COFT—A NEW CONCEPT IN TANK GUNNERY TRAINING

Donald E. Jones
Naval Training Equipment Center
Orlando, Florida

Richard K. Hopkins
General Electric Company
Simulation and Control Systems Department
Daytona Beach, Florida

ABSTRACT

The problem of developing and sustaining armor crew gunnery proficiency has become increasingly challenging in recent years due to operational and training costs and limited range availability for realistic gunnery training. The Unit-Conduct of Fire Trainer (U-COFT) was thus developed to provide armor force commanders the capability for improving and sustaining crew gunnery combat readiness between range firing periods. A total training system consisting of crew station, visual, and instructional subsystems, the U-COFT is housed in three environmentally controlled shelters that afford limited mobility and self-contained operation. It will be deployed with armor and infantry battalions in 44 locations throughout the free world. The U-COFT instructional system features an extensive library of exercises which train all the gunnery tasks required of a crew in combat, plus an adaptive training management function that permits each crew to improve its proficiency at a rate commensurate with its ability. This paper briefly describes the unique instructional features incorporated in the U-COFT training system.

INTRODUCTION

With the largest training device contract ever awarded, the U.S. Army is sponsoring the manufacture and fielding of nearly 300 Unit-Conduct of Fire Trainer (U-COFT) systems configured for the M1 Abrams and M60A3 tanks, and M2/M3 Bradley fighting vehicles. Employing computer image generation, digital control systems, and computer aided instruction techniques, the U-COFT is designed to train armored vehicle commanders and gunners in basic, intermediate, and advanced gunnery skills. Providing crew compartments that closely replicate actual turret interiors, generating high resolution full-color imagery viewed through sights and periscopes, and accurately simulating the sight, sound, and "feel" of fire control system and weapon operation, the U-COFT demonstrated training effectiveness during operational testing by the U.S. Army. A key factor in its capability as a training device is the instructional subsystem used to direct, evaluate, and monitor the training process. Highlights of the U-COFT development and operational testing, system characteristics, and instructional subsystem features are provided in subsequent paragraphs.

PROTOTYPE DEVELOPMENT AND VALIDATION

In September 1979 the U.S. Army awarded contracts to two contractors for accelerated development, over a 21-month period, of prototype versions of an M1 configured U-COFT on a competitive "best-effort" basis. That is, both contractors were allowed maximum latitude in design of the trainers, so long as certain minimum performance requirements were met. Government evaluation and selection of the production contractor was to be based heavily on the training effectiveness demonstrated during field testing. At the end of the contractually fixed development period, only one contractor successfully fielded an operational system. Development of M2 and M60 versions was continued with the winning contractor, General Electric. A production award followed in September 1982.

Assessment of the training capability of the General Electric U-COFT occurred during a full-scale operational test at Fort Hood, Texas, involving a battalion of M1 crewmen and vehicles.

The test was designed to measure the capability of, and differences between, two training programs developed to train crew gunnery. Training effectiveness was measured, within each program, in terms of skills developed and increased proficiency. Transfer effectiveness was measured in terms of crew proficiency — either sustained or increased — resulting from the training programs as demonstrated on the actual M1 tank.

In the test plan devised, one armor company was to train using the actual M1 tank together with other conventional training aids; two other companies were to receive gunnery training exclusively on the U-COFT yet perform all other normal crew tasks during the three month training/evaluation period. Prior to start of the training period all three companies participated in a range firing test to assess basic crew proficiency levels. At the conclusion of training a second range firing exercise was conducted and graded, and the results compared to the pretraining scores.

Final test results concluded that both training programs sustained proficiency; each provided a satisfactory level of transfer effectiveness. Additionally, the U-COFT was found to be training effective in that as a training medium it sustained and in some cases improved gunner and tank commander skills in all areas measured. Moreover, a supplementary test designed to assess the ability of both tank and COFT-trained crews to operate with malfunctioning fire control equipment indicated that crews trained on the COFT were, in fact, clearly superior. This was not unexpected since crews training on the U-COFT experience programmed malfunctions as part of the exercise matrix and hence become more familiar with procedures to follow when confronted with failed or degraded weapon system components. A fourth M1 tank company newly formed immediately prior to the start of the test, and which could not be "officially" included, was also involved. This company was largely but not entirely composed of personnel untrained on the M1, and due to the non-homogeneous mix did not represent a true transition group. This company was, however, trained solely on the COFT with a course of instruction designed for transition training, the length of which was approximately three times that of the sustainment companies. Approximately two-thirds of the way through this training the skill levels demonstrated on the COFT were beginning to match those achieved by the sustainment crews; at the completion of the test, the skill levels of the transition company, demonstrated on the COFT, *equalled or bettered those of the sustainment companies.* These findings are expected to be verified by planned testing when the U-COFT reaches field units.

PRODUCTION SYSTEM DESCRIPTION

As illustrated in Figure 1, the U-COFT is composed of the following hardware elements:

- A crew station in which the appearance and functions of training-critical vehicle operating controls, indicators, and weapon sights are replicated.
- A computer image generation (CIG) visual system that produces realistic, full-color action scenes allowing crew members to view and interact with a broad range of target situations.
- An instructor-operator station (IOS) through which the instructor (a master gunner or platoon sergeant) initiates the computer-selected exercises and monitors crew performance. He can freeze action, replay all or part of a particular exercise, select remedial exercises to suit specific crew needs, or obtain soft or hard copies of crew performance. Color displays included in the station let him view all visual scenes as presented to the trainees.
- A general-purpose computer which provides the control interface between system elements, as well as manages the total U-COFT training, scheduling, and performance/proficiency evaluation.
- A shelter subsystem composed of three air-transportable MIL/ISO standard containers, with two of these housing the trainer equipment and the third providing space for crew briefing/debriefing and maintenance. Environmental conditioning, power distribution, and fire protection is self-contained.

The special-purpose computer image generator provides three-dimensional color daylight, reduced visibility, and night scenes with various terrain and topographical backgrounds, manmade structures, moving targets, projectile tracers, and special effects (round impact, missile signature, artillery fire — both friendly and enemy, smoke grenade explosion, etc.) that allow tank crews to develop gunnery proficiency in a variety of simulated battle conditions. Correct visual perspective is instantaneously computed and maintained for all orientations of the simulated vehicle targets and overall data base. The 10km-by-7km data base around which the training exercises are developed is composed of eight separate data blocks; six of these can be moved or interchanged to provide scene flexibility. Ownvehicle can be programmed for movement through seven of the eight blocks; targets can be placed anywhere in the data base. Weapons simulated include the 105 mm main gun, 7.62 mm coaxial machine gun, .50 caliber machine gun, and smoke grenades used on the M1 and M60 tanks, and the 25 mm automatic weapon, 7.62 mm machine gun and TOW missile system used on the M2/M3 fighting vehicles. Data bases are available for both visible and thermal engagement exercises; in the latter, thermal signatures of scene objects and targets are taken into account to assure realism.

Over 500 tactical exercises, each approximately 10 minutes long, are available for the M1 U-COFT. The M60 version will be equipped with a comparable number, and the M2/M3 will have more than 350. These exercises range from a three-hour introductory session for trainee familiarization with the U-COFT and orientation in basic elements of tank gunnery, to complex multiple-target air/ground exercises which test the mettle of even the finest tank crews. Ranking of the exercises is in order of increasing difficulty in each of three skill areas: target acquisition, reticle aiming, and systems management. By a systematic method of butting and stacking, these exercises form a three-dimensional matrix through which a student advances— on an exercise-by-exercise basis—toward certification levels established for basic,

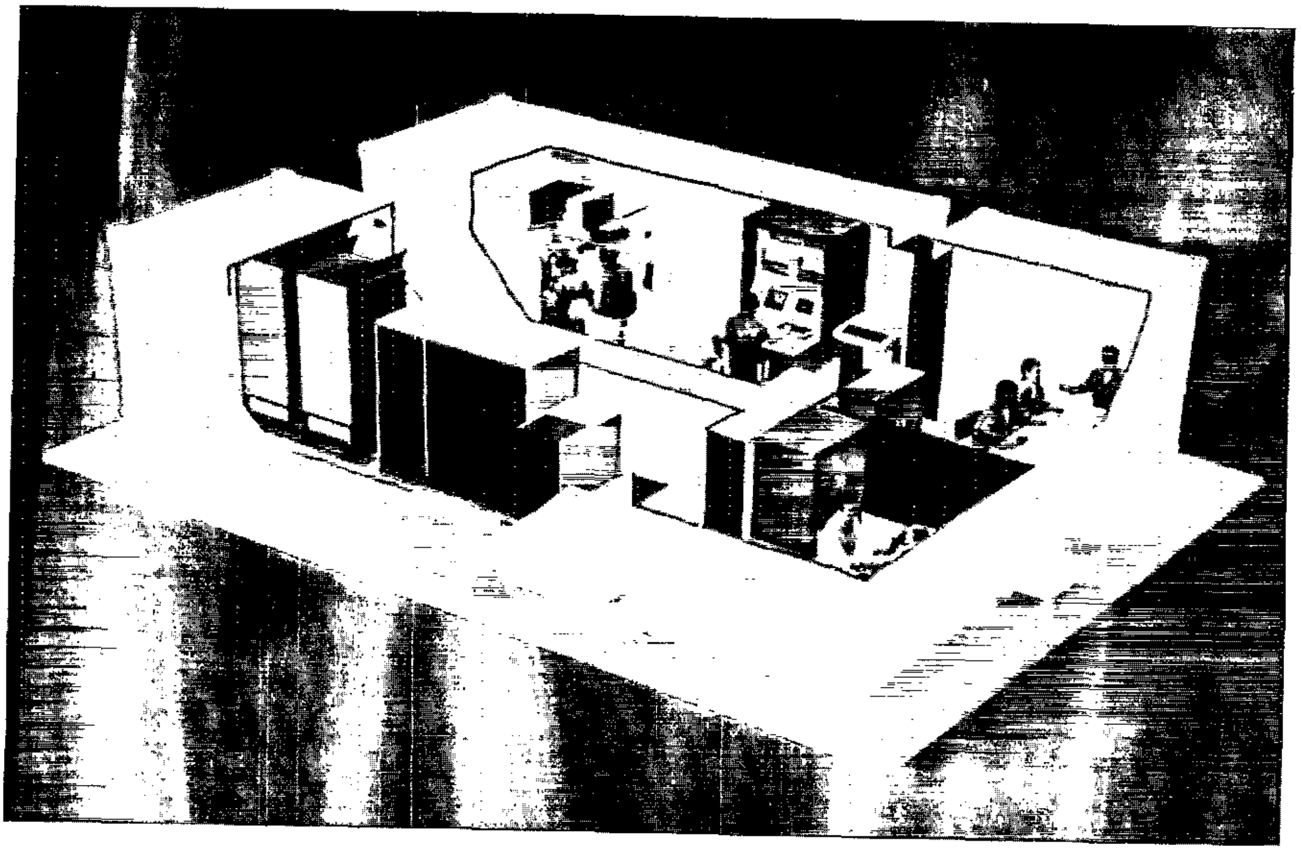

Figure 1. Unit-Conduct of Fire Trainer (U-COFT)

cross, transition, and sustainment courses of instruction. Ranking the exercises according to difficulty makes "controlled adaptive learning" possible, in that the student progresses to the next successive exercise (or level of difficulty) only if his current and/or previous performance justifies it. He either advances, regresses, or remains at the same level in accordance with pre-established matrix movement rules and conditions that will be discussed later. For each exercise in the commander/gunner and commander matrices, there are either two or four repetitions of that exercise available. In the case of stationary ownvehicle exercises, each exercise has four repetitions in which the situation conditions are the same but the order of appearance of the targets is changed. For moving ownvehicle exercises, there are two repetitions, each of these being a unique exercise since in a moving exercise merely changing the order of appearance could mean that the target would not be visible due to ownvehicle position at that time. The repetitions are utilized when the computer recommends "no advancement" and the crew is required to retrain at that same difficulty level. The repetition capability also serves to deter crew memorization of exercise content and target appearance.

As students progress through the matrix, they move from simple stationary owntank-stationary target engagements to increasingly difficult conditions involving various combinations of moving ownvehicle, moving targets, multiple stationary and moving targets, reduced visibility, malfunctioning fire control components, and incoming enemy fire. Overall, an extremely realistic, effective, and stringently controlled training environment results.

INSTRUCTIONAL SUBSYSTEM

The instructional approach employed in the U-COFT has evolved as the result of inputs from tank crewmen, engineers, educators, training psychologists, training managers, project managers, and other sources, and has proved to be extremely effective to date in achieving the Army's goals for this trainer. The U-COFT instructional subsystem consists of a library of preprogrammed exercises for teaching gunnery skills, an adaptive evaluation system for evaluating crew progress, a training management system to process student records and assist in scheduling, and an Instructor Operator Station (IOS) to provide the instructor with real-time instructional feedback and control features to aid in monitoring and critiquing student actions.

Training Matrix

As discussed earlier, the training exercises form a matrix, as illustrated in Figure 2, that is organized according to target acquisition, retical aiming, and systems management levels of difficulty. Ranking exercises in this manner makes possible an adaptive learning process that is controlled by selection of exercises of known change in difficulty based on trainee performance on previous exercises. Target acquisition levels of difficulty cover a range of target exposure, visibility, lighting, friendly and enemy fire, and various distracting conditions such as thermal clutter, friendly and enemy fire, and friendly vehicles in the target areas. The reticle aim levels are ranked by difficulty by forc-

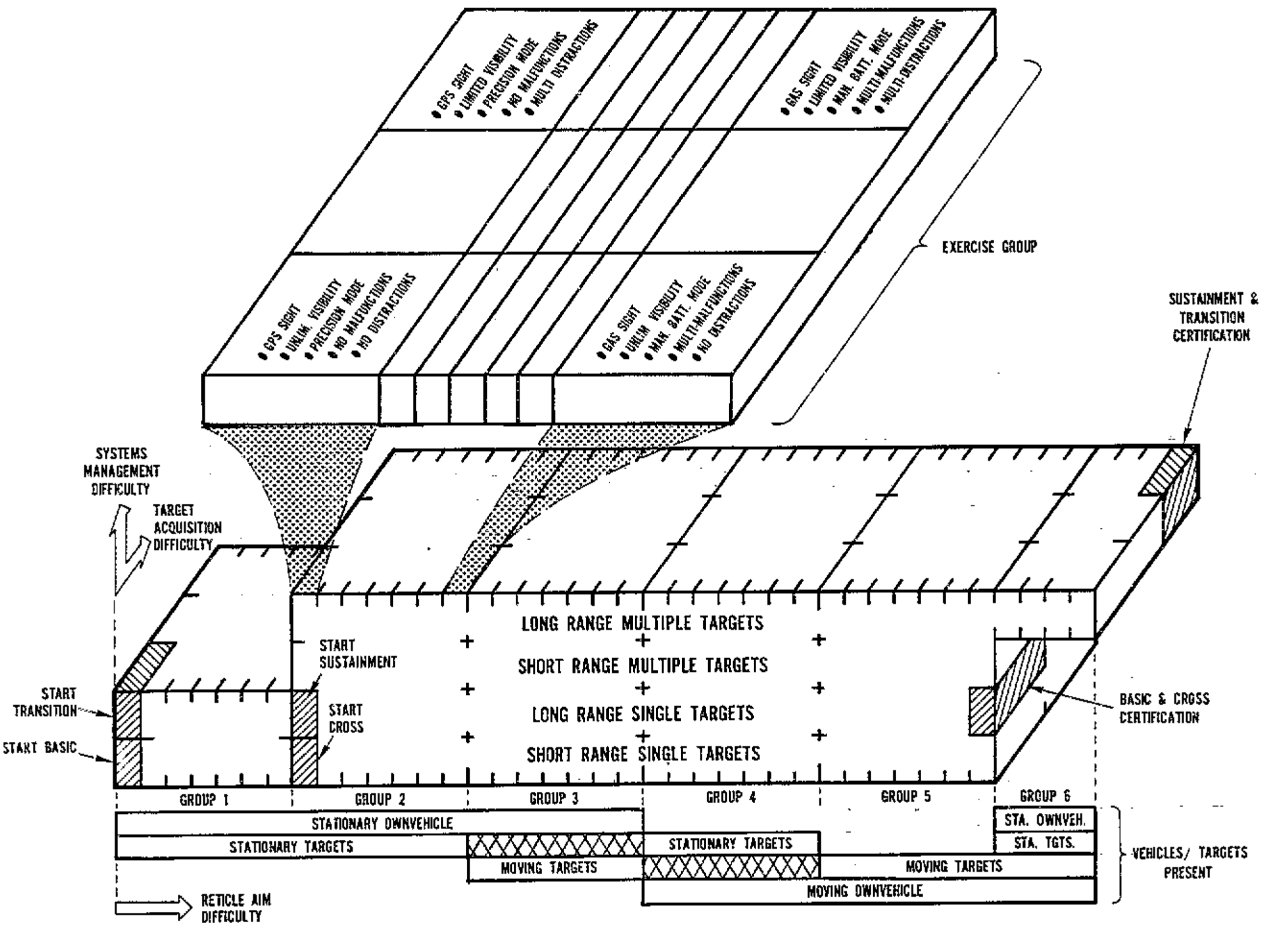

Figure 2. Commander/Gunner Training Matrix for M1

ing the use of primary and auxiliary gunsights either with or without fire control system malfunctions present and required use of NBC (Nuclear, Biological, Chemical) equipment by the crew. And finally, systems management levels are layered according to whether single or multiple targets are present, and to respective target range. There is a similar but smaller matrix which consists of exercises designed specifically for the training of the tank commander (TC), and the firing of the various weapons from the TC position.

The exercises comprising the commander/gunner and commander-only matrices are organized into groups, with each group addressing a specific type of ownvehicle motion and target mix. Each exercise in the group consists of from four to ten independently scored situations with similar tactical and environmental conditions. Each group contains a mixture of target types, both friendly and enemy, including tanks, armored personnel carriers, trucks, helicopters, and area (troop fire) targets, and is structured according to the target acquisition and reticle aim levels of difficulty. In each of the first five groups or blocks of exercises shown in Figure 2, each group provides seven types of reticle aim problems, with three degrees of difficulty in target acquisition, and two or four levels of difficulty in systems management. As the crew progresses from Group 1 through Group 6, the conditions become more difficult as the owntank targets proceed from stationary to moving, and from single to multiple.

Following an orientation, trainees enrolled in the basic course of instruction enter the matrix at the beginning position shown in Figure 2. After completing an expected number of exercises, progressing along a nominally diagonal movement through the layered groups of exercises, the trainees exit the matrix at the point where certification for the basic course is achieved. That is, at that point exercises are provided which test the capability of the crew to proceed to the more difficult sustainment blocks of exercises.

Trainees in the cross training program category enter the matrix at a more advanced level than that specified for basic, but then move toward certification in similar fashion as those students in the basic course. Transition and sustainment trainees enter the matrix at yet higher levels and after completing their respective expected number of exercises achieve certification at the uppermost point of the matrix.

The training exercises provide for moving or stationary firing ownvehicle in combination with moving or stationary targets. Target and ownvehicle motion is preprogrammed to assure that all trainees at all unit locations are measured in the same way; allowing random "wandering" may involve heavy reliance on instructor judgement and result in inconsistencies in scoring. For stationary engagement exercises, motion paths such as those representing movement from and to defilade positions connect stationary firing positions; for stationary target exercises, the paths cause the targets to move into view and then remain stationary until the exposure time limit is reached. In all cases, the targets withdraw from the scene if not hit. In no cases do targets to be engaged appear or disappear suddenly from the scene. Ownvehicle speed is specified for each exercise requiring ownvehicle motion, with both constant and variable speed and direction paths chosen as appropriate for the objectives of each exercise. Exercises provide varied terrain roughness, with ownvehicle operation in stabilized and nonstabilized conditions.

Targets in an exercise are spaced in range and azimuth to provide training in target search and acquisition. Targets become visible within two or three seconds after the start of each situation; and since each has a preprogrammed exposure time, it withdraws from the training field of view if not hit within the time allowed. Vehicle and area targets appear at any aspect angle with respect to the viewing ownvehicle, from full front to full rear and including all angles in between. All targets may be programmed for movement throughout the data base gaming area, the only restraint being the existence and location of other objects in the data base.

Target classification levels range from "most dangerous" to "friendly", with each target in a situation being ranked with respect to the other targets in the situation. Classification is based on the following variables: target type, target range, target orientation (including turret orientation in the case of tank targets), and other targets visible. Friendly targets always receive the lowest classification value, and the levels of targets within the same lethality group are equal. Engagement in order of lethality is one of the criteria considered in the grading of crew performance.

Training the commander to fire the main gun and his own weapon involves use of the commander's exercise matrix, which is similar to the commander/gunner matrix (Figure 2), but has only two systems management levels. The exercises in this matrix are organized around specific types of ownvehicle motion and target mix, and each exercise includes independently scored situations with similar tactical and environmental conditions. Commander training occurs concurrently with crew training in that as the crew progresses through the basic, cross, transition, or sustainment programs the computer periodically recommends a commander exercise. Access to the commander's matrix is automatic and progress is based on the commander's learning progress. The first commander's exercise is automatically selected after the third computer-recommended crew exercise but thereafter commander exercises are recommended based on the commander's "lag". This is defined as the difference between his position in the commander's matrix versus the position of the crew in its matrix, and can be positive or negative. The frequency of commander exercises can vary from one exercise for each five crew exercises to one for every crew exercise.

As noted previously the library also includes special-purpose exercises that are used for U-COFT introduction/orientation, calibration and zeroing, preparation for operation, acquisition and manipulation, and evaluation.

Scoring Criteria

Each U-COFT training exercise contains a minimum of four to a maximum of ten independently scored situations involving similar tactical and environmental conditions. A situation may involve one, two, or three targets which may be stationary or moving. The composite of situation scores for a given exercise is used to form a computer recommendation as to student movement in the matrix.

Each situation is scored, on the basis of predetermined criteria, for performance by the trainees in the requisite skill dimensions of target acquisition, reticle aiming, and systems management. The measured state for each dimension is determined on the basis of the criteria listed in Table 1.

Skill Dimension	*State Measurement Criteria*
Target Acquisition	• Time to acquire target • Number of identification/classification errors
Reticle Aiming	• Time to first round burst • Time to hit • Magnitude of aiming error
Systems Management	• Number of switch setting errors prior to firing • Number of switch setting errors at time of firing

Table 1. Situation Scoring (Measured State) Criteria

To illustrate how scoring occurs within each skill dimension, the measurement of reticle aiming error is used as an example. This error, which is evaluated for main gun rounds only, is defined as the total distance that the reticle is displaced from the centroid of the target or from the correct aiming point for situations requiring manual lead, wind, or cant aim-off. The correct target aim for all point targets is within a 0.67 mil circle of the target centroid. A target hit plate is designed for each target type such that the portion of the target outside the 0.67 mil circle but within the target silhouette is designated as sensitive to hit damage. The reticle aim error evaluation is based on the criteria indicated in Table 2.

Following measurement of student performance in each skill area the evaluation function of the instructional subsystem formulates recommendations for action by the instructor. These are displayed on the IOS terminal CRT at the conclusion of each exercise. At the same time, a disk file of crew performance is automatically updated; this file is catalogued by crew member, student name, and training program type (i.e., basic, transition, sustainment, cross). Access to student records is under strict password control.

Progression through the commander/gunner and commander exercise matrices is guided by matrix movement rules designed to prevent critical levels of training from being passed over, and to present exercises of remedial content to students for whom "reduction in standing" is recommended by the computer. The rules also assure that key exercises which train the critical tasks associated with a reticle aim group are not passed over as a result of a "rapid advancement" computer recommendation. After an exercise is completed and the scores for each of the three skill dimensions have been calculated, the system checks the movement rules against the computer recommendation criteria before recommending the next exercise. The matrix movement rules are shown in Table 3.

Round No.	Reticle Error	Evaluation	Grade
1.	a. Target hit and aim error less than or equal to 0.67 mil.	4	A
	b. Target hit and aim error greater than 0.67 mil but within the hit plate area.	3	B
	c. Target missed and no second round fired.	1	F
2.	a. Target hit and aim error less than or equal to 0.67 mil.	3	B
	b. Target hit and aim error greater than 0.67 mil but within hit plate area.	2	C
	c. Target missed.	1	F

Table 2. Reticle Aiming Error Evaluation

To assure that crews do not progress out of an exercise group prior to demonstrating proficiency in the critical tasks required of that exercise group, the following special rules are enforced:

- In each reticle aim group a specific exercise at a designated position in the matrix must be completed and the crew (or commander) must achieve at least a "normal advancement" recommendation in all three skill areas.
- A minimum acceptable proficiency level is established for system management and target acquisition skill areas during the conduct of exercises with malfunctions.
- Crews will be designated as certified upon obtaining at least a "normal advancement" recommendation in all three skill areas in specific certification exercises in sustainment, transition, basic, and cross training.

Skill Dimension	Matrix Movement Requirements		
	To Next Higher Level	To Next Lower Level	To Skip a Level
Systems Management (SM)	Two or more successive "normal advancement" recommendations in conjunction with a "normal" or higher recommendation for reticle aim on the last exercise fired.	Two or more consecutive "reduced" recommendations for either systems management or reticle aim.	Two-level increase or decrease is not allowed.
Target Acquisition (TA)	"Rapid advancement" recommendation for the last exercise fired, or two consecutive "normal advancement" exercise recommendations.	Two or more consecutive "reduced" exercise recommendations.	Not allowed.
Reticle Aim (RA)	"Normal advancement" except in certain special cases.	Not allowed. Reduction in systems management level is recommended instead.	"Rapid advancement" exercise recommendation, (In certain special cases, movement to the next level may be recommended)

Table 3. Matrix Movement Rules

The U-COFT instructional subsystem is characterized by an extensive range of capabilities, selectable at the instructor's option, that enable him to efficiently and effectively control and manage the overall training process. These capabilities, which are implemented through data collection, performance evaluation and analysis, and training management functions embodied within the subsystem, are summarized in Table 4.

Exercise Selection

In the training mode, exercise selection may be accomplished by the instructor in three different ways:

- By computer recommendation, in which the computer assesses the crew's matrix position, evaluates the results of computer-recommended exercises previously completed, and selects the next exercise for the crew to perform. Each training session begins with the last computer-recommended crew exercise performed during the previous training session; this helps account for any performance loss since the last session. The instructor can accept the computer's recommendation, or based on his personal assessment of crew performance he may select an exercise by content or by specific exercise number.
- By exercise content based on descriptors, including ownvehicle speed, target type, target speed, initial target range, crew member firing, weapon selection, sight selection, visibility conditions, and malfunctions. Successive content selection pages for each of the descriptors are presented to the instructor and, via a "selection by elimination" process, a listing of those exercises in the library which contain the selected descriptor elements is displayed to the instructor by exercise number. Upon selection of an exercise from the list, a detailed description of that exercise is presented; at this point the instructor may opt to run that exercise or he may select another.
- By exercise number, based on instructor apriori knowledge or selection via his field manual which lists and describes all exercises available for use.

Although the instructor has the option of ignoring the computer recommendation for the next crew or commander exercise, progression through the matrix will not be affected by his selection. For example, if at the conclusion of an exercise the computer recommends exercise "12345" but the instructor decides to select exercise "98765", the system would run exercise "98765". At the conclusion of this exercise and regardless of

FUNCTION	PURPOSE	RESULT/EFFECT
Mode control	Select and terminate specific operational mode (i.e., training, training management, daily readiness check, diagnostic test).	Mode selected is executed.
Exercise selection, preview, briefing	Provide instructor with exercise description for briefing to the crew.	Description of exercise and initial tactical environment is displayed to instructor after exercise is selected.
System setup	Perform automatic check of crew compartment switch settings (by trainees) for correctness.	Exercise will not start if check fails. Incorrect settings are displayed to instructor, who will inform crew to correct settings.
Performance monitoring and analysis	Convey trainee performance data to instructor during exercise, during playback, and on completion of exercise.	Displays via situation monitor page: • Current ballistic computer data • Operational mode • Current switch positions • Current exercise and situation numbers • Elapsed exercise time • Current and past engagement data • Engagement results/scores
Session summary	Summarize overall crew performance for each training session.	Session summary is displayed and/or printed.
Shot pattern (For 105 mm main gun only. No shot pattern for area fire weapons, i.e., coax and cal .50	Provide graphic view of shot patterns for up to two rounds per target in the exercise.	Shot pattern reflecting hit data relative to center of mass of the target, accurate to 0.1 mils in azimuth and 0.2 mils in elevation is printed.
Exercise control	Provide instructor with comprehensive control of exercise.	Selected controls are executed: • Exercise freeze/unfreeze at any point. • Record/playback of visual scenes and aural cues for current exercise (no voice communication). • Exercise repeat. • Logging of verbal commands by crew during exercise (i.e., gunner identified, from my position, driver stop/go, cal. 50). • Ammo selection input. • Printout of situation monitor, performance analysis, and/or shot pattern pages. • Input of identification (ID) error.

Table 4. Instructional Features Summary

how well the crew performed, the computer would once again recommend "12345" as the next exercise. This process would continue regardless of the type or number of exercises selected by content or number by the instructor. The intent of the rule is to prevent situations in which critical skill elements may not be exercised if instructor manipulation of crew progress was allowed, and to standardize crew instructional content which could be compromised by instructors having different levels of skill. It is entirely probable, however, that by exercising crews in specific exercises selected by content or by number the instructor may bring about a more rapid advancement once the system and exercise selection is returned to the computer.

Performance Monitoring

An instructional feature that is expected to be highly critical to training is the situation monitor page, displayed on the IOS display terminal CRT, that conveys student performance data to the instuctor both during and immediately after the exercise. This page, a typical example of which is shown in Figure 3, contains information such as current ballistic computer data, operational modes, current crew station switch positions, current exercise number, elapsed exercise time, current situation number, current enemy target and past target engagements (in terms of weapon firing, target type, main gun round number or machine guns burst number, reticle aim error in azimuth and elevation), and results for the engagement. While the situation monitor page is updated once each second, aiming errors are updated as each round is fired. Data for the current engagement is highlighted on the display to distinguish it from previous data and data for upcoming targets; the latter is listed for each target in terms of seconds before target appears, target bearing, and target type. Also included is the situation letter grade, system status prompt, and keypad options prompt. Letter grades are interpreted in relation to the student progress recommendation; i.e., "A" for rapid advancement, "B" for normal advancement, "C" for no advancement, and "F" for reduction in standing (regression).

In the example provided in Figure 3, eight of the ten situations have been presented to the crew. In situation No. 1, the crew engaged a fully-exposed T72 target, fired cue round and missed due to an elevation aim error of 21.10 mils low. In situation No. 5, the crew engaged troop (area) targets with the coax machine gun, fired 128 rounds, hit 38% of the target and received a "miss" because 75% coverage is required for a "kill". In situation No. 9, a HIND-D helicopter will appear in 35 seconds at a position five degrees to the crew's right. Situation No. 10 will be a T72 tank which will appear in 83 seconds at a point directly in front of the present viewing point. Additional information presented on this page is the true range of the target and the range input to the computer by the crew's ranging to the target; the mode of operation is normal (no malfunctions); laser is set to First Return; the gunner has main weapon selected and SABOT indexed; SABOT is loaded. All of this data is available to the instructor and is updated in real time. He may use it to cue or assist the crew, or not, as he sees fit.

Exercise Control/Monitoring

The instructor utilizes dedicated keys on a VT-102 auxiliary keypad to control the exercises and the overall conduct of the training session. The auxiliary keypad, shown in Figure 4, allows the instructor to accomplish the following functions:

- Freeze/Unfreeze - Interrupt an exercise at any point in its execution and resume the exercise at the point of interruption. At this point the instructor may critique the crew and then proceed; repeat the exercise from the beginning; playback all or part of the exercise; terminate the exercise; display the performance analysis page at the situation monitor; or print the shot pattern.

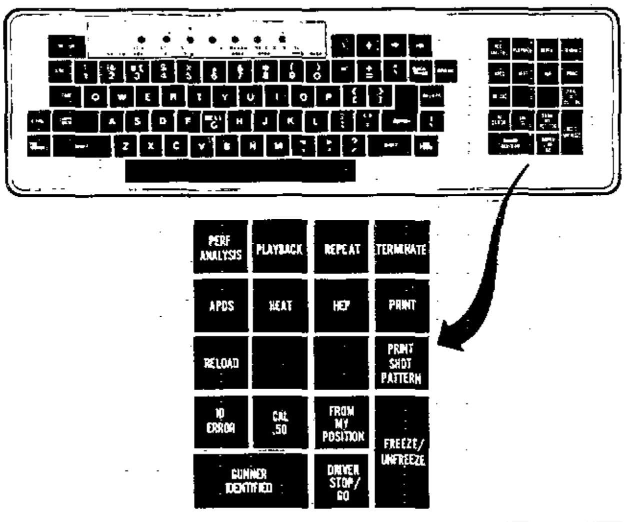

Figure 4. IOS VT-102 Terminal Keyboard Arrangement

Situation Monitor

	Mode	Cmptr	True		Control	GUNNER		Ex No 312111
Range	AUTO	1860	1860		Mode	NORMAL		
Lead	AUTO	0.0	0.3		Laser	FIRST RTN	Time	6:37
Crosswind	AUTO	-7.2	-7.2		Weapon	MW-SABOT		
Cant	AUTO	2.2	2.2		Load	SABOT	Sit No.	8

Sec Act	Bearings/ Weapon		Tgt Type	Numb Rnds	Reticle Lay Az	El	Results/ Errors
	SABOT		T72 WHOLE	1	L 0.00	D 21.10	MISS — 0
	HEAT		T72 WHOLE	1	L 0.92	U 0.39	KILL — 1
			BMP				
			TRUCK				
	COAX		TROOPS	128	* * * * *	* * * * *	MISS — 38%
	SABOT		T72 WHOLE	1	L 0.20	U 0.77	KILL — 1
	SABOT		HIND-D	2	L 0.83	U 0.27	KILL — 1
	L	0	TRUCK	1	R 0.31	U 0.14	KILL — 1
35	R	5	HIND-D	* * *	** * *** *	** * *** *	** * *** * * **
86	R	0	T72 WHOLE	* * *	** * *** *	** * *** *	** * *** * * **

Grade: Tgt Acq: A Ret Aim: A Sys Man: C

Figure 3. Typical Situation Monitor Page

- Record/Playback - Playback all, or part, of the last ten minutes of all of the visual and aural events for that exercise period.
- Exercise Repeat - Repeat the selected exercise from the beginning.
- Command Logging - The instructor can log various verbal identification commands by the crew members during the conduct of an exercise. These include:
  - — Identified (gunner response)
  - — From my Position (commander response)
  - — Driver STOP/GO. In this way the instructor acts as the driver to move the tank to and from defilade, or to halt and resume movement in a moving exercise.
  - — Cal .50
- Ammo Selected Keys - The instructor may act as the loader by pressing either the APDS, HEAT, or HEP keys when the tank commander announces the round type.
- Reload Key - Removes round currently in the breech and reloads a different type round if so designated by the tank commander. A suitable delay is initiated before the next round can be fired.
- Print - Will print situation monitor or performance analysis page as selected.
- Print Shot Pattern - Prints page containing shot patterns for up to two main gun rounds for each target in the exercise. This pattern will reflect the reticle lay error for each round indicator to an accuracy of 0.1 mil in azimuth and 0.2 mil in elevation.
- ID Error - Allows the instructor to assess a penalty against the crew if an improper target identification has been made.

The U.S. Army is closely monitoring the development of voice recognition technology with an eye toward utilizing this technique to accomplish some or all of the instructor monitoring noted above. Exploratory evaluation of existing voice recognition systems has shown that U-COFT needs for connected/continuous voice recognition cannot be fulfilled at present. However, the software currently used for implementing the various keyboard functions is designed to easily accept the addition of voice recognition when such technology is sufficiently advanced to warrant it.

CONCLUSION

Through the extremely realistic overall equipment and tactical environment made available in the U-COFT, crews should experience training that is every bit as challenging as it would be in the actual armored vehicle and in real tactical settings. And, with the ever-changing mix of scenarios that they'll train in, anticipation of "what's coming next" is highly improbable. In short, crews will train as they will fight.

But the system's instructional capability is also important to training success. By striking a careful balance between human involvement and computer automation, the instructor can completely oversee and control all aspects of the training and yet be free to provide critique and feedback when necessary since the computer relieves him of the routine and burdensome data handling and record-keeping tasks.

When field deployment of the U-COFT begins in 1985, U.S. Army Armor and Infantry battalions will have a trainer that has been found to be effective at developing, improving, and sustaining crew gunnery proficiency. Most significantly, any increase in combat readiness that results will be gained with substantially fewer dollars — dollars saved in ammunition, fuel, range space costs, and vehicle maintenance.

ABOUT THE AUTHORS

MR. DONALD E. JONES is a Project Engineer with the Naval Training Equipment Center. He is currently the Lead Engineer for the Conduct of Fire Trainer (COFT) program for Program Manager for Training Devices (PM TRADE). He holds a BSEE from St. Louis University, St. Louis, MO and an MBA from Rollins College, Winter Park, FL. In previous associations he was a Field Engineer with Philco Corp. and Naval Aviation Engineering Service Unit (NAESU) working in the Anti-Submarine Warfare (ASW) field. Since 1966, he has been a project engineer at NTEC for various land warfare training devices for both the Army and the Marine Corps.

RICHARD K. HOPKINS, a graduate of Stetson University, DeLand, Florida, served as an Armor Officer in the U.S. Army from 1957 to 1977. During his military career, which included commanding Armor platoon, company, and battalion size units, he was responsible for the training of crewmen on a variety of tank types. Mr. Hopkins is currently serving as an Armor Training Consultant to the General Electric Company, a position he has held throughout the U-COFT Development Program.