Close Combat Tactical Trainer (CCTT)
Critical Technical Parameters Report

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OUTLINE

1.0 Introduction

This report documents the evaluation of the Close Combat Tactical Trainer (CCTT) Critical Technical Parameters (CTP). The report covers the efforts of the Evaluation Analysis Center's Independent Evaluation (IE) for the CCTT OTRR III of 13 February 1998 (Ref. 1) as well as any updated data and analyses that is relevant to issues raised by the IE that have been received since the Feb 98 time-frame. The CCTT CTPs are defined in the CCTT Test and Evaluation Master Plan (TEMP) (Ref. 2). Table 1 extracted from the TEMP shows these CTP and their associated performance thresholds. This report will not address CTP 10, Reliability and CTP 11, Integrated Logistic Support. These are being addressed separately by EAC analysts and will be provided individually for inclusion in the CCTT System Evaluation Report (SER).

The report addresses each CTP individually, using the following format. First the requirements and technical thresholds are reviewed, then the available data, and results are discussed. Finally the status of any applicable Program Trouble Reports (PTRs) are considered. A summary of the PTRs can be found as Excel ™ spreadsheets in the Appendices. Appendix A provides the current list of PTRs that have been assigned configuration management verification control (cmvc) status of either open, working or canceled. For purposes of this report we have sorted these according to the CTP that is most closely associated with each PTR. Appendix B lists the PTRs that at the current time have been assigned a closed status. These are arranged in order of the PTR number.

Table 1 Critical Technical Parameters and Thresholds

Critical Technical Parameters	Technical Threshold
1. Capacity of simulation network	Supports 851 entities and five simultaneous training sessions at one site.
2. Target detection, recognition and identification	Point estimates of success shouldn't differ from the baseline performance by more than five percent
3. Target tracking	Target tracking capability of primary/secondary fire controls should not differ from the baseline performance by more than 10 percent
4. Ballistic parameters	Ballistic trajectory should not differ from the baseline by more than five percent
5. Weapon effects	Casualty assessment should not differ from the baseline by more than five percent
6. Maneuverability	Mobility of simulated entity on simulated terrain should not differ from the baseline performance by more than 15 percent
7. Command, control, combat support, combat service support	The system must simulate functions of tactical operations center, combat trains command post, fire support, engineer, resupply, refuel, and transport
8. Semi-automatic forces	SAFOR will have capability to perform all the battlefield tasks and supporting functions that live forces can perform in the simulation [see *TDR 5.g(1)-(7)]
9. After action review	The system will provide a means to monitor, record, and play back the events that take place during a unit training session [see TDR 5.f.(1)-(6)]
10. Reliability	Complete 90% (95% desired) of tactical training exercises without termination (system abort) during IOTE
11. Integrated logistic support	Mean time to repair ≤ 1.1 hours. Maximum time to repair ≤ 120 minutes. Mobile CCTT will be transportable on highway and secondary roads
12. Operational environments	Mobile CCTT can be stored and operated in basic climate environments

* TDR= Training Device Requirement, (Ref. 3)

2.0. CTP#1. Capacity of Simulation Network

2.1. Requirements.

2.1.1. TDR 5.a.(1): "The system must provide the interactive networking of vehicle simulators and command, control, communications and support workstations that represent the vehicles, operations centers, support functions, and weapons systems of a battalion task force, a company team or troop, a platoon, and the Combat Support and Combat Service Support elements."

The most demanding of these elements involves the battalion task force, which requires the capacity to simulate 851 entities.

TDR 5.a (5). "The system must allow for the conduct of up to five separate unit operations simultaneously at a site."

PIDS 3.7.4.1.d. " The execution of an exercise or multiple exercises totaling a combined count of 851 entities shall not result in any restrictions to real time training or cause abnormal visual effects or delays".

2.1.2. Technical Thresholds. The CCTT must support 851 entities and five simultaneous training sessions at one site.

2.2. Data. A STRUCTT Battalion Task Force movement to contact exercise was conducted at Ft. Hood, TX on 11-12 Sep 97 and on 4 Nov 97 involving 851 entities on both occasions. Another exercise involving 950 entities was conducted on 6 Nov 97. An exercise involving five separate unit operations was also conducted on 12 Jun 97.

2.3. Results. After Action Review (AAR) tapes of these exercises were compiled and witnessed by Government personnel from the Evaluation Analysis Center (EAC) and STRICOM (Ref. 4). From these reviews it was concluded this CTP has been adequately addressed. These tapes are available for review from the CCTT program office; however they can only be viewed in one of the After Action Review (AAR) modules.

2.4. Status of Applicable PTRs.

There is one remaining PTR , #v14523, applicable to this CTP. This PTR involved the disappearance of an opposing force entity from the simulation. The status is canceled per recommendation of AMSAA in February 1998.

3.0. CTP#2. Target Acquisition Capability

3.1. Requirements.

3.1.1. TDR 5.b.(6). (Vehicle Simulator Modules) "The system must be fitted with vision blocks, sighting systems, and sensors that replicate those on the actual vehicles. The visual resolution of the simulated terrain must be such that true perspectives are maintained as distance to an object increases or decreases. The system must be capable of displaying both friendly and threat personnel, vehicles, and weapons effects. An object must appear to be the proper size with distinguishing characteristics for the indicated range as viewed through the optical systems or sensors employed by the weapons systems. Terrain feature clarity must be sufficient to provide authentic depth perception and distant vision. Visual distortion caused by the operation of the simulators must not interfere with visual task performance."

TDR 5.c.(6). (Simulated Terrain and Environment) "The system must provide normal day and night visibility, and exhibit the effects of smoke, fog, haze, vehicle exhaust, dust, weapons flash, terminal ballistic effects of simulated ammunition and explosive ordnance, and precipitation."

3.1.2. Technical Threshold. Point estimates of success shouldn't differ from the baseline performance by more than five percent

3.2. Data and Results.

3.2.1. Target Icon Test. The TRADOC System Manager Combined Arms Tactical Trainer (TSM-CATT) performed and reported target icon visual inspections for three test matrices.

3.2.1.1. Conditions.

Matrix One. The matrix one was tested on 23 Sep 96. This matrix presented three target arrays (T-80, HEMMT, HIND-D icons) at 500, 1100, and 1900 meters. The manned module was placed at a viewing point so that all three arrays could be seen from the vehicle. Examples of all types of manned modules were manned by subject matter experts and all fire control view ports and magnifications were used to observe the target arrays. This included driver, loader, and observer optics. This was to determine any significant difference in the way the models were presented by the image generator in each view port of each module.

Matrix Two. This matrix was known as the "Motor Pool Matrix". Samples of all moving models and re-locatable models were placed in groups along a road in the terrain database. Two manned modules (M1A2 and Bradley) were driven along the arrays at close range to determine if any gross problems existed in the models. This was run in OTW (out the window) daylight and thermal and at night in thermal. This was the first time that all models were looked at during a short period of time in the anticipated training environment. Due to Primary 2 (Desert) database tuning efforts and program timing, this matrix was run twice. One run was before database tuning and other one after database tuning.

Matrix Three. This matrix was designed to test the model detail scaling of the image generator and to determine any transition range problems. Three target arrays were presented similarly to Matrix One, but more targets from Matrix Two were included to get a larger visual sample. Each model set was represented so a wide spectrum was displayed. The targets were presented at 500, 1200 and 2500 meters representing doctrinally significant ranges.

3.2.1.2. Results.

The CCTT M1A2, M1A1, and M2A2 modules were tested on 23 Sep 96 for the sensors listed in Table 2. Some abnormalities identified by the SME were: GPS image was black and white when it should have been color; the HEMMT target appeared to be missing the left side or right side tires on front views at 1100 and 1900 meter ranges; and the reticle had the wrong color for range & ammunition.

Table 2. Scope of the Matrix 1 Target Image Inspection

M1A1	mag	M1A2	mag	M2A2	mag
Cdr Vision blks	1x	Cdr Vision blks	1x	Cdr Vision blks	1x
CWS-day	3x	CWS-day	3x		
CPH-direct		CPH-direct		CPH-direct	
CPH-binoculars	7x	CPH-binoculars	7x	CPH-binoculars	7x
CPH-NVG	1x	CPH-NVG	1x	CPH-NVG	1x
GPSE-day	3x	GPSE-day	3x	GPSE/CRA-day	4x
GPSE-day	10x	GPSE-day	10x	GPSE/CRA-day	12x
GPSE-	3x	GPSE-night	3x	GPSE/CRA-night	4x
GPSE-	10x	GPSE-night	10x	GPSE/CRA-night	12x
		CITV-thermal	1x		
		CITV-thermal	10x		
GPS-day	3x	GPS-day	3x	GPS-day	4x
GPS-day	10x	GPS-day	10x	GPS-day	12x
GPS-night	3x	GPS-night	3x	GPS-night	4x
GPS-night	10x	GPS-night	10x	GPS-night	12x
Unity window	1x	Unity window	1x	Unity window	1x

GAS	8x	GAS	8x	GAS/BUS	5x
				Vision Blocks	1x
Driver Vis blocks	1x	Driver Vis blocks	1x	Gnr Vis Blocks	
Drvr-bino	7x	Drvr-bino	7x	Driver Vis blocks	1x
Drvr Night Vis	1x	Drvr Night Vis	1x		
Loader-Vis Blk	1x	Loader-Vis Blk	1x	Drvr Night Vis	1x

Abbreviations: mag=magnification; bino=binoculars; Vis=vision; Blk=block; Drvr=driver; Gnr=gunner

3.2.2. Field of View Test. AMSAA performed the field of view (FOV) manned module limited target acquisition test in 1996 (Ref. 5) The test is described below.

3.2.2.1 Conditions. A total of 32 military observers participated in the FOV trials. Observers included gunners, vehicle commanders, loaders, and drivers. Tank targets included the T72, T80, and M1A1; APC targets included the BMP-1, BMP-2, M2, and BTR-60; and truck targets included the M1078 and M1083. The FOV Test results are applicable only to the Primary I terrain database, which represents a Central US terrain. All scenarios conducted on Abrams simulators were run using 7 kilometer meteorological visibility, which represented "good" meteorological conditions. Scenarios run on the M2 simulators utilized 5 kilometer meteorological visibility, which represented a "moderate" meteorological condition. All targets tested on the Abrams simulators were situated in low ground clutter, while all targets tested on the M2 simulators were placed in medium ground clutter. Targets were placed using the CCTT Battlemaster station.

3.2.2.2. Results.

Comparison of test results from individual scenarios with corresponding ACQUIRE model predictions were made. A review of these indicates that, in general, the test results do not match the corresponding ACQUIRE model predictions. In many cases, the ACQUIRE Model tends to over-predict sensor performance.

Plots were examined of detection probabilities versus target range for each combination of sensor/field of view (FOV) tested during the FOV Test. Data points for the Abrams Direct View Optics (DVO) wide field-of-view (WFOV) and the Bradley DVO narrow field of view (NFOV) show a trend of decreasing probability with range, as expected. For the Abrams DVO NFOV, all observer detection probabilities were 100 percent. The Abrams FLIR WFOV, Abrams FLIR NFOV, and the Bradley DVO WFOV do not show any consistent pattern of decreasing detection probabilities with range. Examples for the Abrams DVO and FLIR in NFOV are shown in Figures 1 and 2 below.

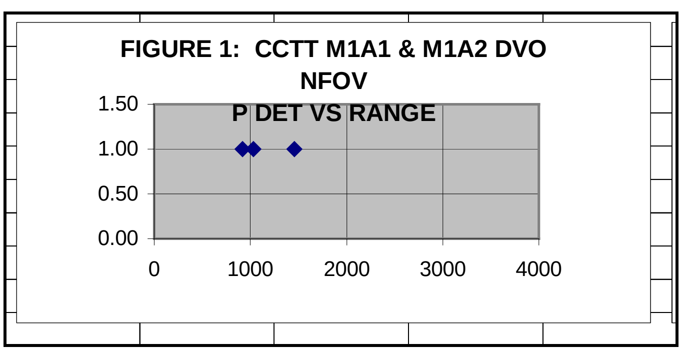
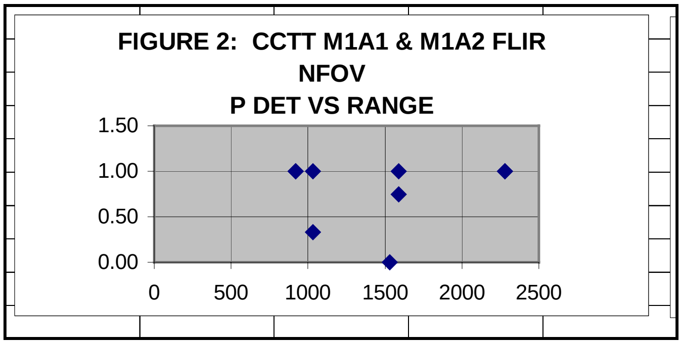


FIGURE 1: CCTT M1A1 & M1A2 DVO NFOV
P DET VS RANGE



Our analysis of the FOV test data to date indicates a mismatch between the predicted performance of the SAFOR forces and the tested performance of the CCTT observers. Future analysis of the FOV test data will concentrate on development of performance parameters for scenario aggregations and ACQUIRE model excursions aimed at finding values for input parameters that will yield an optimal match between simulator and SAFOR target acquisition performance.

The FOV test results are applicable only to the Primary I terrain database, which represents a Central US terrain. To assess SAFOR versus simulator performance issues on the Primary II (desert terrain) database, additional observer testing should be conducted. AMSAA suggests a condensed FOV test on the Primary II database using a single simulator type. Future testing should incorporate revised procedures, such as manual control of FOV setting, in order to eliminate situations that have greatly complicated the analysis of the FOV LVT test data.

A review of the FOV test data indicates a number of scenarios where the number of participating observers were 5 or fewer. This small number of observers does not agree with recollections and records of AMSAA analysts who participated in the FOV test cases in various supporting roles. AMSAA suspects that some of the observer data may have been lost during the data collection process at the test site. This issue should be resolved prior to any additional observer testing so that a more robust sample size may be achieved in future observer test efforts.

3.3. Status of Applicable PTRs.

There are four open PTRs applicable to this CPT.

PTR # 19635 is a significant concern (urgency = amber). The M1A2 Commander's Independent Thermal Viewer (CITV) thermal image has too much noise. A plan to resolve this issue should be addressed prior to production. The Integrated Development Team (IDT) needs to fix and test this issue prior to the full production decision.

PTR # 18577 concerns the atmosphere visibility range being inconsistent with the attenuation coefficients. A 5 km visibility range is behaving as if it's a 7 km visibility range. AMSAA will provide the data table and algorithm to help identify and fix this concern. This PTR is open, however resolution of this issue has been deferred to Post Deployment Software Support (PDSS).

PTR # 19570 was found in the VV&A Matrix 3 testing. The light truck model size is not in correct proportion to that of the tank. The IDT is to fix and test this issue in PDSS.

PTR # v14525 is a visual concern in which the M113 appears to be a box without tracks or road wheels. It is recommended that the problem be fixed and verified during the Pre-Planned Product Improvement (P3I) phase.

There are six additional PTRs applicable to the CPT which have been assigned a canceled status.

PTR # 17715 is a target acquisition concern in which the CGF entities do not spot previously spotted manned modules (MM) after the MM is reconstituted. This appears to be a problem unique to the MM. AMSAA said to remove this PTR in February 1998.

PTR # 15375 is a target acquisition concern. The M1A1 and M1A2 target icons do not appear the correct size for the Gunner's Primary Sight (GPS) reticle. ATC conducted target icon tests but did not test the reticle. The recommendation was to develop a procedure to test reticle and icon sizes through the GPS.

PTR # 17975 is a visual PTR involving the M1A1 sight's peripheral focus capability. The status of this PTR is also canceled.

PTR #19660 refers to the HMMWV mounted observer eyepoint. The mounted observer eyepoint was at the wrong location. This PTR has also been canceled.

4.0. CTP#3. Target Tracking.

4.1. Requirements.

4.1.1. TDR 5.b.(2). "The vehicle simulators must represent the physical appearance and functional aspects of the crew compartments and functional controls, and replicate the performance characteristics of the vehicle and weapons systems they simulate. During operation, the crews must be able to perform the collective tasks they normally perform to shoot, move, and communicate."

TDR 5.d.(1) "The system must simulate dismounted soldiers in scout sections, infantry squads, and platoon headquarters, who can be made to dismount their vehicles/aircraft to perform reconnaissance, scan 360 degrees, engage point and area targets with small arms and anti-armor weapons, move in selected formations at appropriate rates, interact with mounted crews and with one another, communicate as they would under combat conditions that require them to dismount, and remount their vehicles/aircraft."

TDR 5.g. "The simulation must provide semi-automated forces (SAFOR) the capabilities to perform all the battlefield tasks and supporting functions that live forces can perform in the simulation with a minimum of human involvement."

4.1.2. Technical Threshold. Target tracking capability of primary/secondary fire controls should not differ from the baseline performance by more than 10 percent

4.2. Data.

Data are from ATC's Oct-Dec 96 target lay test on a CCTT M1A2 manned module at STRICOM test site and on a real M1A2 tank at Aberdeen Proving Ground, MD. Additional data was obtained from a re-test conducted from 26 Aug through 28 Aug 1997 (Ref. 6). Two ATC's civilian gunners operated in both the CCTT M1A2 and real M1A2 tank. Target condition was stationary. The target lay time is extracted from a time-coded video recording. The target lay time is accounted for from the gunner's starting action to a point when the center of the gun sight is on the center of the target. There were twelve test cases. There are about four trials per gunner per test case. The average target lay time per test case in Table 3 includes data from both gunners. The laser rangefinder data are from AMSAA CCTT manned module direct fire test (AMSAA CCTT VV&A report, Ref. 7).

4.3 Results.

4.3.1 Based upon the ATC test engineer observation during the target lay test, the CCTT M1A2 provided the gunner operations of laser range-finding, turret/gun rotation control, and primary and secondary fire controls. The gunner in the CCTT M1A2 module took longer to lay on a target than he did in the real

M1A2 tank. The time differences are 27 to 100 percent; therefore the CCTT failed the 10 percent criterion for this CTP. In particular, the time differences are larger when the gunner needs to control the elevation of the gun as revealed in test case number 1, 2, 4, and 5 as shown in the Table 3. Additional similar results are shown in Table 4.

Also the CCTT rangefinder performance is not affected by clutter such as background and foreground terrain features and weather conditions. Therefore, the CCTT rangefinder always provides more accurate target range than the real rangefinder.

Table 3. Average Time to Lay on Target for CCTT M1A2 and Actual M1A2 Tank

	Layoff Position, mils		CCTT	M1A2	Difference
Test Case No.	Azimuth	Elevation	second	second	%
1	0	-1689	8.4	4.5	86.7
2	0	177.8	7.6	4.3	76.7
3	25	0	4.6	3.4	35.3
4	25	-168	9.7	5.3	83.0
5	25	177.8	10.2	5.1	100.0
6	200	0	7.7	4.7	63.8
7	400	0	8.3	6.3	31.7
8	800	0	9.8	7.7	27.3
9	1600	0	12.8	9.6	33.3
10	3200	0	16.7	12.4	34.7

Table 4. Target Lay Test Case 1 Data on M1A2, seconds

	Gunner 1		Gunner 2	
	Dec-96	Oct-96	Dec-96	Oct-96
Test Trial No.	M1A2	CCTT	M1A2	CCTT
1	3.92	10.35	6.31	9.06
2	3.35	7.58	5.56	7.28
3	3.37	7.27	4.04	7.45
4	4.18	8.44	5.4	9.49
sum	14.82	33.64	21.31	33.28
average	3.70	8.41	5.32	8.32
Standard deviation	0.41	1.38	0.94	1.11
0.8 confidence	0.26	0.88	0.60	0.71
Higher limit	3.96	9.29	5.93	9.03
Lower limit	3.44	7.52	4.72	7.60

4.4. Status of Applicable PTRs.

4.4.1.Open PTRs.

PTR # 19796 is an open critical deficiency (urgency = red). The laser rangefinder's range is wrong when the M1A1 shoots at a moving target. The fix needs to be tested and verified prior to the full production decision.

4.4.2. Canceled PTRs

PTR # 14516 related to the M1A1 remaining boresighted inappropriately. This PTR was associated with a data or algorithm problem. The recommended action was for AMSAA to retest. The CMVC status is now canceled.

5.0. CTP#4. Ballistic Parameters.

5.1. Requirements.

5.1.1. TDR 5.b.(4) " The simulated weapons systems must exhibit the external and terminal ballistics characteristics of the actual weapons…"

TDR 5.b.(5) " The system must represent correct vehicle and weapon system operation, movement, and orientation characteristics. The system must represent weapon system primary and secondary armament systems of 120mm cannon, 25mm automatic gun, .50cal and 7.62mm machine gun, and TOW II missiles."

TDR 5.d.(4) " The system must portray the dismounted elements as teams of individuals, armed with appropriate weapons, and supplied with selectable basic loads. The dismounted elements must be able to engage the enemy with the following weapons: (a) M16A2 Rifle, (b) M60 machine gun, (c) M249 Squad Automatic Weapons, (d) M47 Dragon or the Anti-Armor Weapon System – Medium (AAWS-M), (e) AT4 Antitank Weapon, (f) M203 Grenade Launcher."

TDR 5.e.(9) " The system must provide for indirect fire support to the ground maneuver forces."

TDR 5.g.(4) " The system must provide a SAFOR workstation that will allow the operator to control vehicle movement, formations, weapons employment, and orientation of friendly semi-automated platoon vehicles in support of command field exercises; and to control fire support assets consistent with the deployment of the Threat Regimental Artillery Group (RAG) and supporting elements of the Division Artillery Group (DAG). Employment of these assets must be consistent with weapons systems capabilities and doctrine."

5.1.2. Technical Threshold. Ballistic trajectory should not differ from the baseline by more than five percent.

5.2. Data. The ballistic trajectory data discussed in this evaluation was obtained primarily from an analysis of CCTT ballistic performance compared with the U.S. Army Research Laboratory's (ARL) General Trajectory Program version 3, or GTRAJ3 (Ref. 8). Trajectories evaluated are for: the M1A1/M1A2 Abrams tank 120mm main gun firing the M829 and M830 rounds; the M1A1/M1A2 7.62mm machine gun firing the A141 round; the M1A1/M1A2 50 caliber machine gun firing the A534 round; and the M2A2/M2A3 Bradley Fighting Vehicle firing the 25mm M792 and M919 rounds.

5.3. Results. The comparative analysis report indicates that a 5 percent time-correction factor brings the CCTT trajectories in line with the ARL GTRAJ3 trajectories. For the cases studied only when the M792 round is fired at maximum elevation did the difference in trajectories exceed the 5 percent accuracy requirement at the same time the round was within it's effective range. An unresolved issue is why the ARL results yield larger ranges than the CCTT trajectory results, even though ARL's model includes atmospheric drag effects and the CCTT model doesn't.

5.4. Status of Applicable PTRs.

5.4.1. Open or Working PTRs

PTR # 20618 refers to HMMWV weapons. The HMMWV weapon's maximum range is far shorter than AMSAA expected. It is recommended that a fix be performed and tested. This PTR remains open.

PTR # 20493 refers to the M1A1. A fire control error causes the HEAT round to miss by 0.137 mils. The fix needs to be completed and verified. This PTR is being worked.

5.4.2. Canceled PTRs

PTR # 18127 refers to Combat Damage Repair. Ballistic superelevation values were 5% less than firing tables values. AMSAA checked the CCTT model against ARL's trajectory model. AMSAA said to remove this as of February 1998. PTR has since been canceled.

<u>6.0.CTP#5. Weapon Effects.</u>

6.1. Requirements.

6.1.1. TDR 5.b.(4) "…Ammunition…basic loads must be selectable as initialization parameters. Primary fire controls and sighting systems must be represented in sufficient detail to allow the use of precision gunnery techniques from the primary sight using normal gunnery mode from a stationary or moving vehicle. These systems must also replicate secondary fire control systems, night vision devices, and thermal capabilities associated with each weapon system."

TDR 5.b.(5) " The system must represent correct vehicle and weapon system operation, movement, and orientation characteristics. The system must represent weapon system primary and secondary armament systems of 120mm cannon, 25mm automatic gun, .50cal and 7.62mm machine gun, and TOW II missiles."

TDR 5.b.(8) " The simulators must exhibit the effects of deterministic failures consistent with the operating characteristics and capabilities of the actual weapons and equipment; stochastic failures that could occur within the RAM envelope of the actual weapons and equipment; and battle damage caused by enemy and friendly weapons effects in the actual weapons and equipment."

TDR 5.d.(1) "The system must simulate dismounted soldiers in scout sections, infantry squads, and platoon headquarters, who can be made to dismount their vehicles/aircraft to perform reconnaissance, scan 360 degrees, engage point and area targets with small arms and anti-armor weapons, move in selected formations at appropriate rates, interact with mounted crews and with one another, communicate as they would under combat conditions that require them to dismount, and remount their vehicles/aircraft."

TDR 5.e.(4) "The simulated vehicles and their functions must …be vulnerable to the effects of enemy, terrain and weather, time, and stochastic failures, deterministic failures, and battle damage in the performance of their functions. The system must provide for their emplacement as initialization parameters, and their movement and functions on the battlefield must be controllable by workstation or by slaving to a manned simulator."

TDR 5.e.(7) "…must have the capability to assess personnel casualties on both mounted and dismounted soldiers based on probable weapons effects."

TDR 5.g.(4) " The system must provide a SAFOR workstation that will allow the operator to control vehicle movement, formations, weapons employment, and orientation of friendly semi-automated platoon vehicles in support of command field exercises; and to control fire support assets consistent with the deployment of the Threat Regimental Artillery Group (RAG) and supporting elements of the Division Artillery Group (DAG). Employment of these assets must be consistent with weapons systems capabilities and doctrine."

6.1.2. Technical Threshold. Casualty assessment should not differ from the baseline by more than five percent.

6.2. Data. Table 5 depicts the weapon-target pairings planned for the evaluation of this CTP. Direct fire weapons were used against the M1A1, and M1A2. Indirect fire and mines were only evaluated against the M1A1 vehicle.

Table 5 Weapon-Target Pairings

	Direct Fire (DF)	Indirect Fire (IDF)	Mines
M1A1	x	x	x
M1A2	x		
DI*	x	x	

*The dismounted infantry (DI) vulnerability V&V tests will be conducted at a later date and will be included in the AMSAA final V&V report.

6.2.1. Direct Fire Weapons

AMSAA conducted V&V testing of Manned Module direct fire weapons and reported results in May 1997 (Ref. 9). Direct fire weapons simulated included 12.7mm, 23mm, 30mm, and 125mm kinetic energy (KE) rounds, as well as 73mm and 125 mm High Explosive Anti-Tank (HEAT) rounds. Anti-tank missiles included the AT-5 and RPG-7.

6.2.2. Indirect Fire Weapons

AMSAA conducted a limited verification and validation (V&V) assessment of the CCTT manned module for Indirect Fire (IDF) vulnerability testing at Ft. Hood, TX in late Sep 1997 and documented the results in Dec 1997. (Ref. 10). The target array consisted of 6 manned modules, one of each type, in a clear area and a fully exposed posture. Threat weapons consisted of 30 rounds each of threat 122mm and 152mm HE and dual purpose-improved conventional (DP-ICM). The range was 4 km from weapon to target, but the best case accuracy associated with an expert artillery threat was assumed in order to get more chance of target damage and hence a higher sample size for purposes of V&V.

6.2.3. Mines. Using the MCC, each OPFOR minefield subcategory (AT Scatterable, AP Scatterable, AT Conventional, AP Conventional) was emplaced along a separate road along a four-way intersection. Minefield markers were visible along each road. The M1A1 was then driven along the road in the simulation.

6.3. Results.

The probability of kill (Pk) given a hit, lethal pattern of indirect fire, and mine effects are simulated in the CCTT, with varying degrees of realism as explained below. For the SAFOR the Pk given a hit are satisfactory for direct fire weapons and mines. For the M1A1 manned module the Pk is satisfactory for direct fire but not for indirect fire or mines. The main problem with the indirect fire weapons is that the orientation of the lethality pattern was found to be incorrectly related to the arbitrary X-Y axes instead of oriented in relation to the line-of-fire.

6.3.1. Direct Fire Weapons

There are two basic parts to direct fire weapon evaluation – delivery accuracy, which determines the probability of hit, and combat damage given a hit. Both parts were examined in depth through AMSAA's V&V Testing. Results are summarized in this section.

6.3.1.1. Delivery Accuracy

6.3.1.1.1. M1A1/M1A2 Manned Module

Two problems were identified which resulted in PTRs being written and fixes made for the main gun fire control. PTR #12736 addressed incorrect fire control default settings. AMSAA verified this fix. PTR #14510 addressed the occurrence of reticle jump when using the laser range finder. This fix has not yet been verified. AMSAA recommended a third fire control PTR be written on the inability to input hull cant and crosswind effects in the ballistic computer. This has not been done.

For the stationary firer versus stationary target case PTR #18127 addressed a discrepancy in the superelevation settings. These were 5 percent lower than the firing data table. It is not known whether this fix was implemented or verified. Another problem identified was the occurrence of rounds passing through a target without hitting it. PTR #14517 addressed this. The fix was made and verified by AMSAA. Yet to be verified is whether or not this problem was corrected for all the other manned modules which use the same target collision algorithm. AMSAA also recommended a PTR be written on the random number generator which appears to produce an erroneous distribution of numbers.

Two problems were identified which relate to main gun variable bias errors. PTR #14498 addresses the incorrect representation of the variable bias as a round-to-round error. Also PTR #17143 addressed the smaller than expected values of the variable bias and random error horizontal and vertical components. Several problems result from the boresight mis-alignment error being represented as a muzzle droop effect. PTRs #13846, 14516, 17696, 18192 and 18324 addressed these issues, and were fixed but the fixes have not yet been verified.

For the moving firer versus stationary target case a problem was found in the moving add-on dispersion data. While the algorithm implemented is correct, the value of the add-on dispersion was incorrectly set to zero. PTR 17143 addressed this problem.

For the case of stationary firer versus moving target, the variations in the lead angle is larger than expected. While the specific cause has not yet been isolated, PTRs 19429 and 19477 addressed this issue. Also PTR 17982 addressed the lack of add-on dispersion for moving targets. These three fixes still need to be verified.

The case of moving firer versus moving targets has not yet been tested because of known implementation problems.

For the M1A1/M1A2's machine gun the effect of burst size on the variable bias error was incorrect. PTR 14498 was written on this but the fix has not yet been verified.

6.3.1.1.2. BFV Manned Module

AMSAA recommended a PTR be written to address incorrect use of AP munition delivery accuracy data for HE munitions. As with the M1 manned module, the random number generator was also found to produce an incorrect number distribution. This still needs to be investigated. PTR 17143 addressed the occasion bias and random error value being incorrectly set to zero.

6.3.1.1.3. HMMWV Manned Module

V&V testing was not conducted, however based on observations it was found that random dispersions were not being applied. A fix was subsequently applied but V&V testing is still required.

6.3.1.1.4. M113/FISTV Manned Module

A problem was found regarding the incorrect times of flight for the FISTV when firing at long-range targets. As previously discussed for the M1A1/M1A2 machine gun, PTR

14498 addressed the incorrect occasion bias error, and for the BFV, PTR 17143 addressed the lower than expected values of the occasion bias and random error data. These fixes still need to be implemented and verified for the M113/FISTV.

6.3.1.1.5. Dismounted Infantry Module (DIM)

V&V of the DIM could not be conducted due to significant non-functionality issues. However based on observations it was determined that the accuracy of the infantry direct fire weapons was incorrect (nearly perfect). PTR 17713 addressed limiting the effective range if the dismounted infantry weapons.

6.3.1.2. Combat Damage

The following summarizes the results of V&V testing for Manned Module Combat Damage and Repair (Ref. 9)

A problem was found in one test when a turret impact was erroneously recorded as a hull impact. This may be related to the previously discussed case involving an error in the target collision algorithm. A separate PTR, 17885 was written for this problem.

An incorrect threat class was used for 30mm ground vehicle threat lethality data. PTRs 17887, 18471 and 18765 addressed this problem.

The horizontal attack angle was calculated incorrectly. PTRs 16583 and 16887 addressed this problem. The Combat Damage Repair (CDR) bin selection algorithm was found to contain errors and AMSAA recommended a PTR be written on this.

An error was found in the system-level repair time algorithm. PTRs 18193 and 18472 addressed this problem. Another error was found in the calculation of the number of components damaged (NCD). PTRs 18193 and 18472 also addressed this problem.

The algorithm for determining combat damaged components (CDC) contained two errors. One involved incorrect selection of critical kill components and crew and the other involved a mismatch of the components modeled in CCTT and in the CDC data. PTRs 17884, 17886 and 18710 addressed these problems.

The repair time was being calculated incorrectly when damage from multiple hits occurred to components. PTRs 18194 and 18712 addressed this problem.

6.3.2.Indirect Fire Weapons. Results from the AMSAA V&V assessment revealed various anomalies. Consequently several PTRs were submitted for the following reasons: incorrect HE range bin calculation; FISTV invulnerability to ICM rounds; ICM round damage occurring beyond its effects radius; incorrect radius of effect parameters for ICM rounds; non-play of ICM carrier reliability; lack of effect/or reporting of damage from the 152 HE-variable time (VT) round; and orientation of HE damage function related to arbitrary X-Y coordinate system not line-of-fire.

6.3.3. Mines. The M1A1 MM was driven along each road without detonating any mines. With support from IDT personnel, several more attempts were made to verify mine detonation. However these were also unsuccessful. PTRs 14933, 16586, and 18552 were written on this problem. Further investigation by IDT discovered that several specific mines did not damage the M1A1 MM. AMSAA then conducted a data/mapping review for mines versus the M1A1 MM. PTRs 16331, 17471, 18467, and 18468 addressed this problem.

6.4. Status of Applicable PTRs.

There are 11 open PTRs.

PTR # 19648 refers to the MM and is of significant concern. The machine gun is not very effective against the mounted machine gun. The urgency is listed as amber. A fix needs to be made and tested prior to the full production decision.

PTR # 19630 also refers to the MM. The machine guns fires at double the correct rate if the trigger is rapidly depressed. IDT needs to fix and test this problem during VV&A testing.

PTR # 20909 also refers to the MM. The M1 MM round loading times are not log-normally distributed. This PTR is being fixed and the fix needs to be verified.

PTR # 20910 refers to the M2/M3. The M2/M3 MM tow loading times are not log-normally distributed. This PTR is being fixed and the fix needs to be verified.

PTR # 16664 refers to a vulnerability issue. The GAZ-66 trucks show improper damage. IDT is waiting for data. AMSAA is working to fix the data. This PTR is deferred to PDSS.

PTR # 17391 refers to another vulnerability issue. The small caliber weapons create too much damage to aircraft. AMSAA provided data that did not fit the CCTT structure. AMSAA stated they will reformat the data. The temporary fix is in. A P3I PTR was opened to initiate and track a permanent fix.

PTR # 17884 refers to combat damage repair. The modules combat damage component data is incorrect. IDT's damaged parts list diverges from AMSAA's, when TSM desired items are not on the list. Need AMSAA repair time. Recommendations are to map extra components. The TRADOC System Manager & AMSAA need to determine the best course of action. The PTR is deferred until PDSS.

PTR # 18765 refers to another vulnerability issue. This involves incorrect 30_mm ground platform data.. This needs to be fixed and tested. AMSAA needs to check and fix this concern. PTR is deferred to PDSS.

PTR # 20906 refers to AMSAA data for the MM. The M1 MM combat damage data is incorrect for some direct fire threats. PTR is deferred to PDSS.

PTR # 16588 refers to combat damage. The SAFOR repair time equation does not follow the AMSAA methodology. The recommendation is to fix the algorithm. This PTR is deferred to PDSS

PTR # t18670 refers to component repair. The HMMWV gun does not overheat as it should if enough rounds are fired in the CCTT. The recommendation is to fix the algorithm. This PTR is being worked on.

Three additional PTRs have been canceled.

PTR # 17711 refers to the TOW missile hitting targets beyond its maximum range of 3750m. In fixing PTR #15729 this problem should have also been fixed. The recommendation was to verify the fix. PTR has since been canceled.

PTR # 17812 refers to the OPFOR not being affected by scatterable mines such as FASCAM. AMSAA data is currently being evaluated. The recommendation was for AMSAA to send the new data then verify the fix. The status of this PTR is now canceled.

PTR # 17983 refers to HMMWV M2 round expenditures being higher than the number of M2 rounds loaded. Recommendations were to fix the data, retest and to verify the fix. This PTR has since been canceled.

7.0.CTP#6. Maneuverability.

7.1. Requirements.

7.1.1. TDR 5.b.(3) "The simulators must replicate the aural, visual, and tactile sensations and cues normally associated with these activities in the actual vehicles. The simulated vehicle speed and maneuverability must be consistent with the trafficability and profile of the simulated terrain. Those controls that are necessary for the performance of collective tasks must be functional. Those that are not required for the functioning of the vehicle during the performance of collective tasks will be mock-ups. The training developer must provide the materiel developer with a list of specific controls which must be functional."

TDR 5.d.(1) "The system must simulate dismounted soldiers in scout sections, infantry squads, and platoon headquarters, who can be made to dismount their vehicles/aircraft to perform reconnaissance, scan 360 degrees, engage point and area targets with small arms and anti-armor weapons, move in selected formations at appropriate rates, interact with mounted crews and with one another, communicate as they would under combat conditions that require them to dismount, and remount their vehicles/aircraft."

TDR 5.e.(4) "The simulated vehicles and their functions must be controllable from work stations, and must be vulnerable to the effects of enemy, terrain and weather, time, and stochastic failures, deterministic failures, and battle damage in the performance of their functions. The system must provide for their emplacement as initialization parameters, and their movement and functions on the battlefield must be controllable by workstation or by slaving to a manned simulator."

TDR 5.g.(4) " The system must provide a SAFOR workstation that will allow the operator to control vehicle movement, formations, weapons employment, and orientation of friendly semi-automated platoon vehicles in support of command field exercises; and to control fire support assets consistent with the deployment of the Threat Regimental Artillery Group (RAG) and supporting elements of the Division Artillery Group (DAG). Employment of these assets must be consistent with weapons systems capabilities and doctrine."

7.1.2. Technical Threshold . From the TEMP, critical technical parameter (CPT), #6 "Mobility of simulated entity on simulated terrain should not differ from the baseline performance by more than 15 percent."

7.2. Data. The data sources are AMSAA's VV&A report.(Ref. 11) and Analysis of Mobility Test Data (Ref. 12) Test Engineers from U.S Army Aberdeen Test Center (ATC), MD conducted the performance tests on the manned modules at a CCTT site in Orlando FL, Sep 96 and provided test data to AMSAA. During the test, a software program, APROBE was used to capture data from the simulator's computer system. These data include time, velocity, displacement, fuel consumption, current gear ratio, engine output torque, etc. Terrain types 1 (soft sand), 3 (hard sand), 5 (soft terrain), 7 (average hard), and 20 (paved surfaces) at slopes of 0, 3, 9,13, 30, and 41 percent are the primary focus of this evaluation. Altogether there are 30 types of terrain available for simulation.

7.3. Results. The analysis focuses on vehicle maximum sustained speed, acceleration, deceleration, and fuel consumption. Real vehicle test results collected by ATC are compared with the CCTT simulator results. Supplemental data can be found in Appendix C.

7.3.1. Maximum speed.

7.3.1.1. Paved Surfaces. Scope and results are illustrated in the Tables 6 and 7. The M1A1, M2M3, FIST-V manned modules demonstrated maximum speeds 40.9mph, 39.2kph, and 40.9mph on the level pavement road respectively which do not differ from the baseline by more than 4 percent. The M1A2 and M1A1 manned module have similar mobility algorithms and the same is true between the FIST-V and M113 modules. Therefore, the M1A2, M1A1, M2M3, M113, and FIST-V manned modules met the maximum speed requirements on the level pavement. Table 6 revealed that the M1A1, M2M3, FIST-V manned modules show their maximum speeds are different than the baseline by more than 15 percent on some terrain types and slopes. Because of the similarity of algorithms, the M1A2 can fail where the M1A1 failed and the M113 can fail where the FIST-V failed. Table 7 reveals that 8 of 10 failed tests are at speeds below 10 mph.

Table 6. Maximum Sustained Speeds Differences, Percent,
Between Manned Modules and Baseline

Terrain Type	Slope, %	M1A2	M1A1	M2M3	M113	FIST-V	HMMWV
20	0		-3.4	-2.0		2.0	
1	0				11.3		6.4
	9						-100.0
	13				21.1		
	30				-48.3		
	31						
5	0			13.3	6.4		-26.9
	3				7.2		
	9			-35.5			-13.5
	13				41.2		
	30				38.2		
	31			-5.0			7.0
	41			-3.2			8.0
3	0	2.2	-3.2	9.7			
	9	0.9		-43.4			
	13		-11.7				
	30		-7.1				
	31	-7.4		-7.1			
	41	13.5		-8.8			
7	0	-4.3	-2.3	27.0			
	9	0.7					
	13		-21.8				
	30		-5.0				
	31	-6.8					
	41	-4.1					

Difference, percent = [(*a*-*b*)/*b*] * 100 where *a* is CCTT's maximum speed and *b* is the baseline speed derived by from the AMSAA model. The CCTT manned module fails a test when the difference is greater than 15 percent. As an example, the M1A1 failed the test on 13 percent slope for terrain type 7.

Table 7. Manned Modules Maximum Speeds

Terrain Type	Slope, %	M1A2 mph	M1A1 mph	M2M3 kph	M113, mph	FIST-V mph	HMMWV mph
20	0		40.3	63.1		40.9	
1	0				19.7		31.6
	9						0
	13				10.9		
	30				3		
	31						0
5	0			26.1	18.3		22.36
	3				16.3		
	9			9.7			18.6
	13				12		
	30				7.6		
	31			6.1			10.7
	41			4.8			9.4
3	0	18.3	18.1	27.2			
	9	11.5		9.0			
	13		8.3				
	30		5.2				
	31	5		6.3			
	41	4.2		5.0			
7	0	24.6	25.4	47.0			
	9	14.4					
	13		9.7				
	30		5.7				
	31	5.5					
	41	4.7					

Abbreviations: kph = kilometers per hour

7.3.1.2. Un-Paved Surfaces.
7.3.1.2.1. M1A1. CCTT maximum sustained speed on sand and on average hard terrain was all within acceptable limits except for 15 % slope on average hard terrain. The CCTT Manned Module differed from AMSAA simulation results by 21.8 percent on this surface. This difference is a reflection of the larger speed difference at low speeds. A PTR should be written on the M1A1 MM mobility performance on 15 % slope on average hard terrain. After this problem is resolved, a test should be done to confirm the fix. Overall, five out of the six (83 %) maximum sustained speed CCTT tests were within 15 percent of AMSAA simulation results.

7.3.1.2.2. M113. In soft sand CCTT maximum sustained speeds differed from AMSAA simulation predictions by about nine percent on level terrain and by 21 and 49 percent on 13 and 30 percent slopes. Similar results were obtained on terrain type 5 (soft terrain). Maximum sustained speeds obtained by the CCTT MM and the AMSAA simulation were well within 15 percent on level and 3 % slope, however on 13% and 30% slopes the differences were 41 and 38 percent respectively. As a check, soil/slope for this vehicle on the 30 percent soft terrain slope was computed and a value of 11791 pounds was obtained. This resistance corresponds to a speed on the vehicle's tractive force curve of between five and six mph; the AMSAA simulation computes a speed of 5.5 mph. A PTR should be written on the M113A3 MM maximum speed on soft terrain for 13% and 30% slopes. After this problem is fixed, a mobility test should be done to verify the fix. Overall, four out of the seven (57%) of the off road speed tests were within acceptable limits.

The FISTV was not tested on un-paved surfaces due to limited availability of the FIST-V MM. However, because its paved surface acceleration performance compares favorably with ATC test data it can be assumed that its performance off-road will be similar to that of the M113A3.

7.3.1.2.3. HMMWV. Maximum sustained speeds on soft sand from HMMWV CCTT tests and the AMSAA simulation results differed by only 6.9%, well within acceptable limits. CCTT speeds were comparable with the AMSAA simulation results on the two slopes that were tested. On terrain type 5 (soft terrain) CCTT tests and the AMSAA simulation were within acceptable limits on 9, 31, and 41 percent slopes, however on 0 percent slope they differed by 24.8 percent. A PTR should be written on this issue. Resistance computations and reference to the vehicle's tractive force curve indicate the vehicle should be faster on the 0 percent slope. Examination of the acceleration plot for this surface at 0 percent slope indicates that perhaps the vehicle did not shift into 3-lo gear. After this acceleration problem is resolved, a 0 % slope test should be conducted on the HMMWV MM for un-paved surfaces. Overall six out of seven (86 %) off-road conditions tested were within acceptable limits of the AMSAA simulation data.

M1A2 CCTT test data and AMSAA simulation data compare well on all eight unpaved surfaces that were tested (0%, 9%, 31%, 41% slopes on sand and average hard terrain). No speed differences were higher than 13.5 %; most were much lower than this.

M1A2 maximum sustained speeds in hard sand and soft terrain were comparable with AMSAA simulation results on all slopes tested with the exception of the 9% slope. Percent differences in speed between the AMSAA simulation and CCTT test results on the 9% slopes were quite large. Speeds were not comparable on level average hard terrain. A PTR should be written on this issue. Acceleration runs were not consistent, often yielding widely separated curves for different runs on the same surface. A PTR should be written on this issue. In general, instances of comparable speeds occur near where the unusually shaped CCTT acceleration curve crosses the AMSAA simulation curve. The curves are widely separated at regions other than their intersections.

7.3.2. Acceleration.

7.3.2.1. M1A1 Acceleration on Paved Surfaces. The CCTT MM acceleration test curves diverge initially from ATC test and AMSAA simulation curves; see Figure 3. After about nine seconds of acceleration the CCTT curves are within 15 percent of the ATC and AMSAA curves. Maximum speeds obtained from CCTT, ATC tests, and the AMSAA simulation are all within three percent of each other. The unacceptable portion of the acceleration curve is in the 0-20 mph range. A PTR should be written on this issue. After the problem is resolved, the M1A1 MM acceleration test should be redone to verify fix. Overall, 91 percent of the test data is within acceptable limits for this test.

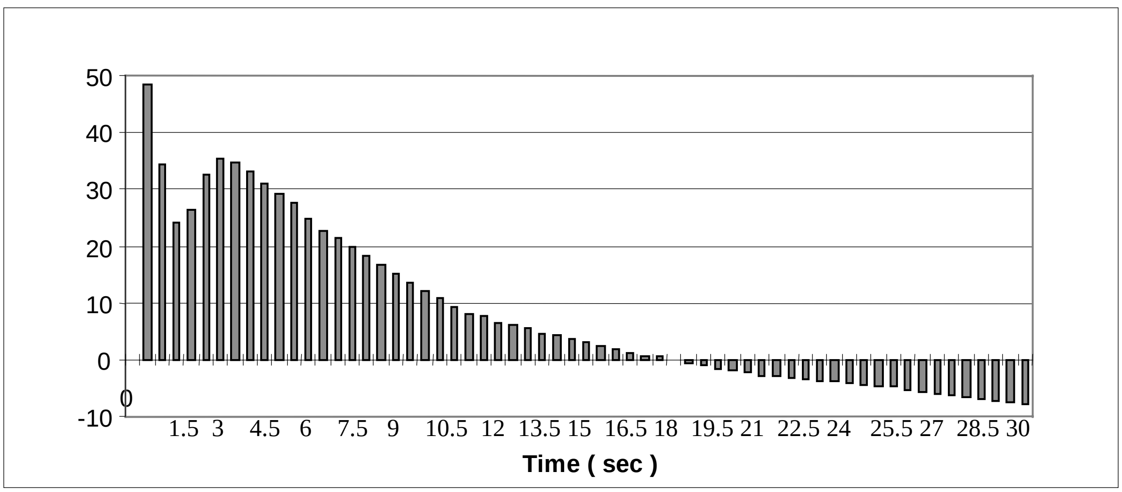


Figure 3. Percent Difference CCTT M1A1 vs. AMSAA Acceleration Data

7.3.2.2. M2/M3 acceleration. Acceleration performance of the CCTT M2/M3 MM is not comparable with ATC test data or with AMSAA simulation data. Acceleration rates are much higher than either ATC tests or AMSAA simulated acceleration. A PTR should be written on this issue. Maximum sustained speeds however, whether CCTT test data, ATC test data, or computed using the AMSAA simulation are all within two percent of each other. Overall, the entire CCTT acceleration curve is outside the 15 percent limit of acceptability. After about 28 seconds of acceleration the curve gets within 15 percent of the baseline.

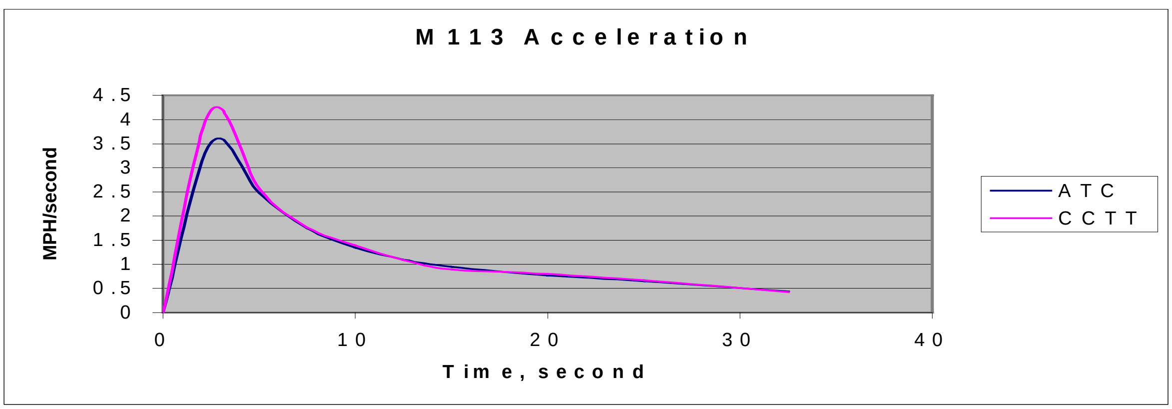
7.3.2.3. M113 acceleration. The CCTT M113 acceleration in Table 8 and Fig 4 is the average of two test sample results. The M113 acceleration at ATC is the average of four test sample results. Test conditions are level paved road and full throttle. The largest difference between CCTT acceleration data and ATC test results (of the time intervals examined) was 19.0 %, which occurred after 2.5 seconds of acceleration. This exceeds the 15 percent threshold requirement at this point. By the five second mark the percent difference had decreased to 12.6 and it continued to decrease to a value of 5.4 at the end of the run. Overall, about 88 % of the data examined were within acceptable limits for this test.

Table 8. M113 Accelerations vs. Time

Time, second	ATC, MPH/second	CCTT, mph/second	difference
0	0	0	0
2.5	3.52	4.19	0.19
5	2.47	2.56	0.03
7.5	1.75	1.76	0.01
10	1.35	1.39	0.03
12.5	1.10	1.08	-0.01
15	0.95	0.89	-0.06
20	0.77	0.80	0.04
25	0.65	0.67	0.03
32.5	0.43	0.42	-0.01

Difference = (CCTT-ATC)/ATC

Figure 4. M113 Acceleration Comparison of CCTT and ATC Test Data



7.3.2.4. HMMWV. The HMMWV CCTT MM acceleration performance compares very well
with both ATC tests and AMSAA simulation results. If large (percent not magnitude) speed differences in the initial two seconds of acceleration are ignored, speeds at all 0.5 second time intervals are within 15 % of the AMSAA simulation. Overall about 97 % of the CCTT acceleration curve is within 15 percent speed differential of the AMSAA simulated curve. The AMSAA curve fits test data for this vehicle very well and was thus used for the baseline in this comparison.

7.3.2.5. The FISTV CCTT acceleration data and ATC test data are very similar for this vehicle. All CCTT speeds along the acceleration curve, starting at the 2.5 second mark, are within 15 percent of ATC test data, some very much closer. CCTT, ATC, and AMSAA sustained maximum speeds are all within two percent of each other. Overall, a good match exists between FISTV CCTT data and ATC tests.

7.3.2.6. The M1A2 CCTT MM acceleration curves diverge initially from ATC test data and from the AMSAA simulation curve. A plot of this data is very to similar to a plot of the M1A1 acceleration on paved level surface, as would be expected since the two vehicles are automotively identical. After 11 seconds of acceleration the initial separation of the CCTT and ATC/AMSAA curves has dropped below the 15 percent level. Overall, 89 percent of the CCTT acceleration curve is within acceptable limits of the AMSAA simulation curve.

7.3.3. Braking. The average of M1A1 CCTT and ATC braking tests differ by 4.2 %, well within acceptable limits. The M1A2, M1A1, M113 manned modules met the deceleration requirements by not differing from the baseline by more than 15 percent. However, the M2/M3, and FIST-V failed the deceleration test (See Table 9). The initial speeds of the manned modules in the tests are 20 miles per hour (mph) on a level pavement. The FIST-V manned module decelerates faster than the baseline by about 40 percent. The FIST-V and the M113 are automotive twins. The CCTT FIST-V and M113 MM should have the same model and algorithms for simulating mobility and should have similar deceleration. The deceleration failures of the FIST-V and M2/M3 need to be resolved. Results of the HMMWV vehicle braking tests are marginal. CCTT deceleration rates differed from ATC test data by an average of 15.8 percent. A PTR should be written on this issue. For the M113, the CCTT and ATC test deceleration rates are within 7.6 percent of each other for this vehicle, well within acceptable limits.

FISTV CCTT and ATC test results were not comparable, there is an average of 46 percent difference between the two sets of data. The smallest difference was 33.6 percent and the largest was 68.6 percent. This was unexpected since the automotive twin of this vehicle, the M113A3 did well in the braking comparison. A PTR should be written on this issue. When the problem is resolved, a braking test on the FISTV should be conducted.

Percent difference between M1A2 CCTT tests and ATC test data is 11.2, within acceptable limits.

M2/M3 CCTT deceleration rates are much higher than ATC test results, differing by an average of about 30 percent. A PTR should be written on this issue.

Table 9. Deceleration Test Results

	M1A2, m/s^2	M1A1, m/s^2	M2/M3, m/s^2	M113, m/s^2	HMMWV, m/s^2	FIST-V m/s^2
Trial #1	4.5	5.1		4.4	6.3	
Trial #2		4.7				
Trial #3		5.1				
Average	4.5	4.96		4.4	6.3	
Baseline	5.0	4.8		4.8	7.5	
Difference, %	-11.2	3.5	22.0	-7.6	-15.8	40.7

7.3.4. Road Load Fuel Consumption. All fuel consumption tests were conducted on level pavement. The CCTT M1A1 fuel consumption tests were all within 7 % of ATC tests at the same vehicle speed. As can be seen from Table 10, the M1A2 and M1A2 MM met the fuel consumption requirements by not differing from the baseline by more than 15 percent.

The M113 and FIST consume more fuel than the baseline by 15 percent and more while at speeds below 30 miles per hour and do not meet the requirements.

The HMMWV MM does not meet the requirements while at speed 30 mph and below. The HMMWV MM consumes less fuel than the baseline. No data are available to address the fuel consumption of the M2/M3 MM.

M113 CCTT road load fuel consumption at six speeds was sampled and compared to ATC test data. At speeds above 30 mph differences between ATC test data and CCTT results were well within acceptable limits. At speeds below 25 mph all differences between CCTT and ATC tests were greater than 15 percent. A PTR should be written on this issue.

After this problem is resolved, the M113 MM road load fuel consumption test should be redone to verify the fix. The overall shape of the fuel consumption curve matches ATC test data however most of the curve is too high. Only two of the six (33 %) CCTT fuel consumption rates measured were within 15 percent of ATC test values. At speeds above 40 mph, HMMWV CCTT and ATC test data are virtually identical; at lower speeds there are large differences. A PTR should be written about the unrealistic fuel consumption rates at speeds below 40 mph. Overall, two of the five fuel consumption rates sampled were within acceptable limits.

FISTV fuel consumption comparisons between CCTT and ATC test results, at most speeds tested, are within 15 percent. The percent difference between averages over all speeds was 11.1. The largest difference was 18.8 percent at 26 mph and the smallest was six percent at 34.5 mph.

The percent difference between M1A2 CCTT tests and ATC test data is 6.2, well within acceptable limits.

M2/M3 CCTT fuel consumption rates are much lower than ATC test values. The average percent difference is 35.3. A PTR should be written on this issue.

Table 10. Fuel Consumption Difference
Between Manned Modules and Baseline, percent

Speed, mph	M1A2	M1A1	M2M3	M113	HMMWV	FIST
10		6.5		16	-35.25	15.68
15		2.5		18	-28.13	17.50
20		7.0		23		9.43
25		-2.5		18		18.75
30	6.2	1.5		13	-20.00	12.62
35				8		5.99
40					-0.27	
45					-3.86	

7.3.5. Speedometer. In Table 11 we note the speedometer readings of the M2/M3 manned module are about three kilometer per hour (km/h) less than the vehicle speed measured by the APROBE software test tool. The data were collected while the M2/M3 manned module was driven on a level pavement at maximum possible speed (M2M3Log.doc, 6 Nov 96).

Table 11. Speedometer Reading Vs. Vehicle Speed
Of M2M3 Manned Module

APROBE		Speedometer	Difference
m/sec	Km/h	km/h	km/h
17.1	61.56	58	3.56
17.5	63	60	3

7.3.6 Steering. In Table 12 are summarized the comments of test drivers from ATC (AMSAA's VV&A mobility report, Subjective Evaluation of the CCTT Manned Modules). The overall steering simulation of the CCTT manned modules is considered to be satisfactory. The pivot steering problems of the M1A2, M2M3, and M113 need to be fixed because the pivot steer can be performed without proper operator's input.

Table 12. Test Driver Comments

M1A2	Partial steer at partial throttle is satisfactory. Full pivot steer is not realistic by not requiring additional throttle or P (pivot) transmission.
M1A1	Partial steer at partial throttle is satisfactory. Rotational speed is too fast while pivoting at moderate to full throttle.
M2M3	Partial steer at partial throttle is satisfactory. The vehicle appeared to eventually go into pivot steer and the turning radius is much smaller than real vehicle when at full steer and high speed.
HMMWV	Steering response is good. However, it tended to steer more than the actual vehicle.
M113	Partial steer at partial throttle is satisfactory. Full pivot steer is not realistic by not requiring additional throttle or P (pivot) transmission. Rotational speed is slightly too fast while pivoting at moderate to full throttle.

7.3.7 Fording. The following are the comments of test drivers from ATC (AMSAA's VV&A mobility report, Subjective Evaluation of the CCTT Manned Modules). The MM forded across streams of various depths and soil bottom types. The real M1A2, M2M3, M113, and HMMWV can cross up to 48, 33, 32, and 30-inches deep water without water fording kit. The MM's fording results are consistent with the real vehicle and met the requirements. However, on some test occasions the MM experienced difficulties exiting the river if the river bank was too steep. We could find no comparative baseline test data currently available regarding the steepness of the river bank which should prohibit the exit of combat vehicles from a river.

Table 13. Fording Results of Manned Modules

	Water Depth, inches		
	16	33	60
M1A2		Crossed	Killed
M1A1			
M2M3		Crossed	Killed
HMMWV	Crossed	Killed	
M113	Crossed	Crossed	Killed

7.3.8 Obstacles. MMs can run through the shrubs and haystacks. While at 39 mph and upon collided with large trees, the M1A2 bounced backwards, and stalled; see Table 14. The MM was able to re-start the engine and continue operation with no apparent damage. There is no baseline for the 39 mph collision. However, the "no damage" may be unrealistic. At creep speed and upon colliding with large trees, the MM moved to the side of the tree and there was no damage. After four and five bumps at creep speed the manned module went through the building. The M1A2 modules climbed at creep speed 46 inches, 6 feet, and 11 feet high vertical road fill and descended. There is no baseline for 6 and 11 feet vertical wall climbing. However, being able to climb and descend may be unrealistic.

Table 14. Obstacle Performance

	Shrubs/Haystacks	Trees/building	Vertical wall
M1A2	Pass through	Clash, stop & no damage	Climbed 46”, 6ft, and 11 ft high vertical road fill
M1A1	Pass through	Clash, stop & no damage	
M2M3	Pass through	Clash, stop & no damage	
HMMWV	Pass through	Clash, stop & no damage	
M113	Pass through	Clash, stop & no damage	

7.4. Summary of applicable PTRs.

There are three open PTRs .

PTR # 20907 refers to the M113A3 fuel consumption being less than the actual vehicle fuel consumption at speeds less than 25 mph. The problem is being fixed. It needs to be tested and verified.

PTR # 20908 refers to the HMMWV fuel consumption being less than the actual value at speeds less than 40 mph. The problem is also being fixed. It needs to be tested and verified.

PTR # 20911 refers to the M1 MM speeds being slower than expected on 13% slope and average hard terrain. The problem is being fixed. It also needs to be tested and verified.

There are four canceled PTRs.

PTR # v14938 refers to the mobility of the M1A1. The M1A1 will not ascend a 60% slope. The problem has been fixed and AMSAA recommended it be canceled.

PTR # 14942 refers to the M1A1 pivoting without throttle. The problem has been deferred to Block 2. AMSAA recommended it be canceled.

PTR # 6242 refers the BFV MM mobility being inaccurate. The M2/M3 transmission model needs refinement. This is to be fixed in PDSS.

PTR # 15079 refers to the M2M3 braking deceleration being unrealistic. It was recommended to verify and fix in Block 3. AMSAA is to check and see if cancellation is valid.

8.0. CTP#7. Command, Control, Combat Support, and Combat Service Support

8.1. Requirements.TDR 5.e. The system must simulate the TOC, CTCP, UMCP, TACP, and designated combat support systems and the functions they normally perform.

8.1.1. Technical Threshold. The system must simulate functions of tactical operations center, combat trains command post, fire support, engineer, resupply, refuel, and transport.

8.2 Data

The primary source of information for this CTP is the Operations Center Workstations V&V Report (Ref. 13). This consisted of V&V testing on the following workstations: Combat Train Command Post (CTCP); Unit Maintenance Collection Point (UMCP); Combat Engineering Support (CES); Field Artillery Battalion Tactical Operations (FABTOC); Fire Support Element (FSE); Fire Direction Center (FDC); and Tactical Air Control Party (TACP).

Functionalities examined were: mandatory procedures; vehicle movement; vehicle vulnerability; reliability and maintainability; resupply transfer; communications, command and control; battle damage assessment repair and recovery; combat engineering functions; ballistics; and fire support.

Specific data elements relevant to this CTP included: reporting requirements; mapping of vehicles into vehicle classes; ammunition and fuel transfer rates; SINCGARS and digital communications; repair and recovery times; Engineer function production rates and artillery and mortar firing mission capabilities.

8.3 Results

Problems encountered with regard to mandatory procedures reporting were: the Unit Unavailable message is not provided when a unit selected for movement is being repaired; situation reports are being generated too often; the Task Completed message for Engineer functions is incorrect.

A problem found in the vehicle movement V&V testing was in the mapping of the vehicles into classes. The M1025 HMMWV with a gross vehicle weight (GVW) of 3722 kg and 95 liter fuel capacity was mapped into a vehicle class for vehicles with GVW over 9500 kg and 450 liter fuel capacity.

Regarding resupply transfer data, it was concluded that the fuel transfer rates were not valid. The maximum rate in the CCTT is 379 liters/minutes whereas the correct rate is 2271 liter/minute.

The majority of communications elements were verified and validated. The only problem found was in the mortar ballistic computer algorithm which prevented proper communications between the fire direction center , forward observer and fire support element.

The combat damage repair time algorithm was not properly implemented for SAFOR. Also recovery procedures were found not to be completely valid; however workarounds are available as a substitute.

The simulated production rates for Engineer functions were below the Army standard rates.

With regard to Fire Support procedures, a problem was found in that no method exists for firing a single round for an Adjust Fire mission. Also the time-of-flight data is incorrect. This has been deferred to the P3I phase.

8.3. Summary of applicable PTRs.

PTR # 19276 refers to the MCC does not support minefield emplacement by mine name. It was recommended to fix algorithm and test. AMSAA recommended removal in February 1998. This PTR was canceled.

<u>9.0. CTP#8. Semi-Automated Forces</u>

9.1. Requirements. TDR 5.g. "The simulation must provide SAFOR with the capabilities to perform all the battlefield tasks and supporting functions that live forces can perform in the simulation with a minimum of human involvement."

9.2. Technical Threshold. The following technical thresholds are extracted from the Training Device Requirement paragraphs 5.g.(1) through 5.g.(7).
TDR5.g.(1) SAFOR "…must replicate both friendly and enemy forces in battalion size units or a distribution of the subordinate elements thereof including tanks, personnel carriers, (etc.)…"These forces will be controlled down to platoon level…and will be indistinguishable from live forces…"
TDR 5.g.(2) "… capable of assuming offensive or defensive roles…consistent with selected allied or Threat doctrine or tactics".
TDR 5.g.(3) "…interact under the control of manned command simulators and to move as simulated adjacent, forward, and rear elements".
TDR 5.g.(4) " ..allow operator to control vehicle movement, formations, weapons employment and orientation of friendly semi-automated platoon vehicles in support of command field exercises… control fire support assets consistent with deployment of a Threat Regimental Artillery Group (RAG) and supporting elements of a Division Artillery Group (DAG)…"
TDR 5.g.(5) " … must provide for the conduct of fixed and rotary wing aviation operations to include attack, CAS and lift/airmobile."
TDR 5.g.(6) " …must provide the capability to emplace vehicles …in selected positions and execute movement sequences on the terrain for the conduct of pre-planned exercises."

TDR 5.g.(7) "P3I … must include SAFOR to Regimental or brigade level".

9.3. Data

The primary source of data for the evaluation of Semi-Automated Forces (SAFOR) is the AMSAA V&V effort conducted from April-October 1996 (Ref.14) AMSAA's efforts concentrated on the CCTT physical models and the associated databases. These include models of: target acquisition; direct-fire rates-of-fire, vulnerability, and delivery accuracy; indirect fire vulnerability; combat damage repair; mobility; and reliability.

For direct-fire vulnerability the factors examined were: target and impact locations; target exposure; range; dispersion; aspect angles; probability of kill given a shot (Pks); and the random number generator.

For target acquisition V&V testing, AMSAA evaluated the following factors: sensor type; magnification; target dimension; target exposure; range; intervisibility; contrast; cycles on target; acquisition time; probability of acquisition given infinite search time (P infinity); and the random number generator.

For direct-fire delivery accuracy the data elements examined were: locations of target, firer, and aimpoint; target exposure; movement effects; dispersion and bias errors; horizontal and vertical miss distances; and hit assessment.

For combat damage repair, factors examined were: target range; kill level; round type; attack angle; hit location; level of repair; number of components damaged; identity of damaged components; random number generator; mean and standard deviation of maintenance man-hours; number of repair people required; and total repair time.

For the reliability V&V testing the following data elements were examined: time of SAFOR vehicle failures; probability of failure for mobility, firepower or electrical/sensor functionality; mean and standard deviation of times to repair mobility, firepower or electrical/sensor functionality; random number generator; and total repair time.

Mobility data elements examined fell into one of three testing groups: acceleration, deceleration and fuel consumption. For all testing groups the following factors were examined: soil type; vehicle speed; and distance traveled. The acceleration test also examined the average vehicle acceleration, the deceleration test also examined stopping time, and the fuel consumption test also examined the amount of fuel consumed.

9.4 Results

For SAFOR direct fire vulnerability, early problems in the calculation of dispersion and attack angles were addressed with PTRs #13981 and #16583, corrected and verified by AMSAA. All other direct fire vulnerability data elements were verified, including Pk table look-ups, random number generator, target and impact locations, target exposure and range.

The target acquisition testing revealed a problem in that the target bounding volume was too large. PTR #17926 addressed this issue, the correction was made and verified. Another problem found was the sky-to-ground ratio was inconsistent with the visibility range. PTR #17771, since replaced with #18577, addresses this, but remains open. Also when 30 or more targets appear on the target list, the target aspect is no longer calculated in real time but is replaced by a fixed side orientation. PTR #18589 addresses this issue but it has not been fixed because of a hardware computational speed limitation. AMSAA also recommended that targets with intervisibility of 30% or less not be dropped from the engagements. No PTR was written on this issue because it is not feasible until faster processors could become available. All other SAFOR target acquisition data elements were verified as working correctly.

Results from direct-fire delivery accuracy testing identified higher than expected hit probabilities, addressed by PTR #16596. The fix that was made didn't completely solve this problem until another problem with the random number generator was also identified and fixed. Following this AMSAA concluded the SAFOR delivery accuracy routines are working correctly.

A problem was found in the SAFOR combat damage repair times and reported in PTR #16588. This fix for this was deferred to the CCTT P3I program.

The reliability routines checked out correctly except for the reliability "thermometer". This determines what the proper reliability status is (working or failed) depending on the value chosen by the random number generator. The reliability thermometer was fixed and the fix verified.

Initial results from the SAFOR mobility testing found a problem with the acceleration and deceleration routines. There was good agreement between the M1A1 Manned Module and US Army Waterways Experimental Station (WES) data showing good agreement with the SAFOR results until speeds exceeded 25 miles per hour. Beyond this speed the SAFOR results show lower acceleration and speeds than the actual data. By bypassing the behavior/driver model results consistency with the test data was found to occur. There was no test conducted to verify fuel consumption.

The following areas also remain to be V&V tested: mine vulnerability; helicopter vulnerability; and indirect fire vulnerability.

9.5. Summary of applicable PTRs.

There are 19 open PTRs.

PTR # 17119 refers to the MM and CGF maximum speeds being different. The CGF is slower then the MM. The MM have the correct accelerations and velocities. It is pending resolution in PDSS.

PTR # 18608 refers to combat damage. There is no catastrophic (K-kill) with 120mm HEAT on BRDM's. The vulnerability data provided shows some K-kill for fully exposed posture. It is recommended that further investigation be required to fix and verify. It is pending resolution in PDSS.

PTR # 18598 involves problems with AMSAA indirect fire damage data. Resolution is deferred until PDSS.

PTR # 18903 refers to the SP Howitzer direct fire being too accurate. See PTRs 18832 and 18934. AMSAA is evaluating. It is also pending resolution in PDSS.

PTR # 18970 refers to the Javelin not producing a K-kill against the BREMS. This is a mapping issue. It is also pending resolution in PDSS.

PTR # 17978 refers to Engineer production rates. It will be corrected in PDSS. It is recommended to change according to the FM.

PTR # 17990 refers to the artillery and mortar times of flight being the same for all fuzes. It is pending resolution in the P3I phase.

PTR # 18934 refers to the artillery howitzer damage assessment not being correct. It is waiting for AMSAA's analysis of data. Resolution is also pending PDSS.

PTR # 16543 refers to the Company/Team M1's firing at dismounted infantry instead of BMP targets. The recommendation is to resolve this issue in the P3I phase.

PTR # 13578 refers to excessive scanning by a Blue tank platoon while in platoon defense mission.

PTR # 13210 refers to the Blue tank platoon in column scanning wrong sectors. There is some consideration of upgrading the urgency from five to three.

PTR # 13212 refers to the Blue tank platoon vehicles in a "V" formation are in the wrong spots. There is also consideration of upgrading the urgency to 3.

PTR # 13213 refers to the Blue tank platoon vehicles that are in a "Herringbone" formation are in the wrong spots. There is also consideration of upgrading the urgency to 3.

PTR # 13214 refers to the Blue mechanized platoon vehicles that are in a "Herringbone" formation are in wrong spots. There is also consideration of upgrading the urgency to 3.

PTR # 15256 refers to an invalid transition from CIS B0118 to CIS B0119. It is recommended to fix or work around. Verification is deferred until Block 2.

PTR # 13821 refers to there being no weapons selection by range. It was decided this was out of scope and was deferred until Block 4.

PTR # 17968 refers to incorrect fuel transfer rate between pre-stocks. This PTR is being worked. It is pending resolution in PDSS.

PTR # 17969 refers to fuel transfer between the M1091 fuelers and simulated vehicles. This PTR is being worked and is also pending resolution in PDSS.

PTR # 17981 refers to the Engineer breaching rates. It will be corrected in accordance with the Field Manual. This PTR is being worked and is also pending resolution in PDSS..

The following nine PTRs are canceled.

PTR # 15368 refers to the SAFOR entities not spotting previously spotted MM's. It was recommended to fix, test , and try to recreate. AMSAA recommended this be canceled in February 1998.

PTR # 16914 refers to the OPFOR BMP being too accurate at long range. This is a duplicate of 17387. This is for kept for PTR tracking purposes only.

PTR # 17607 refers to the invalid SI to AD for Tanl PLT (??? Need clarification on this from IDT???)

PTR # v17714 refers to problems with the CGF platform lethality. The lethality table is incorrect. The data file has been corrected, and retested. AMSAA needs to verify. Status is now canceled.

PTR # 16665 refers to the Operations Workstation for computer generated forces. Could perform recovery operations. Status has been canceled.

PTR # 17424 refers to the SAFOR Tank platoon. It will not increase to dash speed in CIS B0013. It was recommended to fix or work around. It has since been canceled.

PTR # 17609 refers to the SAFOR Situation Reports (SITREP) not being issued when the platoon clears the SP. It has since been canceled.

PTR # 15724 refers to the platform mobility. The CCTT M1A2 incorrectly climbs vertical embankments. It was recommended to fix, implement, and test. It has since been canceled.

PTR # 15028 refers to the lack of a halt report being transmitted when a scheduled halt occurs. It has since been canceled.

The following PTR was returned closed.

PTR #13599 refers to the BFV vehicle not being resupplied correctly.

10.0. CTP#9. After Action Review

10.1. Requirements. TDR 5.f.(1) “The system will provide a means to monitor, record, and playback the events that take place during a unit training session. The system must record unit movement, weapons engagements, hits, kills, ammunition expended, communications conversations, combat support, combat service support operations in video and data printout forms during the conduct of training.”

10.2. Technical Thresholds. The following technical thresholds have been extracted from the Training Device Requirement paragraphs 5.f.(2) through 5.f.(6).
TDR 5.f.(2) “ The recorded data must be time-stamped…”
TDR 5.f.(3) “The system must provide video playback of a UTM projection view of the entire operation on a high resolution video screen and project the playback onto a standard 60-inch by 80-inch video projection screen with icons and menu controls for scale…”
TDR5.f.(3) “…must allow the trainer to flag events as they occur…”
TDR5.f.(3) “…must be capable of superimposing the operations overlay onto the viewing display at the same scale as was used in its creation…”
TDR5.f.(3) “…must provide the capability to increase or decrease the scale of the composite view thereafter…”
TDR5.f.(3) “…must provide the capability to playback an exercise at a selectable ratio of 4:1 or greater over real time.”
TDR5.f.(4) “…must provide for the conduct of up to five independent/simultaneous AARs..”
TDR5.f.(5) “…must provide a horizontal view of the simulated terrain from any selected perspective and elevation (up to 300 meters…”
TDR5.f.(6) “…must provide the capability to freeze or stop an exercise for a during action review…”

10.3 Data
10.3.1. Sources of Information
a. Completeness of training event recording.
(1) Individual workstations and manned modules should generate event PDUs for operator's actions in accordance with the threshold values set by the software design.
(2) The generation of event PDUs should be independent of the data traffic.
(3) The AAR workstation records all event PDUs generated by the workstations and manned modules.
b. Adequacy of tools for presenting training events. Proper formats and accurate information.
c. Credibility of recorded training events. Does the AAR report represent trainee's capability in the real world?

10.3.2. Evaluation Examples

(1) M25 mm gun's burst firings from M2 manned modules.
(2) Threshold values of an event PDU for M25 mm gun firing.
(3) M25 mm gun firing PDUs recorded by the AAR workstations.
(4) The number of bursts and rounds fired in the AAR report.
(5) VV&A reports on the manned modules and workstations.

b. Test conditions.

(1) M25 mm gun firings. One gun firing. Multiple guns firing.
(2) VV&A data. In accordance with the VV&A plans.

10.3. Results. After Action Review (AAR) tapes of these exercises were compiled and witnessed by Government personnel from the Evaluation Analysis Center (EAC) and STRICOM (Ref. 4). From these reviews it was concluded that the monitoring, recording and playback functions are provided and functional. The data analysis and recording (DAR) only indicates when catastrophic kills occur; the lesser kill categories such as mobility kill, are not indicated. The limited test data available cannot verify the AAR is faithfully recording all required events during a maximum training capacity exercise. The AAR tapes are available for review from the CCTT program office; however they can only be viewed in one of the After Action Review (AAR) modules.

10.4. Summary of Applicable PTRs.

There is one remaining PTR , #v14523, applicable to this CTP (also applicable to CTP#1). This PTR involved the disappearance of an opposing force entity from the simulation. The status is canceled per recommendation of AMSAA in February 1998.

<u>11.0. CTP#10. Reliability</u>

This CTP is being addressed separately and will be included in the SER.

<u>12.0. CTP #11. Integrated Logistics Support</u>.

This CTP is being addressed separately and will be included in the SER.

<u>13.0 CTP#12. Operational Environments (Environmental Conditions)</u>

13.1. Requirements. TDR 5.h. “… Environmental protection for the system is required in accordance with the operational parameters detailed in the operational mode summary and mission profile.”

13.2 Technical Threshold. Mobile CCTT can be stored and operated in basic climate environments.

13.3. Data. The environmental effects were tested as part of the Pre-Production Qualification Testing for the Mobile CCTT by the Aberdeen Test Center from January through June 1997. The final report was published in July 1997 (Ref. 15)

13.4. Results.
13.4.1 High Temperature. The environmental control unit (ECU) of the Primary Power Supply (PPS) trailer is not rated for temperatures above 115 °F; therefore the criterion of 125 °F was not met. The interior temperature requirement of 73 °F could not be met inside the crew compartments of the mobile trailers due to improper circulation of cool air into those areas.
13.4.2. Low Temperature. The interior temperature requirement of 73 °F could not be met inside the crew compartments of the mobile trailers due to an insufficient amount of heat transferred to those areas by the ECUs. The M2 PPS generator would not operate at 0 °F because of fuel gelling. The cause was determined to be non-operational block heaters.
13.4.3. Roadability. During the paved road transport from Orlando, FL to Aberdeen Proving Ground, MD and to Ft. Hood, TX cracked welds in the trailer storage compartments and loss of air in the suspension system occurred.
13.4.4. Rain Leakage. The rain test uncovered leaks in the underbelly storage compartment. The PPS had water leaking through the louvers on the roof. The power generation equipment inside the trailers are adequately covered to ensure there is no water damage; however when fuel and oil spills present in the drip pan become mixed with rain water, the resulting mixture can drain out into the environment, creating an environmental hazard.
13.4.5. Wind. The method for wind tie-down of the trailers has not been proven.

13.5. Summary of Applicable PTRs

There are no remaining PTRs chargeable to this CTP listed in the PTR database.

14.0 Conclusions

A grading method was proposed for the CCTT at the September 1997 Executive TIWG Meeting. Table 15 shows this method.

Table 15. Proposed Grading Method

Criteria	Points
If Required Functionality Is Available	75/100
If No Priority I and II Problems	10/100
If No Simulation Realism Problems	15/100

Using this method Table 16 summarizes the results of the evaluation of the CCTT CTPs.

CTP*	**TIWG Method Score**
1. Capacity of Simulation Network	95/100
2. Target Acquisition Capability	92/100

3. Target Tracking	87/100
4. Ballistic Parameters	90/100
5. Weapon Effects	90/100
6. Maneuverability	90/100
7. C2, CS, CSS	92/100
8. SAFOR	95/100
9. AAR	95/100
12. Operational Environments	90/100

* CTP 10 RAM , and CTP 11 ILS are provided separately in the SER

Overall the CCTT appears to satisfy the CTPs to a high degree of performance. Most of the remaining concerns are being addressed through the CCTT Integrated Product Team and the use of configuration management verification control and independent V&V. Table 17 summarizes the open or "being worked" PTRs for each CTP that should be verified as fixed prior to the full production decision.

Table 17 Open/Being Worked PTRs For Full Production Decision

CTP	**PTR Number**
2. Target Acquisition	19635
3. Target Tracking	19796
4. Ballistics	20493, 20618
5. Weapon Effects	19630, 19648, 20909, 20910, t18670
6. Mobility	20907, 20908, 20911
8. SAFOR	13210, 13212, 13213, 13214, 13578

15.0 References

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