they have got to identify for the force the amounts of munitions required to train to the standards or criteria that they have established for particular weapons systems. In the case of the tank, we have got to be able to express to the force through the mechanism of our training literature what it is that we expect the force to expend in the course of acquiring the standards we establish. In brief, if we publish a Soldier's Manual for any particular MOS which involves tank gunnery or the expenditure of munition of any sort, this Soldier's Manual has got to have as what we refer to as ammunition guidelines.

ow ammunition guidelines will not be expressed in terms of a fixed amount of munitions required for a particular type unit or given MOS. Rather, it will be expressed in terms of what is required to support training toward a particular task on a single iteration. The number of times that such training will be conducted during the year can then be determined by the commander or the G3 in the field. Each Army Training Evaluation Program should have a section which identifies ammunition requirements to support the ARTEP. Here for example is an ARTEP, and if we turn back to the rear, we will encounter some ammunition guidelines. They are expressed as you can see here in a large table; opposite each ARTEP event, down the right-hand side of the page, there is listed the munitions that are required to support training or evaluation to practice that particular task. Equipped with this, the G3 can now make out his total annual requirements. He knows how many times he is going to train or evaluate towards these tasks and he knows therefore what his total requirements will be or at least he will have a pretty good factor to enter into building such an equation. Under the new Department of the Army budgeting system, some such approach to managing training munitions will become mandatory and those ammunition guidelines will be very important in estimating the total annual dollar costs of training munitions for serving commands world-wide.




## Armor WSTEA Summary

Now to summarize what we are doing in the armor systems -- as the time bars indicate we are today in a posture in which the expenditure of actual munitions takes place throughout tank training. Tables I-VIII all require the expenditure of live ammunition. There is in the Mark 55 laser device some assistance on Tables 1-3 and REALTRAIN of course is being used to teach collective proficiencies and in the ARTEP. When we get the new Field Manual 17-12 in the field we hope to be able to shift the expenditure of live ammunition to the right so that live munitions would begin to figure only from table 4 on up and there would be much more recourse to sub-caliber the use of mini ranges, etc. for individual training. REALTRAIN would still of course figure as it presently does in our collective training. This posture (middle posture) will put us in a much better position to get at platoon gunnery. But where we want to be by 1985 is shown on the bottom line. We want to be able with simulation to handle all individual training and table 7 -- so that the expenditure of main gun rounds would begin with table 8 -- the crew proficiency table and would continue on through the platoon and company exercises which we hope to establish as the criteria for tank company proficiency in that time frame. Note also that sub-caliber will figure prominently in that collective training in that era. The multiple integrated laser engagement system we hope will be available in that time frame, and that will permit us to get at engagement simulation in a much more realistic fashion than we can presently do so with REALTRAIN. Now

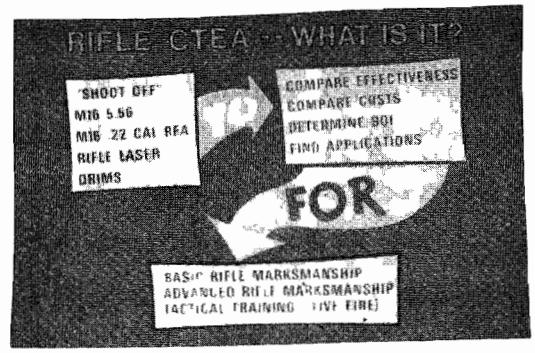


there's a lot of analysis yet to come in order to make this strategy a reality. The Armor School has a great deal of work ahead of it. Each one of these devices, each one of these sub-caliber approaches to training, or MILES itself, are all going to have to be subjected to training effectiveness analyses and those analyses in sum will determine whether we can make this strategy come true. But the Armor School is to be commended for having laid out here a blueprint for its movement into the future. We need some such blueprint for every major weapon system now under analysis in the TRADOC.

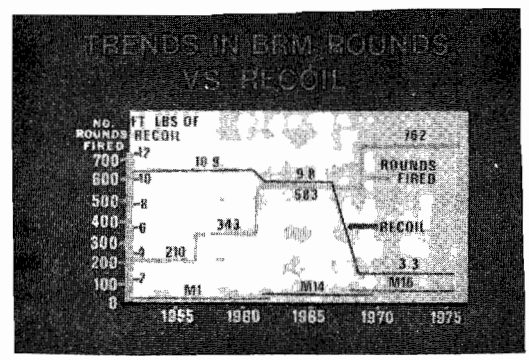
## PART III

## RIFLE MARKSMANSHIP TRAINING EFFECTIVENESS ANALYSIS

TRADOC's analysis of the M16 Rifle System is interesting for two reasons: First, although the M16 round costs only 8¢, we fire millions and millions of them every year so that in the aggregate the total amounts of money spent for training ammunition for the M16 is roughly comparable to that expended for tanks or artillery pieces. Secondly, it is a training effectiveness analyses which probes into a weapons system about which the Army doesn't know enough. That sounds strange--but it is true. Here is the general plan of the Training Effectiveness Analysis. We are going to shoot-off, actually have been involved in doing so for the past year and will be for the next year, 5.56 service ammunition with .22 caliber rimfire ammunition (commercial rimfire round) with the various laser devices and with the diagnostic rifle marksmanship system or DRIMS of which we'll show you more in a moment.



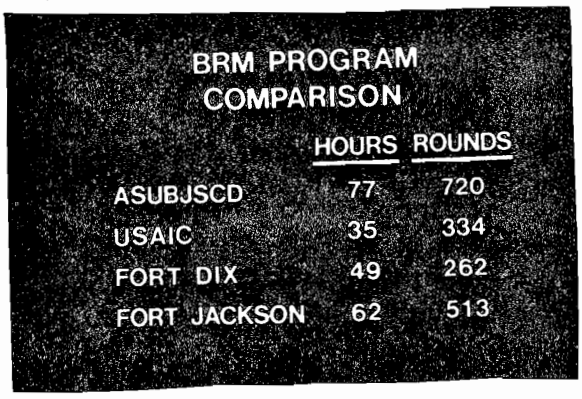

The objectives are shown on the right and we hope to end up as the entries on the bottom of the slide indicate not only with a basic rifle marksmanship program for the Army, but with an advanced rifle marksmanship program. It is of interest that most of the Army shoots to the same standards, that required for entry level soldiers. Every year we go out and requalify and we fire BRM (Basic Rifle Marksmanship. We're convinced that we need to develop a rifle marksmanship program that is designed to develop the proficiency of infantry or scouts who have to fire the rifle for pay in battle to a degree that we don't for most of the Army. Now, why did we need an analysis? Well, sometime ago this set of facts came to light. Here is the track record on the amount of ammunition that the Army dedicated to basic rifle marksmanship or BRM. You'll notice that the amounts of ammunition required for BRM has increased overtime since the early 1950's. During that time the Army had three standard rifles--the M1, the M14, and the M16. In that time therefore, the recoil as measured in foot pounds of recoil at the shoulder has been dropping from 10.9 with the M1 to 3.3 foot pounds with the M16 at present. Now, it is commonly accepted that

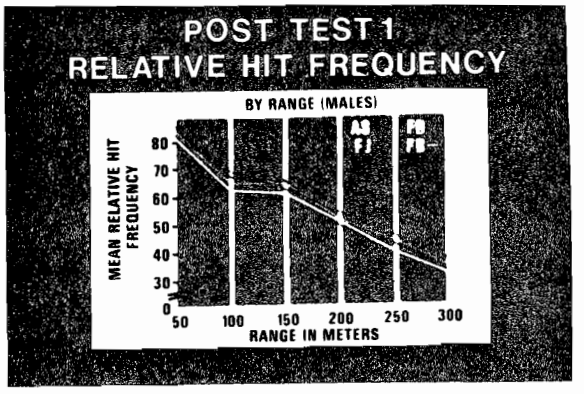


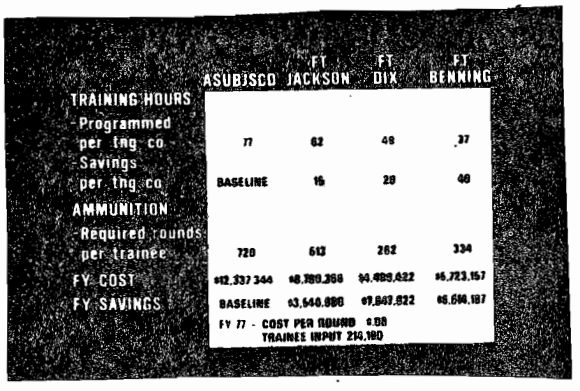
The difficulty of shooting is a function of recoil. Indeed, when the M16 was purchased, one of the representations concerning it was that it would be a more trainable weapon system in that the recoil was so much lower than that of the M14 or M1. And yet despite this lower recoil and therefore greater trainability, the Army has been increasing the amounts of ammunition expended in basic rifle marksmanship systematically over the years.

## BRM Test

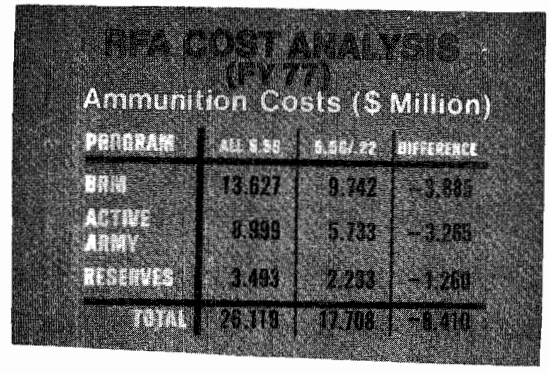
Well, over the past year we have been inquiring into what it takes to develop a basic marksman. Here are four programs which were subjected to analysis in 1976. As you can see they range from that of the Army standard subject schedule, 77 hours and 720 rounds to a short program of 35 hours developed by the Infantry Center and entailing some 334 rounds to a program developed at Fort Dix of 49 hours duration and 262 rounds and finally a program at Fort Jackson. Now 4400 firers participated in these tests. They underwent training of the duration shown there. They fired a practice course involving the rounds expended as shown and then finally they were put on a train fire qualification course where they fired 40 rounds for record. Its important to note here that everybody fired the same criterion tests at the end of the training and the results of that test will surprise you. Pick for example among the four programs, which you believe will produce the greatest proficiency among the firers. Well, the answer is, by actual tests--that it doesn't make any difference whatsoever. All four programs are statistically identical. This display showing probability of hit over range illustrates that by present training techniques, we are able to develop rifle marksmen with very much fewer rounds than we had heretofore suspected were possible. Now what difference does that make? Well, as this chart shows, were the Army to adopt the Fort Benning proposal on the right, we would have a cost avoidance in the TRADOC alone, within the training base, of over 5 millions of dollars every year in ammunition savings. Now those savings could be used to develop an advanced rifle marksmanship program and of course that is exactly where we are going with our subsequent testing. Beginning in February of 1977 we will have under test at Ft Jackson and Ft Dix a variety of devices which we will use to determine whether a mix of devices with actual firing can produce higher levels of proficiency. For example, in the test that we conducted last year the factor which seemed to best forecast high score in the qualification course on the range was simple experience with the rifle system.



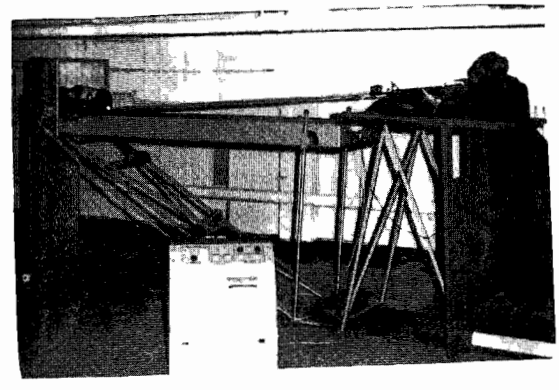
Soldiers who had had previous experience shooting .22 caliber rifles for example, did better in the qualification firing. And that was true incidentally whether they were men or women. So one of the devices that we will put into tests in February of '77 will be a rimfire adapter. This is the adapter itself. It is a device which can be inserted into the M16 in place of the existing bolt-bolt carrier. It consists of a bolt and here you can see a chamber for the commercial rimfire round. This permits us to take the commercial rimfire round, load it in this special magazine, put it in the M16 and have the M16 perform just as it would with the service munition. The rimfire round commercially available for 1¢ than gives us a very considerable advantage over the 8¢ service round. Incidentally this device will fire automatic or semi-automatic just as the actual round itself would. Here are some of the figures bearing on our analysis of the rimfire adapter. As you can see by putting into use some sort of mix of the standard service round and the .22 caliber we can bring about substantial savings overall in ammunition costs. In the first year alone we should have a cost avoidance of 6 millions of dollars. Now we're going to buy this year and deploy into the force, over 60,000 of these rimfire adapters. They'll permit national guardsmen to fire their M16's anywhere they have a .22 caliber range in their armories. They'll permit the use of local training areas for rifle marksmanship in the active Army. Places where rifle practice has never heretofore been possible will be open to the Army. And we'll be able to pay for all 60,000 of those devices out of the savings in the first year alone.





## Diagnostic Rifle Marksmanship Simulator

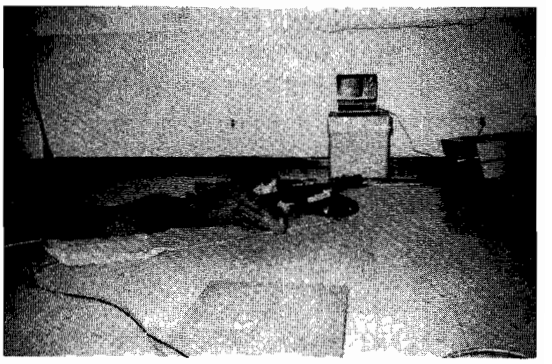
Here is another device that will figure in the tests that we will get underway in Feb '77. This is the diagnostic rifle marksmanship system or weaponeer as it is referred to. You are looking at a device that collapses inside of that long brown box that traverses the center of the picture. The firer is standing in a collapsible stand which in this posture represents a foxhole. The whole affair can be slid down on its carrier, put flat on the floor and the firer can be put in the prone position or any position inbetween. The long rod which extends from the target group on the left to



the rifle will produce recoil which is realistic for that of the M16 system. As a matter of fact the recoil is adjustable from zero to 150% of the actual recoil. You'll notice that the firer is wearing head phones. That permits us to meter the sound of firing. The device on the floor with the cathode ray tube is a micro processor monitor which permits an instructor to watch in great detail exactly what it is the firer is doing throughout the firing sequence whether he is firing semi-automatic or automatic firing. Now let's look at a film sequence that shows the DRIMS in action.

(WEAPONEER Tape Sequence)

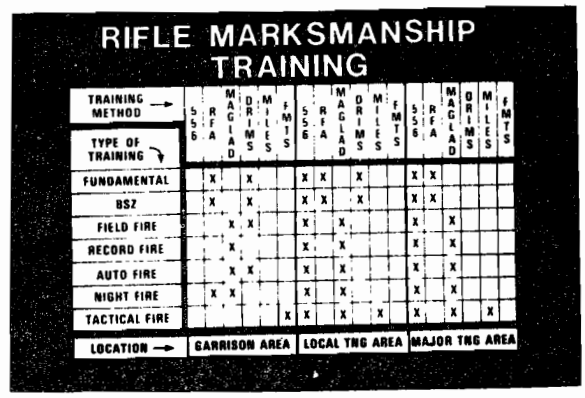
Here is another device that will be in our tests beginning in February. This soldier is using Lasertrain. He is in a prone position. He is firing at targets which appear on the television-like device set on the floor to his immediate front. To his left there is a micro-processer and a monitor which records just how well he is engaging these various devices. Like Weaponeer or the diagnostic rifle marksmanship system just shown--here is a device that can be used in armory training or in the garrison environment for the active Army and which will permit soldiers to engage very realistically, targets that will challenge their marksmanship sights and squeeze off effective shots. We'll find out just how useful this device is by actual tests.

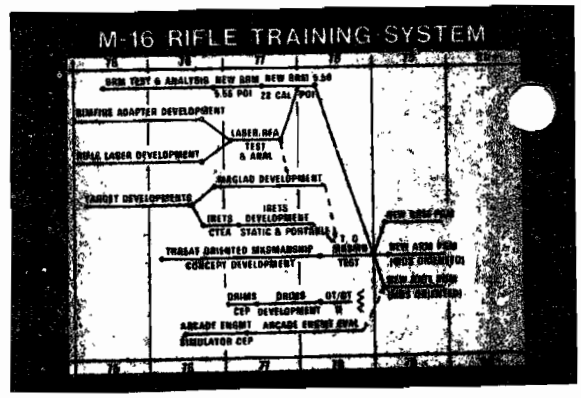


Laser Rifle

Here is still another device that will figure in the tests which I have been referring. This is the Laser Rifle. It was developed and built within TRADOC in order to measure training effectiveness in the Infantry School training effectiveness analyses. It is built around a discarded M16--a reject M16. Up here is a laser which will project a beam of light down range at the target. Out to 300 meters this beam of light will very effectively simulate the trajectory of the M16 bullet itself. When a magazine is placed in the rifle it will activate the firing circuits and this rifle may now be employed with actual targets equipped with laser sensors at the ranges identical to that the man would be firing in combat or in training or it can be employed with miniature targets of this variety. You're looking here at a scale target. This target can be placed out at ranges which will effectively simulate those that he might be expected to engage in combat or training. The rifle beam comes down range, hits the target and is reflected onto a sensor. When the target is hit it will then depress and it will present itself again for refiring or otherwise respond to the control of the instructor on the range. With the laser rifle and such miniature targets, it is of course possible for a drill sergeant for example to bring rifle marksmanship right into the squad bay or into the area just outside the barracks. In an active army unit or a reserve component unit, the applications of such devices are limited only as we are wont to say by the imagination of the trainer.

Suffice to say, if these devices test out, and we have every reason to believe that they will, as being effective in developing rifle marksmanship skills, we will have put into the hands of trainers a much more powerful and versatile set of tools to develop rifle marksmanship skills than we have ever had in the force to date. Now as was the case with the tank system, it is incumbent upon the Infantry School as part of its weapons systems training effectiveness analysis to lay out a plan or strategy which would show how these several devices figure in a training strategy and here you can see such a strategy. Over on the left the training objectives. Along the bottom the several kinds of training environments and the plan showing the application of the several systems that we've just been discussing to training with the rifle system. How much training to accomplish with each of those devices--how many rounds--how many iterations--how much to invest in each--well, that of course will be determined by actual tests in the weapons systems training effectiveness analysis. Now here is the time frame of the M16 rifle training system training effectiveness analysis. We are just now entering into fiscal year '77. The tests that we conducted in '76 have enabled us to establish a new basic rifle marksmanship training program. Basically what we have accepted is the program proposed by the Infantry School and tested this past summer and fall. We will very shortly be coming out to the field with a training circular or Army subject schedule which announces that new basic rifle marksmanship program and we will actually be using that program in our training centers in basic training. The tests which will then go on to compare the laser rimfire adapter and the other devices that I just demonstrated to you will take place early in '77 and by mid-year we expect to be able to bring them to bear on another basic rifle marksmanship program, an elaboration of the first, in which we will talk about the mix of these devices with the service ammunition. In the center of the chart you see references to a number of developments that we have not discussed to date. MAGLAD is a laser rifle which is simply the commercial version of the laser rifle that I just showed you. One that has been developed by DARCOM to our specifications and which will be, we hope, more effective and reliable than the one that TRADOC built in-house....but, it is important to note here that we will already have demonstrated the training effectiveness of the laser system. IRETS refers to Infantry targets. We know that targets in combat do not behave like those on the traditional train fire range. The Combat Development Experimentation Command for example has demonstrated pretty conclusively that most targets in combat (over 80%) will be moving laterally with respect to the firer. That most engagements in combat take place not at 90 degrees dead ahead of the firer but at some angle like 45 degrees to the dead ahead view of the firer.



Moreover those targets will go up and down. The average target is rarely exposed more than 6 seconds. Now we've got to put all of that together with the consideration that only rarely do riflemen engage singly; like tanks, most engagements with rifles are collective, and we've got to bring into play collective training in our advanced rifle marksmanship. We've got to each suppression as a team. Where a squad or a fire team is assigned a suppression mission, we've got to teach them how effectively to employ the rifle system for suppression. That is what we mean by a target development and a threat-oriented concept. Now those will have to be brought to fruition as we suggest on the bottom with a number of other devices. We're working on arcade-like shooting gallery-like devices for installation in dayrooms and barracks. We certainly want to bring along the diagnostic rifle marksmanship simulator which you've just seen and we want to bring all of that together so that by early '79 we can go to the force with a new basic rifle marksmanship program and with a new advanced rifle marksmanship program and with a program that is designed expressly for infantry and calvary units where the rifle system plays a prominent role in the overall effectiveness of the unit. That's the promise which the Infantry School has got to fulfil.

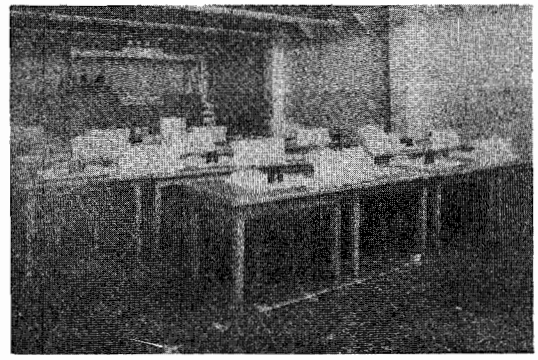
## PART IV

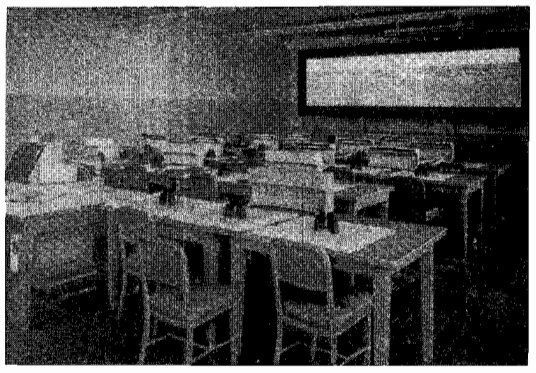
## FIELD ARTILLERY TRAINING EFFECTIVENESS ANALYSIS

As I mentioned at the outset, the Field Artillery School's work with the artillery system has been concentrated on the role of the forward observer and training techniques to develop skill as a forward observer. About 50% of the system error is at issue and if we can find a more effective way of training the field artillery forward observer or the mortar forward observer--we will have done the Army a great service.

### BT33

The approach we are taking in this instance is interesting in that we went abroad and purchased a training device which is presently in use in the German Army, the Swedish Army and the British Army. Its manufactured in Sweden and we've been using it at Ft Sill, Oklahoma for the purposes of conducting a training effectiveness analysis. The device is called the BT-33 and here is a picture of the device in the classroom. You're looking at the student positions. As you can see, each man has a set of binoculors and a chair, and to look at the classroom from the back you can see that all are looking at a piece of terrain. This terrain can be representative of anywhere in the world. In the particular instance it is a piece of terrain in Sweden. On this terrain there can be portrayed targets of the various military types including moving targets. In the rear of the classroom there is a micro-processor and here we see the instructor minipulating the micro-processor for portraying the targets and for showing where the rounds are striking on the terrain relative to target. The student must go through all of the procedures he





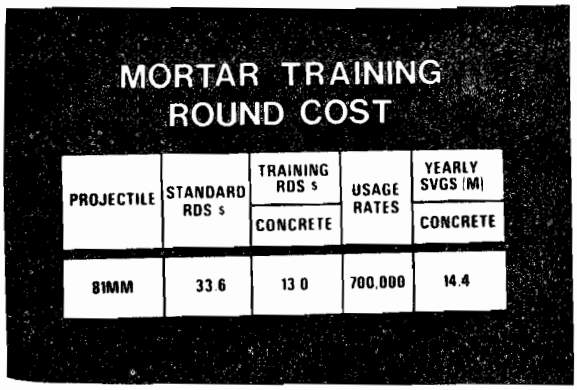
would follow in actually firing ammunition and the device is particularly interesting for instructional purposes since obviously many students can follow each fire mission and the instructor can speed up the transaction between the student and the putative battery to bring about the maximum proficiency on the part of the student itself. Now we conducted a test of the BT-33 in the Field Artillery Officer Basic Course at Ft Sill over the past several months, throughout '76 and early '77. In these tests student officers were divided into four groups. One group was trained as the Field Artillery School has been training officers for years, largely with live fire. The other three groups had various mixes of training with the BT-33 and as you see from this chart--one of the groups was trained entirely on the BT-33. Now at the end of their training all groups were fired through a live fire exercise from a mobile OP, tank or APC and their performance was measured by their ability to locate the target and to get effective fire thereon. So all were measured to the same criterion. The results are displayed as shown here. We're comparing each group to the control group trained with all live ammunition. The plus signs indicate that the groups listed performed better than that control group, thus, in the line time to locate the target, we can see that two of the groups performed better than the control group and one of the groups performed 3% less ably. However total mission time, shown here, and their final grade and the percent failed showed substantial advantages for training strategies which involved a good mix of the BT-33. As a matter of fact, by adopting either the central strategy on this chart or the strategy on the right the Artillery School in the Field Artillery Officer Basic Course alone could realize a cost avoidance of over 650,000 thousans of dollars per annum based on fiscal '76 ammunition costs--a very substantial savings indeed. Now shown here is a digital message device. This is part of the tacfire system which will be introduced into the force in the time frame 1979 or thereabouts. There will be large numbers of these in the force--one with each field artillery forward observer team. This device which is in itself a small microprocessor could be hooked up with an observed firer trainer of the BT-33 type so that

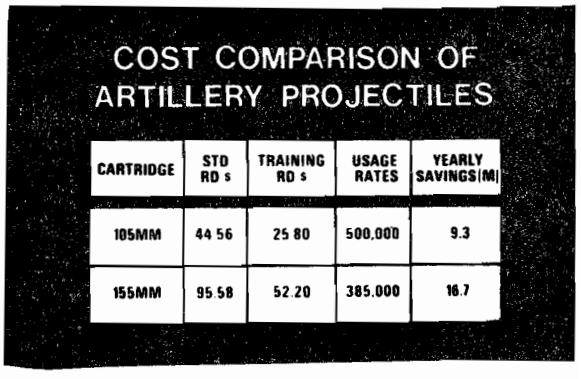
| ALL NUMBERS ARE % MEABURE | LIVE/33 | PUFF/33 | ALL/33 |
|---|---|---|---|
| INITIAL TARGET LOCATION ERROR | +29 | +23 | +20 |
| TIME TO LOCATE TARGET | + 9 | + 9 | - 3 |
| TOTAL MISSION TIME | + 5 | +15 | +14 |
| GRADE | +10 | +17 | +18 |
| % FAILED | 0 | +29 | +14 |

n effect one could have a closed loop--the machine could respond directly to commands of the forward observer and the instructor could become an observer only--he would not have to manipulate the micro-processer. So this DMD, or Digital Message Device, could become a part of a training system and that of course is one of the avenues of investigation for the field artillery's training effectiveness analysis.

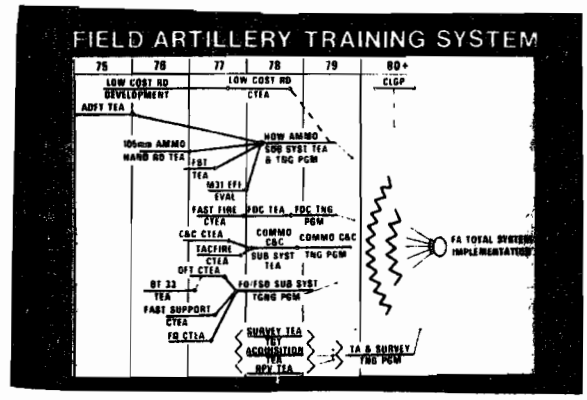
## Low Cost Ammunition

We presently train all indirect firer forward observers with live ammunition, for the most part. The question presents itself--why should we fire our ammunition that costs as much as our service rounds? Could we not devise a low-cost training round for the mortar or for the artillery? The answer is yes. Here is a low-cost training round which has been developed by Picatinny Arsenal for the TRADOC. From this portion of this projectile on down, the round is identical to that of the service round. From here on up, its all new. This is a plastic case with a concrete filling. There is here a very cheap inexpensive hammer and anvil fuse. Much of the cost of the service round is associated with the fusing. By using this simple fuse, you eliminate a lot of that cost. There is a very simple shotgun type of igniter and this cavity inside the round is then filled with a black powder marking charge which will emit a large puff of smoke and permit spotting a round or adjusting it in the course of training. To look at the cost advantages of such a round, these figures are germaine. As you can see, a concrete training round would cost, or present estimates tell us, about $13.00 compared with $33.00 for the service round of the mortar. Similar savings can be realized by taking the same concept into the production of an artillery training round. Here you can see that a concrete training round developed in parallel with the mortar round could produce a round which costs about $25.00 a copy for the 105 vs $44.50 for the service 105 round. For the 155 round we could produce a concrete round for about $50.00 vs $95.00 for the service round. The total savings for the artillery projectiles could amount to as much as 9 millions of dollars in cost avoidance for the 105 round per annum and upwards of 16 millions of dollars in cost avoidance for the 155. Now of course we're going to have to establish in our training effectiveness analyses that in fact these rounds will train as effectively as the service round. We don't know that, but we will in short order have information which enables us to make a judgement on the degree to which these concrete rounds can be substituted for the service rounds in training.



Here is the layout for the training effectiveness analyses which have been launched by the Field Artillery School at Ft. Sill. As was the case with the rifle system, it will take years for us to follow out all of the paths which we must explore before we can make a judgement on what it is that we ought to commend to the force in the '79 time frame as the optimum approach to field artillery training. Suffice to say however, we have a number of very promising leads and we ought to be able to train forward observers far more broadly than has ever been possible in the force before and far more efficiently than we have ever been able to do it before in the 1979 time frame. That is the promise which the Field Artillery School has offered to the force with its weapons system training effectiveness analyses.




PART V

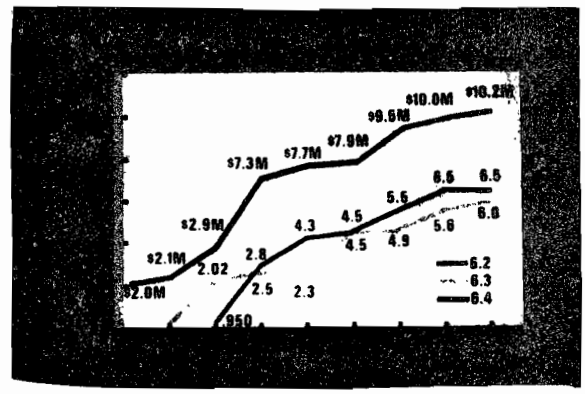
SUMMARY

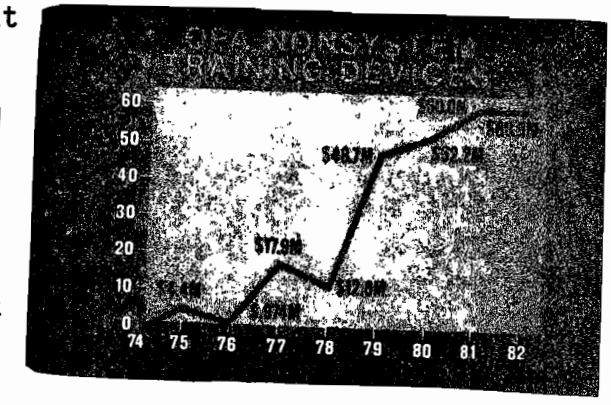
At TRAINCON '76 in Germany, we demonstrated two devices which may be familiar to most of my auditors. One was the Mark 31 Trainer--a 14.5 sub-caliber system which has been in use for some time with the artillery system and the other was a sabot device for use with mortars. Both of these devices of course do effectively permit training on the artillery or the mortar systems in garrison. They go directly to training FO's and they should figure in the overall weapons system training effectiveness analyses. Here's some footage from the TRAINCON tape.

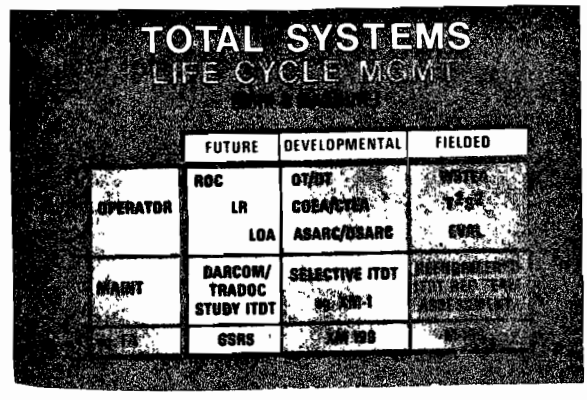
(TRAINCON Tape Footage)

Now I think you can see from the foregoing that it's going to take time for the TRADOC to complete these weapons systems training effectiveness analyses or at least carry them forward to the point where we have results that are worth reporting to the field at large. We clearly understand the urgency of getting forward with this work as rapidly as we can. FORSCOM for example wants us to develop range packages for installation commanders so that they can plan their military construction programs for ranges and training areas out into the 1980's and we want to do that, and will, when we get the results of these weapons systems training effectiveness analyses in hand. USAREUR and Korea have comparable requirements and again we want to be responsive to those requirements. But the simple fact of the matter is that there is little point in our attempting to forecast requirements unless and until we have tested the effectiveness of alternative training techniques and in particular the training devices that will enable us to change the strategy materially from that which we have been pursuing in years past where we have relied principally on firing live ammunition on actual ranges. The Army has been saying for years that it is going to have to put increased reliance on simulation in training, but frankly

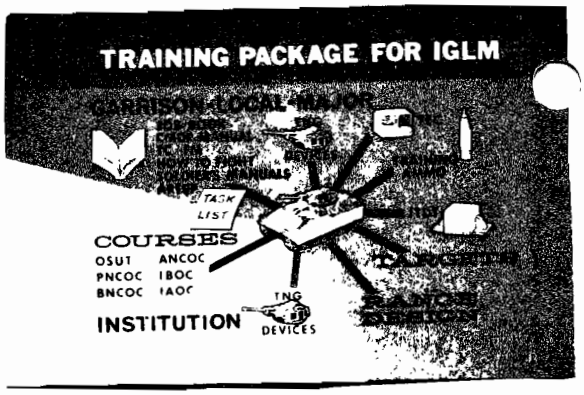
we simply have not put our money where out mouth is. Here is a display of the funds which the Army has allocated to research and development, test and evaluation for the fiscal years 1975-1982. As you can see we just now are getting our programs out of the peanuts class into some sort of meaningful program for developing prototypes under 6.2 funds to completing engineering development under 6.4 funds. And of course you have to appreciate that procurement lags RDT&E. These are procurement for non-systems training devices as projected in the fiscal years shown. As you can see it will be well into the 1979-80 time frame before we have substantial amounts of monies in the Army's procurement program for training devices. In brief, it will be in that time frame when troop units will actually see substitutes for our present training methods available in substantial numbers and impacting on their training. We want to make it clear further that it is our intention to address in our weapons systems training effectiveness analyses not only systems that have already been fielded like the M60 tank or the M16 rifle or the M109 artillery piece, but we want to address developmental systems and future systems as well. In the future system we want to draw up the requirements documents in such a way that the development of a training sub-system is a stated part of the requirement of the DARCOM. We want to bring our weapons systems training effectiveness analyses to bear on integrated technical documentation and training and we cite here of course the case of the General Support Rocket System which is now in the mind of our developers. The case here that is used as an example of a developmental system is the soft recoil 105. We want to, of course, include a training round for that piece in our training package and we want to put that into our integrated technical documentation and training. And of course the operational test with that sub-system must include a look at a total system including a total training package or training sub-system. The example given in the far right M109 155 caliber self-propelled Howitzer gives an instance where we will bring the weapons systems training effectiveness analyses to bear on our fielded systems. A point of emphasis for TRADOC and DARCOM viewers. The new Army Regulation 1000-2 includes the following statement:



"Operational tests will be conducted in a truly tactical environment involving the use of field maintenance, training, manuals, countermeasures, etc. A completed integrated logistics support package and training package must be validated during OT II. Sufficient test hardware will be procured early enough to prepare for and demonstrate during OT II the adequacy of the training and logistic support package." That says that we are indeed very serious about bringing training effectiveness analyses to bear on the developmental process. We don't pretend to have all of the answers on how to conduct such analyses, but we have promulgated certain guidance which are already in use and being developed further within the TRADOC. Here for example is TRADOC Pamphlet 71-10 which talks about costs and training effectiveness analyses such as would figure in these weapons systems analyses to which we have been referring throughout this presentation or in cost and effective analyses for overall weapons systems. There is also available a TRADOC Pamphlet 71-8 which discusses in some detail the means by which we would go about closing a training gap detected in a weapons system. These and other aids are available within the TRADOC and of course we would be delighted to share them with any command who was interested. Overall our objective is to produce a training package for institutional, garrison, local training areas, or major training areas. Shown here is our expectations for the MICV. A weapons systems that will be available in the force in the 79-80 time frame. On the bottom the requirements the training developer must meet for institutional training. Including of course the task lists, the various courses of institutional training that he must build, simulators that would figure in institutional training. But importantly, he must develop the training package for the garrison, local, and major training areas that will figure in unit training and these components of the total training package are what it was that was discussed in AR 1000-2 and include the appropriate training literature up there on the left including the ARTEP events, the Soldier's Manuals, the Commander's Manuals, the How to Fight Manuals, all of the means by which TRADOC provides training support to the force must be brought to play. It includes the simulators, the tech program, the training ammunition, the ranges, the targets, and all of the other components of the training sub-system--these must be available and in test during operational test No. II. Now in the particular case in point--the MICV its already very late in the development cycle. Its problematic whether we will be able in fact to realize the expectations, but we're going to try. We're going to do our darndest to develop these items and get them into operational test; if not with the first generation MICV--then with the subsequent generations and in particular with the version of the MICV that will mount the advanced weapons systems turret out in the 1980 time frame.




To conclude, TRADOC's weapons systems training effectiveness analyses are designed to identify to commanders in TRADOC and in the field better ways of managing training; identifying better approaches to training regardless of the training environment within which the unit may be operating. They are designed

to institutionalize for change; to show the Army how to prepare for all of those new weapons systems that the Army has planned for introduction into the force over the next decade. And finally they are designed to find out how to train the Army in the way that it will fight--decentralized with maximum flexibility available to commanders to approach their training mission as they will approach their operational missions. Whether that commander is a commander of the RC or active components, whether that commander is stationed at a CONUS division post in Germany, Korea, or wherever he may be serving, we in the TRADOC are dedicated to finding out how better to do the training job.