FCS SDD-449 Close Combat Armament System (CCAS) Trade Study – Performance Assessment

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Background

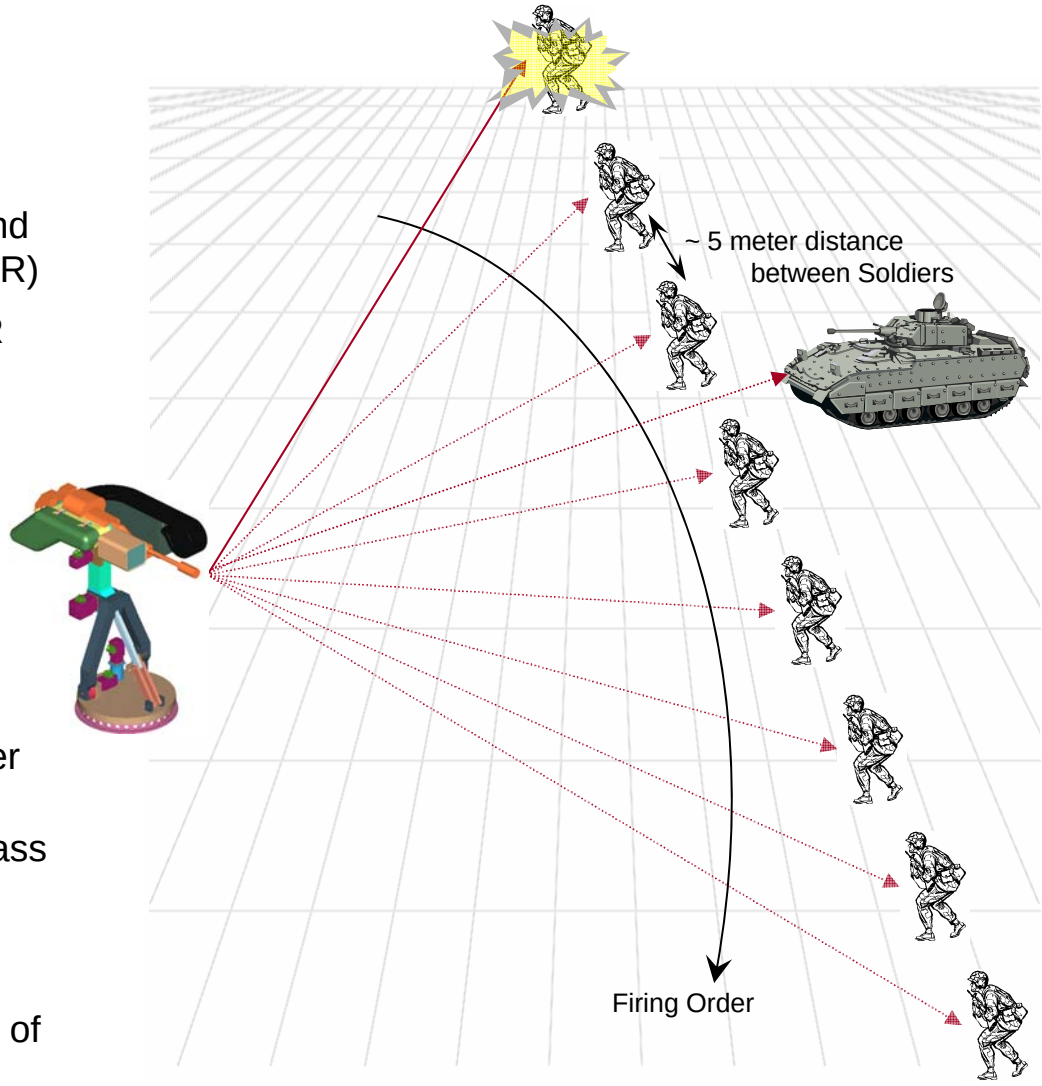
- Budget pressures on both the FCS CCAS weapon and weapon station programs necessitated looking for either Non-Development Item (NDI) or nearly NDI solutions for both the weapon and weapon station – SDD-449 Trade Study was Conducted

- AMSAA used the FBAR model to conduct a performance assessment of select weapon and ammunition systems in support of the SDD-449 Trade Study

- IWARS used to replicate a subset of the CCAS study in order to verify IWARS results consistent with established methodology

Study Scenario

- OPFOR Targets
  - Personnel: 8 man squad
    - Initial posture standing
    - All OPFOR go prone after first round fired (regardless of targeted OPFOR)
    - OPFOR does not return fire (FBAR only plays one sided engagement)
  - Materiel: BTR (Soviet Light Armored Vehicle)
- Terrain: Tabletop
- Candidate Weapon/Munitions mounted on Combat Vehicle
- Engagement Process
  - Aimpoint for bursting munition is 1 meter above target
  - Aimpoint for kinetic rounds center of mass
  - Targets OPFOR on far left first
  - Fires one burst per target
  - Subsequent burst fired at target to right of current target (personnel only)



CCAS Weapon Alternatives and Characteristics

Weapon & Fire Control Basis

- **Remote weapon station**
- **Single or dual feed**
- **Stabilized gun & sight**
- **360 deg traverse**
- **-20/+60 deg gun elevation**
- **Powered Optic w/thermal**
- **Laser range finder (LRF)**
- **Fire control w/lead**

7.62mm machine guns firing bullets
.50 cal machine guns firing bullets
25mm machine guns firing grenades
40mm machine guns firing grenades

Ammo count based on 50kg allotment and 3:1 mix

Alternatives / Ammo Types / Loads

Weapon	Anti -Personnel		Anti - Materiel		Total Load
	Round	Count	Round	Count	
M240	M80	1252	M80	418	1670
L94	M80	1252	M80	418	1670
M134*	M80	1252	M80	418	1670
M2HB	M8	297	M8	99	396
XM312	M8	297	M8	99	396
ATK .50	M8	297	M8	99	396
XM307	XM1019	205	XM1049	69	274
XM307FTE	XM1019	205	XM1049	69	274
ATK LW 25	XM1019	205	XM1049	69	274
XM301*	XM1019	205	XM1049	69	274
MK47	PPHE	106	M430	35	141
M129	PPHE	106	M430	35	141

* multi-barrel gatling gun

AMSAA Analysis Approach

PM / Contractor / ARDEC / ALR / ATC/ AMSAA

Anti-personnel Data
- Frag mass/ velocity, penetration equations, etc

ARL / AMSAA

Anti-Materiel Data
- damage state
- cell-by-cell vuln. data
- Pkill / hit

Contractor / ARDEC / AMSAA

Delivery Accuracy Data
Gunner - Aim/wobble, lasing accy and range determination
Weapon – boresight, parallax, launch angle, recoil
Ammunition – Muzzle velocity, drag, spin, fuze timing, disp
Environment – Temp, wind, air den

AMSAA Models

CASRED *- Lethality Effects*
- PK grids, lethal areas

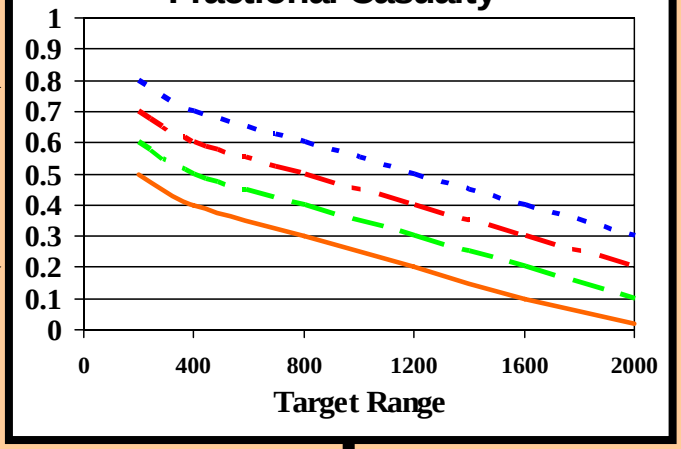
Fbar- Anti-personnel Effects
- Pi, FractCas, Rds/kill etc.

PVTM – Anti-materiel Effects
- Phit, Pkill, Engagement Timeline, Rds/kill etc.

UAMBL / USAIC / AMSAA

Engagement Conditions
- Target set, burst fire meth, tgt exposure, ammo load, etc.

Established ORD Targets



Calculate

- ORD Compliance
- Stowed Kills
- Time to Kill

Measures of Effectiveness

ORD Compliance Scoring Methodology

Criteria	Score	
Exceed Objective	10	Score of 6 or greater indicates that ORD KPP is met or exceeded
Midpoint of Objective to Objective	8	
Threshold to midpoint of Objective	6	
2/3rd of Threshold to Threshold	4	Scores under 6 indicates that ORD KPP is not being met
1/3rd-2/3rd of Threshold	2	
0-1/3rd of Threshold	0	

ORD compliance scoring is performed for each performance KPP

STOWED Kills – Rounds "on board" / Number of rounds required to achieve levels of P_k / F_c = X. Normalized to system with most stowed kills, multiplied by 10, and rounded to nearest whole number

Time to Kill - Average Exposure time to kill (achieve P_k / F_c = X) both the Materiel and 8-Man Infantry targets at the Threshold range (time from first round fired to target is dead based on number of bursts needed to kill – incorporates aim/lay time, rate of fire, and 3 sec BDA). Normalized to system with shortest time to kill, multiplied by 10, and rounded to nearest whole number.

Summary Rankings

Alternatives		M240 7.62mm	L94 7.62mm	M134 7.62mm	M2HB .50 cal	XM312 .50 cal	ATK.50 .50 cal	XM307 25mm	XM30FTE 25mm	XM301 25mm	LW25 25mm	MK47 40mm	M129 40mm
Burst Size *		9	9	9	6	6	6	3	3	3	3	3	3
Anti-materiel Scores Averaged Over SS, SM, MS, and MM	ORD Comp. Scores	3.33	3.33	0.50	7.17	7.17	7.17	3.83	3.83	2.50	3.83	2.00	2.00
	Stowed Kills Scores	7.50	7.50	2.55	6.58	6.58	6.58	4.35	4.35	2.87	4.35	1.41	1.41
	Time to Kill Scores	5.67	5.56	2.27	9.92	9.02	8.97	5.03	5.28	4.03	5.03	3.25	3.40
	Weighted Average	4.96	4.93	1.46	7.71	7.49	7.48	4.27	4.32	2.90	4.27	2.16	2.20
Anti-personnel Scores Averaged Over SS, and MS	ORD Comp. Scores	0.67	0.67	0.00	0.67	0.67	0.67	6.00	6.00	5.33	6.00	7.33	7.33
	Stowed Kills Scores	4.57	4.57	1.13	1.63	1.63	1.63	10.00	10.00	8.87	10.00	5.29	5.29
	Time to Kill Scores	3.30	2.91	1.24	2.82	1.90	1.85	7.35	8.90	10.00	4.75	6.90	8.22
	Weighted Average	2.30	2.20	0.59	1.45	1.22	1.20	7.50	7.89	7.39	6.86	6.88	7.21
Combined Weighted Average Score		7.26	7.13	2.05	9.16	8.71	8.68	11.77	12.21	10.36	10.96	9.04	9.41

Weighted Average Score = 0.50*ORD Compliance Score + 0.25* Stowed Kills Score + 0.25 * Time to Kill Score

CCAS Study Summary

- Results
  - .50 cal (bullet) weapons had the highest ORD compliance and weighted average performance scores versus materiel target
  - 25 & 40mm (grenade) weapons with programmable air burst ammunition had by far the highest ORD compliance and weighted average performance scores versus personnel target
  - Averaged over all target scenarios, 25mm (grenade) weapon alternatives had the highest weighted performance score

- Study results presented to Future Combat Systems IPT and PM FCS

Results used in decision for selection of Close Combat Armament System

Brief Description of IWARS

IWARS is:

- Analysis driven
- Entity-based
- Multi-sided simulation
- Focused on individual and small-unit dismounted combatants and their equipment
- Used to assess operational effectiveness across the spectrum of missions, environments and threats

IWARS v1.0 Approved For:

- Soldier Sensor Performance Analyses
- Soldier Small-Arms Lethality Analyses
- Soldier Survivability Analysis
- Limited Situational Awareness / Battle Command Analysis

Army Requires Small Unit Combat Simulation Capabilities to Address Integrated "Soldier-as-a-System" Issues

IWARS Scenario

Alternatives / Ammo Types / Loads

Weapon	Anti -Personnel	
	Round	Count
M240	M80	1252
M134*	M80	1252
M2HB	M8	297
XM307	XM1019	205
MK47	PPHE	106

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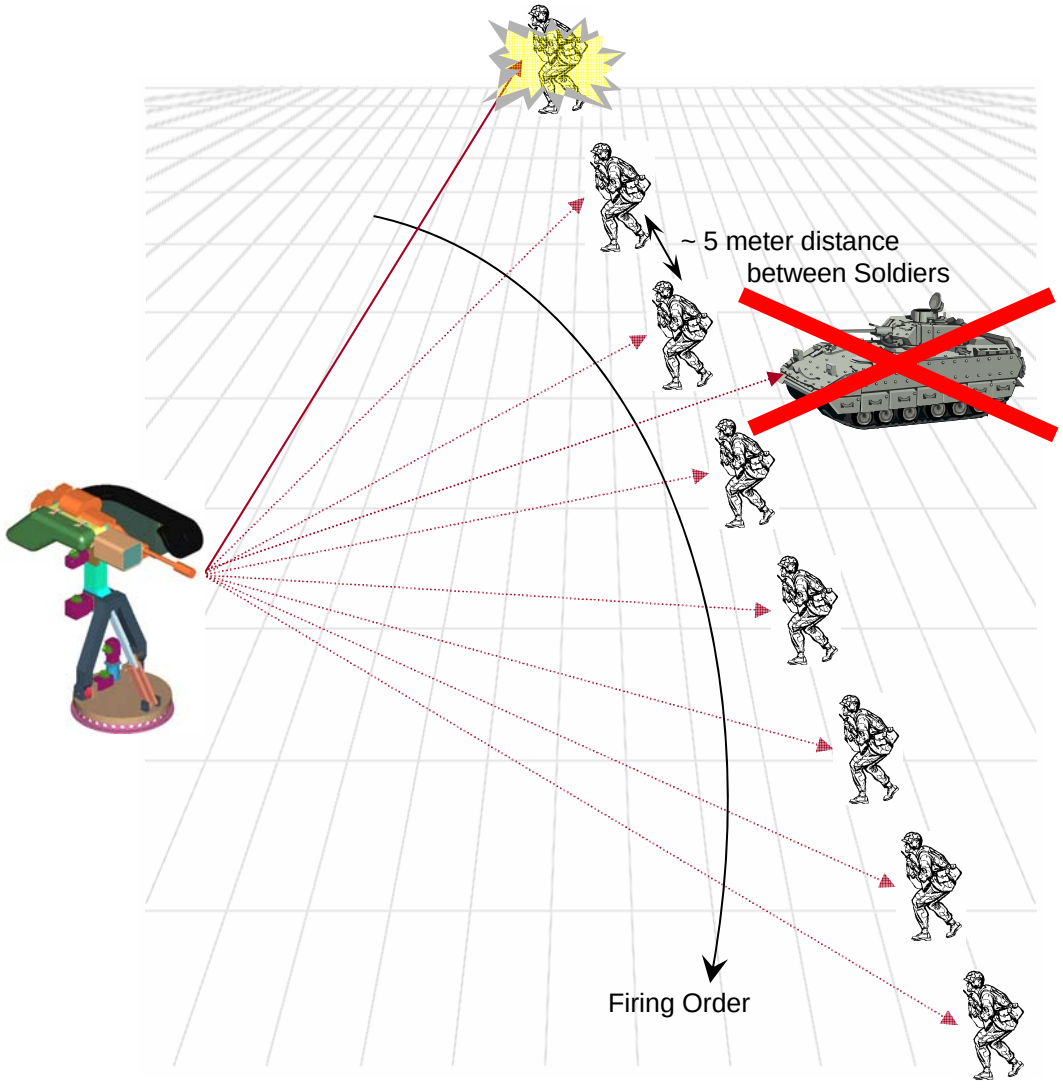

Anti-personnel Results Rank Order of Effectiveness

Medium Range

Weapon System	FBAR	IWARS
M240	3	3
M134	5	5
M2HB	4	4
XM307	2	2
MK47	1	1

Long Range

Weapon System	FBAR	IWARS
M240	4	3
M134	5	5
M2HB	3	4
XM307	2	2
MK47	1	1

The results for the M240 and M2HB are not statistically different.

IWARS Rankings matched well with FBAR

Summary

- Grenades are most effective
- IWARS consistent with CCAS Study
- Ongoing effort using IWARS to investigate effects on weapons effectiveness due to:
  - Two sided engagement
  - Rate of fire contributions
  - Target acquisition (ACQUIRE methodology) and target prioritization