ABRAMS/BRADLEY
APPENDED CONDUCT OF FIRE TRAINER (A-COFT)

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Abstract

The Army National Guard's (ARNG) training strategy prescribes the use of a platform-independent, low-cost, PC-based appended trainer to support the Guard's Armor and Infantry forces to train individual, crew and platoon gunnery at the Armory location. The National Guard is accomplishing this by upgrading the current Abrams-Full-crew Interactive Simulation Trainer (A-FIST) with PC-based image generation and developing the Full-crew Interactive Simulation Trainer-Bradley (FIST-B). The identical Instructor/Operator (I/O) console and open architecture allows training support for both combat vehicles at a fraction of the traditional procurement costs. The combination of these training devices has been renamed the Appended Conduct of Fire Trainer or A-COFT.

Application of open architecture technology allows the ARNG to provide increased gunnery training opportunities for individuals, crews and platoons, producing increased unit readiness at a fraction of the time and funding of conventional training methods (list some of these). A common hardware and software baseline to these and other gunnery systems provides the added advantage of reduced lifecycle costs and "welded" upgrades with Army-approved trainers, such as COFT.

The development of the A-COFT program has lead to the reuse of traditional gunnery training matrices while moving away from a hardware-dependent system. The emergence of PC-based technology may provide the groundwork for the utilization of SIMNET to meet the maneuver training requirements of the ARNG. Networked with the A-COFT, the PC-based trainers will provide increased training opportunities at an Armory location, overcoming the distance and time constraints of ARNG training.

Biography:

Major Mark Leonard is the ARNG Advisor to STRICOM. An Idaho National Guardsman, Major Leonard commanded A Company, 2-116 Cavalry in Emmett, Idaho. His Company was the first ARNG unit to train on the A-FIST and won the Kouma Award for the high Tank Table VIII platoon average in the ARNG. He served three years with DARPA, Project SIMITAR as a Project Director for ground combat systems, and also served three years as the TADSS Plans Officer and Executive Officer at National Guard Bureau. He is a CGSC graduate and holds a Bachelor of Arts degree in History/Political Science and Secondary Education.

Biography 2:

Don Ariel is President and one of the three founders of Raydon Corporation. Mr. Ariel holds a BSEET and started his career at General Electric Simulations and Control Systems Department in 1984 as a Field Engineer on the Conduct of Fire Trainer (COFT) program. He led the team that installed the first COFT units deployed to Fort Knox, Fort Hood and Fort Stewart, as well as many USAREUR sites. Mr. Ariel was promoted through Logistics Management and completed his tenure at GE in software quality and designing software development tools. He formed Raydon Corporation with two other GE engineers in 1988 responding to the migration of COFT work to companies lacking expertise. Collectively, Mr. Ariel and his partners have built Raydon into a leader in the design, development and manufacturing of low-cost precision gunnery trainers. Raydon has built the FIST-B for DARPA, the LAV-FIST for the Marine Corps, the FIST-B LRIP (the first precision gunnery trainer with PC-based visuals) for the ARNG, and was recently selected to design the M1A1 COFT PC-visuals upgrade for STRICOM as well as the Guard's revamped A-FIST XXI.

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INTRODUCTION

The Army National Guard (ARNG) has been leading the movement toward embedded training systems by investing in appended training devices. One of the often overlooked benefits of appended training technology, and consequently embedded devices, is that they are innately reconfigurable. This aspect has particular relevance to the ARNG, as Reserve Components as a whole are not efficient users of single application training devices. Recent technological advances, including PC visualization, are leading to truly generic training devices. The opening of hardware and software architecture combined with the inherent reconfigurability of appended devices empowers the ARNG to dramatically improve trainer use efficiency and drive down the Life-cycle Contractor Support (LCCS) cost of all deployed mounted training devices.

BACKGROUND

The average ARNG armor or mechanized infantry unit has 39 training days annually to achieve and sustain combat readiness. Fifteen of those days are consumed during annual training (AT) at a major training area. The remaining 24 days are spent performing individual drill training (IDT) at the home Armory in approximately 11 weekends per year.

Concentration of training and training devices during AT is easy to achieve, and in fact, the ARNG training mirrors the Active Component's at the major training areas. However, the remaining training days are spent in a remote structure better suited to the state missions. It is this home station condition that drives the ARNG Integrated Training Strategy.

The Integrated Training Strategy prescribes the use of Training Aids, Devices, Simulators, and Simulations (TADSS) in the live, virtual, and constructive environments to achieve pre-mobilization training standards. Title XI, Section 1119 of the 1993 National Defense Authorization Act directs the Secretary of the Army to develop a training program that minimizes post-mobilization training time for the ARNG. This training program should place emphasis on individual soldier qualification; collective training and qualification at the crew, section, team, and squad level; and maneuver training at the platoon level as required of all Army units; and training for command and staff leadership to include annual multi-echelon training to develop battalion, brigade, and division level skills as appropriate.

As a result of the lessons learned from the mobilization of ARNG enhanced Separate Brigades (eSB) for Desert Storm, Congress directed the Defense Advanced Research Projects Agency (DARPA) to research the applicability of inserting training technology to improve pre-mobilization combat readiness. This effort was called the Simulation in Training for Advanced Readiness (SIMITAR) program.

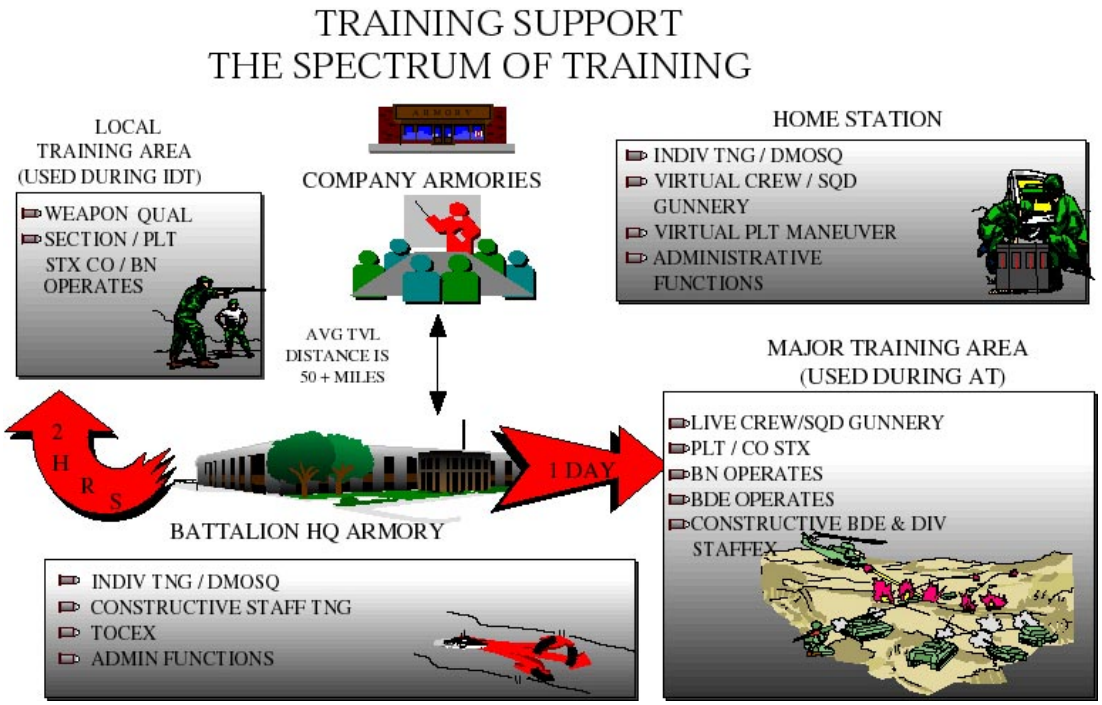
The guiding principle of the ARNG Integrated Training Strategy comes from the lessons learned from SIMITAR. It found that in order to achieve a twofold increase in performance, a unit must conduct a minimum of three to four repetitions of a training task. One of the major challenges the ARNG has in achieving the directives of Title XI and creating the correct number of repetitions is finding the proper mix of live, virtual and constructive simulations to maximize the limited training time available.

With only 39 days to train annually, the mix of simulations varies from state to state and unit to unit based on the facilities, training areas, equipment location, and training tools available. The ability to deliver training within two hours of a unit's armory demands heavy reliance on virtual training technologies. The ARNG discovered that virtual gunnery from the Mobile Conduct of Fire Trainer (M-COFT) was positive, but the M-COFT was not issued in sufficient quantity to provide the repetitions SIMITAR research demanded. To achieve readiness objectives, the ARNG needed to procure training devices that deliver realistic, demanding, low-cost training, fielded down to the armory location.

The National Guard has been very successful in the fielding and using the Abrams Full-crew Interactive Simulation Trainer (A-FIST) to train individual and crew gunnery skills. Units that have implemented the A-FIST into their gunnery program have seen first run qualifications increase and their overall qualification rates rise significantly. With the success of the A-FIST, the ARNG has expanded it's virtual gunnery capabilities by procuring four prototype Full-crew Interactive Simulation Trainers – Bradley (FIST-B) training systems to train Bradley equipped Infantry and Cavalry units.

A-FIST units are fielded at two per company for enhanced Separate Brigades. The best A-FIST utilization rates for these eSB units are approximately 80 percent annually. This utilization results from the fact that each company owns their own training devices and is not sharing them with other companies and battalions. In other words, there are several IDT weekends when a typical A-FIST is not used. The Appended-Conduct of Fire Trainer (A-COFT) concept allows the training system to be divided into vehicle unique reconfigurable packs and generic instructor stations. The instructor station utilization rates can be maximized into the mid 90 percentile by sharing these across multiple vehicle platforms and units.

As Personal Computer capabilities increase, it becomes possible to develop a low-cost simulator with the open software architecture necessary to allow multiple weapon system platforms to operate on a single instructor station. The A-COFT is the primary tool to train individual and crew gunnery task requirements for ARNG troops at homestation.



TRAINER EVOLUTION

Historically, simulation training systems were designed on mainframe computers with closed architecture systems. Thus, common elements for different vehicle trainers, such as visual systems, crew stations, and instructor stations could only be used with the vehicle type for which they were designed. This inefficient system design would be similar to TV networks making you buy a different TV set to watch shows on each network.

The process of converting training databases and exercise tables to an open architecture system is underway with the FIST-B, M1A1 COFT Rehost, and A-FIST XXI programs. The ability to use a common instructor station for both appended and crew station applications also reduces the hardware, software and courseware lifecycle costs.

Progression to Open Architecture

The conversion to an open architecture system began in 1995 with the development of a FIST-B prototype for the National Guard's Enhanced Separate Brigades participating in the SIMITAR training program. The FIST-B prototype was delivered in an unprecedented 12 months by taking advantage of terrain databases and exercise matrixes the government had developed and purchased for earlier programs, such as COFT, PGT, and AGTS. Reuse of government intellectual properties, such as databases and software, facilitated this rapid development.

The FIST-B prototype also had the distinction of being the first mounted trainer to interact in real time with dismounted infantry by integrating the ARNG's Engagement Skills Trainer (EST) so that both systems communicated and fought in the same virtual environment.

Building upon the advances made on the FIST-B, the U.S. Marine Corps developed six Light Armored Vehicle appended trainers (LAV-FIST) to meet their gunnery and maneuver training requirements. These systems included functional enhancements, such as Helmet Mounted Displays (HMD), use of manual controls during simulation, and a graphical user interface (GUI) based on the unique employment conditions of the USMC. The USMC reported a first ever 100% crew qualification for the 4th LAR battalion (a reserve unit). Integration of the LAV-FIST into the 4th LAR gunnery training program, where a 40% qualification rate had been common, was the only variable. Additionally, active units that used the system achieved increased first-run qualification rates which has resulted in ammunition savings of approximately 50%. These first LAV-FIST systems are basis on the concept of the Combat Vehicle Appended Trainers (CVAT) for which the Marine Corps is now developing their requirements.

Building on the advancements of the LAV-FIST and driving toward total open architecture, the ARNG began the FIST-B LRIP. This FIST-B was the first gunnery trainer to employ PC technology as an image generator, instead of the bulky and expensive conventional image generation machines of the past. All FIST-B hardware and software components were designed in a modular fashion to allow interchangeability with different image generators and vehicle types.

These advances have been further refined in the COFT Rehost program for the Army. The Army, through STRCIOM's efforts, is in the process of rehosting and converting the Abrams COFT to an open architecture, with a PC-based host and visual system. This upgrade replaces the old proprietary display technology with easily updateable commercial-off-the-shelf (COTS) technology, effectually extending the lifecycle of the COFT program for at least another 10 years. Included in this COFT Rehost is the conversion of valuable exercise libraries that can now be run on any PC-based training system. The COFT rehost, as in the programs before, reuses Government intellectual property and improves it for use in the new upgraded gunnery trainers.

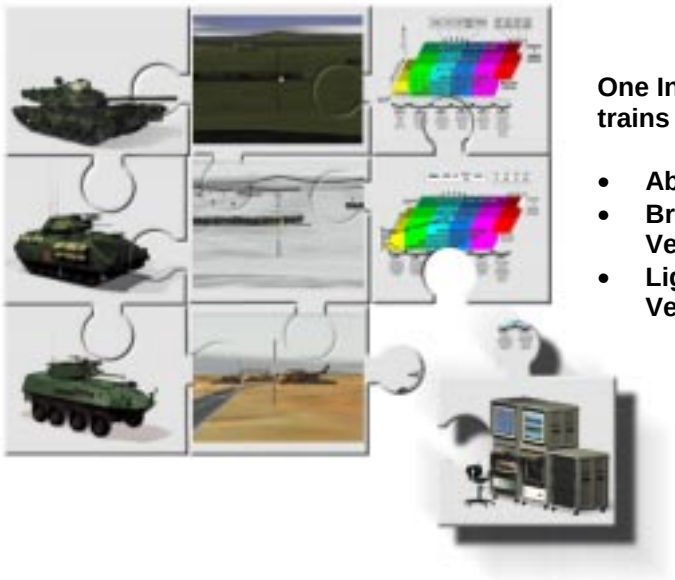
With the COFT as the baseline for all precision gunnery training in the Army, the National Guard is taking advantage of past developments in the LAV-FIST, FIST-B and COFT programs to "weld" the technology and training characteristics to fit the demands of ARNG gunnery training. As a result of the COFT Rehost, all gunnery intellectual property will be fully open. This means the National Guard's new A-FIST, called A-FIST XXI, will merely be a COFT that is appended to a vehicle.

This migration of precision gunnery training properties to a hardware-independent platform is at the heart of the A-COFT concept. Now a single Instructor Station can be purchased for multiple applications (Abrams and Bradley) i.e. A-COFT.

Open Architecture Enables Reconfiguability

Train under a host of scenarios:

- **Euro Summer**
- **Euro Winter**
- **Desert**



One Instructor Station trains armor crews on:

- **Abrams Battle Tank**
- **Bradley Fighting Vehicle**
- **Light Armored Vehicle**

A-COFT CONCEPT

The A-COFT concept, and the ever-changing PC technology market, has made it possible for the government to develop low-cost, open architecture simulators capable of appending to multiple weapon system platforms, while using a single instructor station. The instructor station for appended trainers accounts for between 60 percent to 75 percent of the total cost of each system, depending on the configuration. By standardizing the hardware and software, fewer I/O Stations are required, resulting in significant savings to the ARNG.

For example, to properly outfit an armor brigade, the National Guard's fielding plan requires 18 A-FISTs and 10 FIST-Bs. Each armor crew spends approximately 30 hours training on the virtual gunnery simulators annually. By dividing the training time of all of the armor crews in the brigade by the number of allotted training days, we conclude that each trainer sits idle for approximately 20 percent of the available time. This idle time is a result of unit training priorities, available vehicles, crews, and instructors.

Armor Brigade:

- 6 Armor Companies + 1 Cav Troop
- 3 Mech Infantry Companies + 1 Cav Troop

Strategy indicates 2 A-COFTs per company, therefore:

6 Abrams Co X 2 per Co = 12 Abrams
3 BFV Co X 2 per Co = 6 BFV

Total Required = 18 A-COFTs

Assume 80% Instructor Station Utilization

18 X 80% = 15 Instructor Stations

Procurement Savings

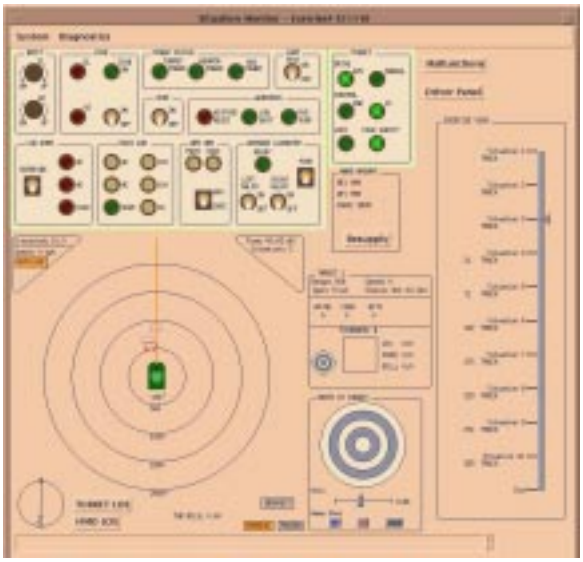
5 X 272K (A-FIST) X 60% = **$490K**

The advent of the A-COFT allows the ARNG, with proper scheduling, to restructure training times for individuals and crews and reduce the number of Instructor Stations by as many as 3 per brigade. This reduction of instructor stations lowers procurement costs an estimated $490,000 per brigade.

With standardization, the Instructor Stations and the vehicle appended elements can be packaged separately, allowing the military to purchase only those elements necessary to provide trainers that fully equip units with an effective mix of devices and training opportunities. The appendage kits can be located at the armory or the closest training location supporting vehicles. The Instructor Stations would be rotated among the locations to provide surge training demands of a particular unit. Since the footprint of the A-COFT Instructor Station has been reduced to four two-man carry transportation cases, the movement and set-up time required is minimal.

The functional common hardware configuration allows the reutilization and newly developed modular software to be run on multiple configurations. This is the true success of the A-COFT program.

The core software for the A-COFT is designed to be independent of the eventual interface. To train on a new vehicle type, the instructor need only select - from the start up menu - the vehicle type on which he wishes to train. The computer detects the correct overlays, vehicle interface cables and support structures for each vehicle type, and a built-in test reports the status of the trainer. The Instructor Station also includes a modern graphical user-interface (GUI) that allows the instructor to easily digest the large amount of information needed to monitor and evaluate crew performance (Figure 1).



LAV-25 Graphical User Interface
Figure 1

BENEFITS

A single hardware functionality and software open architecture baseline offers the benefits of rapid development for different vehicle types and reduces the developmental costs. ARNG units will also realize lower maintenance, repair, documentation and supportability costs for the device. A-COFT also has the advantage of reconfigurability. The same system is able to train the Abrams Tank family, the Bradley Fighting Vehicle, and Light Armor Vehicle crews with only the appendages being exchanged.

In fact, because of the common functional hardware and open software design, the A-COFT systems can be easily networked together to allow section, platoon, or company training, with no restrictions on vehicle types or mixes. This leads to the potential of Simulation Network (SIMNET) reutilization and interoperability with the Close Combat Tactical Trainer (CCTT), providing greater agility and opportunity to provide Active Component and National Guard soldiers who are forward deployed around the world to maintain their warfighting skills. Moreover, the flexibility of use places the training implementation decisions right where they belong: with the commanders. The A-COFT provides the tools to the soldier allowing him to meet the Title XI directives and increase readiness by providing a greater number of repetitions at homestation.

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