COMPARING THE EFFECTIVENESS OF CURRENT TANKS

WHAT IS A TANK FOR?

- TO FIGHT OTHER TANKS (U.S. ARMY)

- TO BRING MACHINEGUNS TO BEAR ON THE ENEMY'S UNPROTECTED REAR, USING SPEED AND SURPRISE (GENERAL GEORGE PATTON)

INSIGHT: IS THE CANNON THE TANK'S MAIN ARMAMENT?

SOME LESSONS OF COMBAT IN EUROPE, RUSSIA, AND THE MIDEAST

- TANKS ARE BETTER USED TO ATTACK INFANTRY THAN OTHER TANKS

- THE MAJOR EFFECT OF TANKS ON INFANTRY IS PSYCHOLOGICAL, NOT PHYSICAL (I.E., MORAL, NOT MATERIAL) - BUT ONLY WHEN USED IN MASS

- TANKS USUALLY OVERWHELM GREEN INFANTRY, BUT RARELY PREVAIL AGAINST TANK-EXPERIENCED TROOPS

COMBAT-DERIVED EFFECTIVENESS CRITERIA FOR TANKS

I	UNIT TACTICS/ COHESION/ TRAINING	4,000 TECHNICALLY INFERIOR GERMAN TANKS ADVANCED 1,000 MILES IN 3 MONTHS AGAINST 23,000 RUSSIAN TANKS
	OPERATIONAL MOBILITY	TIME TO MOVE A TANK COLUMN FROM BIVOUAC TO OBJECTIVE (E.G., 50 MILES OVER DIRT ROADS)
II	NUMBERS AVAILABLE ON THE BATTLEFIELD	TANKS BROUGHT TO BEAR, EXCLUDING THOSE UNAVAILABLE DUE TO BREAKDOWN, REPAIR OF COMBAT DAMAGE, OR LENGHTY CREW TRAINING
	MACHINEGUN EFFECTIVENESS	ABILITY TO PUT BURSTS ON SURPRISE TARGETS RELIABLY, QUICKLY AND SUSTAINABLY (TIGERS WITHOUT MGs WERE SLAUGHTERED BY RUSSIAN INFANTRY)
III	FIREFIGHT MOBILITY	TIME FROM SURPRISE ATTACK (USUALLY ON ROAD) TO REACHING OFF-ROAD COVER AND ENVELOPING OR BYPASSING ATTACKER
	RATE OF KILL AGAINST MULTIPLE TANKS	TIME FROM DETECTION TO DESTRUCTION OF ANY ENEMY PLATOON (E.G., 3 TANKS) OR LARGER UNIT.
	CREW SURVIVAL: • VS. INFANTRY • VS. TANKS	ABSENCE OF FIRE, BLAST, OR FRAGMENT CASUALTIES (INCLUDING FROM ON-BOARD HYDRAULICS, FUEL, AMMO, OR INADEQUATE ESCAPE PROVISIONS) DUE TO: • SIDE/REAR ROCKET ATTACK • MINE UNDER TRACK • 360° CANNON ATTACK

COMBAT-DERIVED EFFECTIVENESS

CRITERIA: OPERATIONAL MOBILITY

DESIRED EFFECT	NECESSARY EFFECTIVENESS CHARACTERISTICS	MEASURE
MOVE A TANK COLUMN FROM FRIENDLY REAR TO ENEMY REAR FASTER THAN THE ENEMY CAN REACT	RELIABILITY UNDER BATTLE CONDITIONS	• MILES BETWEEN FAILURES REQUIRING IMMEDIATE MAINTENANCE
	GOOD AVERAGE (NOT MAX) ROAD SPEED -- INCLUDING STOPS FOR REPAIR AND FUEL	• AVERAGE SUSTAINABLE SPEED OVER POOR ROADS
	ABILITY TO OPERATE A DAY OR TWO WITHOUT TANKER TRUCK SUPPORT	• ROAD RANGE AT ABOVE SPEED • OVERWATCH ENDURANCE
	ABILITY TO WADE RIVERS AND CROSS LOW CAPACITY BRIDGES	• WADING DEPTH • COMBAT WEIGHT

COMPARATIVE EVALUATION: OPERATIONAL MOBILITY

MEASURE	XM-1	M-60 A1	T-62
MILES BETWEEN STOPS FOR NON-DEFERABLE MAINTENANCE	34[1/] (OT II) 43[1/] (OT III)	150-200	100-125
HOURS PER STOP	2.6 (OT II, III)		
AVERAGE SUSTAINABLE SPEED ON POOR ROAD	25 MPH[2/]	20 MPH	15 MPH
TYPICAL RANGE ON POOR ROADS	127 MI (FORT KNOX)	175-250 MI	150-200 MI (WITH EXTERNAL FUEL)
FORDING DEPTH	UNTESTABLE DUE TO LEAKS	1.2m	1.4m
BRIDGE CROSSING: COMBAT WEIGHT	62 TONS	48 TONS (M-60) GREW TO 57 TONS (A3)	44 TONS
TANKS PER RR FLATCAR (U.S.)	1	2	

1/ OT II TEST DIRECTOR'S SCORING OF FAILURES REQUIRING IMMEDIATE MAINTENANCE.

2/ OT II AND III CONDUCTED AT AN ACTUAL AVERAGE OF 10 MPH.

COMBAT-DERIVED EFFECTIVENESS

CRITERIA: NUMBERS OF TANKS AVAILABLE

DESIRED EFFECT	NECESSARY EFFECTIVENESS CHARACTERISTICS	MEASURE
	• BE ABLE TO OUTPRODUCE ENEMY IN TANKS IN PEACETIME	• TANKS PER BILLION $ OF PROCUREMENT
TEAR APART ENEMY'S ORGANIZA-TION WITH MULTIPLE TANK THRUSTS	• BE ABLE TO OUTPRODUCE ENEMY IN WARTIME	• SURGE PRODUCTION RATE
	• HAVE LARGE PERCENTAGE OF INVENTORY READY FOR COMBAT	• DEADLINE RATE (%) IN TROOP USE
	• BRING LARGE PERCENTAGE TO BEAR AT THE FRONT	• PERCENT SURVIVING 200 MILE FORCED MARCH
	• MINIMIZE PERCENTAGE IN PIPELINE FOR REPAIR OF COMBAT DAMAGE	• AVERAGE DAYS TO REPAIR COMBAT DAMAGE

COMPARATIVE EVALUATION: NUMBERS AVAILABLE

MEASURE	XM-1	M-60A1	T-62
TANKS PER BILLION $	360	1,100	1,500
PEAK PRODUCTION PER YEAR (PEACE)	720 - 1,080	1,240	2,000-3,000*
% SURVIVING 4000 MILES WITHOUT POWERTRAIN OVERHAUL	22% (APR 80) 19% (JAN 81) 15% (JUL 81)	60%	0%
OPERATIONAL AVAILABILITY	43 - 47% (OT II, III)	85%	
AVERAGE DAYS TO REPAIR COMBAT DAMAGE	• Armour can't be repaired below depot • Damaged engines to CONUS	1-2 days (Israelis-73)	

*All Models of Medium Tanks.

COMBAT-DERIVED EFFECTIVENESS
CRITERIA: MACHINEGUN EFFECTIVENESS

DESIRED EFFECT	NECESSARY EFFECTIVENESS CHARACTERISTICS	MEASURE
PLACE BURST INSTANTLY ON ANY INFANTRY ANTITANK THREAT -- EVEN AS CLOSE AS ROADSIDE DITCH	UNOBSTRUCTED VIEW OF THREATS	• HATCH-OPEN FIELD OF VIEW • BUTTONED-UP FIELD OF VIEW
	MG RELIABILITY	• BURSTS BETWEEN JAMS
	NEARLY INSTANT RESPONSE	• FREE MOUNT VS. SLOWER CUPOLA OR TURRET
	ABILITY TO FIRE CLOSE-IN AT ANY AZIMUTH	• FIELD OF FIRE DIAGRAM • NUMBER OF INDEPENDENT MG'S
	ABILITY TO SUSTAIN FIRE FOR EXTENDED FIREFIGHTS	• NUMBER OF READY ROUNDS • TOTAL ROUNDS ON-BOARD

COMPARATIVE EVALUATION:
MACHINEGUN EFFECTIVENESS

MEASURE		XM-1	M-60	T-62
HATCH-OPEN FIELD OF VIEW		POOR (WIDE, FLAT TURRET)	GOOD	GOOD
BUTTONED-UP FIELD OF VIEW		POOR	FAIR	POOR
MG RELIA-BILITY/ FAST RESPONSE	COAX	UNRELIABLE FEED (FIXED?)	GOOD* (M240)	GOOD
	CDR	SLOW/NOT AIMABLE	JAMS (M85)	GOOD
	LDR	GOOD MG/FLIMSY MOUNT	N/A	N/A
FIELD OF FIRE		CDR = POOR	CDR = FAIR	CDR = FAIR
NUMBER OF ROUNDS		.50 CAL = 1000 rds. 7.62 mm = 6000 rds.	.50 CAL = 1000 rds. 7.62 mm = 6000 rds.	12.7 mm = 500 rds 7.62 mm = 2,000 rds.

* M73 MG ON M-60/M60A1 IS UNUSABLE.

COMBAT-DERIVED EFFECTIVENESS

CRITERIA: FIREFIGHT MOBILITY

DESIRED EFFECT	NECESSARY EFFECTIVENESS CHARACTERISTICS	MEASURE
MOVE QUICKLY FROM ON-ROAD EXPOSURE TO OFF-ROAD COVER IN ORDER TO ATTACK OR BYPASS THREAT	LEAVE ROAD QUICKLY THROUGH DITCHES, HEDGES, OR STONE WALLS	• TIME TO STOP FROM COLUMN SPEED • TRENCH-CROSSING DISTANCE • TIME TO "DASH" 50 FEET
	TRAVERSE MUD WITHOUT BOGGING	• SIDE-BY-SIDE TEST • GROUND PRESSURE (POOR SURROGATE)
	TRAVERSE ROUGH GROUND QUICKLY	• SIDE-BY-SIDE TEST • SUSPENSION TRAVEL (SURROGATE)

COMPARATIVE EVALUATION: FIREFIGHT MOBILITY

MEASURE	XM-1	M-60	T-62
TIME TO STOP			
TIME TO "DASH" 50 FEET	5 SEC*	6 SEC	5.5 SEC
TRENCH-CROSSING	9 FT	9 FT	9 FT
SOFT-GROUND CAPABILITY: GROUND PRESSURE	13 PSI	11 PSI	10 PSI
SPEED MANEUVERING OVER ROUGH GROUND:	SLOW (DUE TO FEAR OF THROWING TREAD)	FAIR	SLOW (DUE TO HARSH SUSPENSION AND TREAD THROWING)

*SLOW DUE TO SLUGGISH ACCEL OF GAS TURBINE AND INHERENT SLIP OF AUTOMATIC TRANSMISSION

COMBAT-DERIVED EFFECTIVENESS
CRITERIA: RATE OF KILL VS. MULTIPLE TANKS

DESIRED EFFECT	NECESSARY EFFECTIVENESS CHARACTERISTICS	MEASURE
MINIMIZE TIME FROM DETECTION TO DESTRUCTION OF AN ENEMY TANK PLATOON	• QUICK TURRET TRAVERSE AND INSTANT RANGING/ AIMING	• TIME TO FIRST HIT FROM SURPRISE ENCOUNTER AT TYPICAL COMBAT RANGES.[1] (TROOP FIRINGS)
	• QUICK RELOADING AND RE-LAYING	• TIME TO SUBSEQUENT HITS
	• NEAR-CERTAINTY OF "BREWING" UP A TANK FOR EACH HIT	• PERCENT OF HITS RESULTING IN A BURNING TANK (USE ONLY LIVE FIRING RESULTS AGAINST COMBAT-LOADED TANKS)
	• ABILITY TO SUSTAIN FIRE	• NUMBER OF ROUNDS ON-BOARD

1/ DOCUMENTED TANK ENGAGEMENT RANGES ARE:

- EUROPE: 50% WITHIN 500 M; 10% BEYOND 1000 M
- NORTH AFRICA: 50% WITHIN 750 M; 10% BEYOND 1500 M
- ISRAEL: 300 M to 800 M

MAXIMUM POSSIBLE RANGES FROM NATO TERRAIN INTERVISIBILITY MEASUREMENTS ARE:

- CENTRAL EUROPE: 50% WITHIN 550 M; 15% BEYOND 1000 M

COMPARATIVE EVALUATION:
RATE OF KILL VS MULTIPLE TANKS

MEASURE	XM-1	M-60	T-62
TIME TO FIRST HIT (100M TO 1000M)	GOOD*	GOOD*	FAIR (SLOW TURRET INACCURATE ROUND)
TIME TO SUBSE-QUENT HITS	FAIR** (~9 SECS)	GOOD (7 SECS)	VERY SLOW (15+ SECS)
% OF HITS LEAD-ING TO FIRE/ EXPLOSION	NOT TESTED: PROBABLY GOOD (WITH DU)	NOT TESTED: PROBABLY GOOD (WITH DU)	NOT TESTED: PROBABLY POOR TO FAIR
SUSTAINABILITY: NUMBER OF STOWED ROUNDS	55 (40 WITH 120 MM)	63	40

**WILL BE POORER WITH 120MM CANNON AND UNRELIABILITY OF CASELESS ROUND. RELOADING IS SLOW DUE TO POOR LOADER'S STATION LAYOUT.

*ONLY WITH BATTLESIGHTS; WITH RANGEFINDER/FIRE CONTROL, TIME IS UNACCEPTABLY SLOW.

COMBAT-DERIVED EFFECTIVENESS

CRITERIA: CREW SURVIVAL

DESIRED EFFECT	NECESSARY EFFECTIVENESS CHARACTERISTICS	MEASURE
MINIMIZE CREW CASUALTIES DUE TO HITS	INVISIBILITY	• HEIGHT • PRESENTED AREA IN FT^2 (PARTICULARLY FOR TURRET IN DEFILADE) • STRENGTH OF INFRARED SIGNATURE • NOISINESS
	REDUCE FRAGMENT SPRAY AND AMMO/FUEL/HYDRAULICS FIRES CAUSED BY ROCKET (E.G., RPG-7) HITS ON SIDE AND REAR	• % FIRES AND FRAGMENT CASUALTIES FROM LIVE FIRINGS AGAINST COMBAT-LOADED TANKS
	SAME FOR AP, HEP, AND HEAT SOVIET TANK ROUNDS FROM FRONT, SIDE, AND REAR	• SAME • SAME FOR MULTIPLE HITS BY AP AND HEP
	REDUCE BLAST AND FRAGMENT EFFECT FROM STANDARD SOVIET MINES	• % BLAST OF FRAGMENT CASUALTIES FROM LIVE MINE DETONATION • % SERIOUS IMMOBILIZATION (BEYOND TRACK DAMAGE)

COMPARATIVE EVALUATION: CREW SURVIVAL

MEASURE	XM-1	M-60	T-62
INVISIBILITY: TURRET PRESENTED AREA	POOR (WITH HIGHLY VISIBLE PROFILE)	FAIR	FAIR
INVISIBILITY: INFRARED SIGNATURE	LARGE, VERY VISIBLE EXHAUST PLUME CAN IGNITE WOODS	SMALL	SMALL
% CASUALTIES DUE TO ROCKET (RPG-7) HIT ON SIDE/REAR	NOT TESTED: PROBABLY POORER THAN M-60 FROM REAR 180°; MORE FLAMABLE HYDRAULICS THAN M-60	NOT TESTED: HIGH BURN CASUALTIES IN ISREALI WAR-FLAMMABLE HYDRAULICS	NOT TESTED: LIKELY TO BE MUCH POORER THAN M-60
% CASUALTIES DUE TO CANNON HIT ANYWHERE	SAME AS ABOVE	SAME AS ABOVE	SAME AS ABOVE
% CASUALTIES DUE TO MINE DETONATION	NOT TESTED	NOT TESTED	NOT TESTED

OVERVIEW

- IS ONE XM-1 BETTER THAN THREE M-60S?
- IS ONE XM-1 BETTER THAN ONE M-60?

- ONLY LIVE-FIRING TROOP TESTS OF MOBILITY, RATE OF KILL AND CREW SURVIVAL, USING THE XM-1 SIDE-BY-SIDE WITH THE M-60, CAN ANSWER THESE QUESTIONS.
- ONLY SIDE-BY-SIDE TESTING CAN ENSURE CORRECTION OF THE XM-1'S MOST SERIOUS DEFICIENCIES.

SUMMARY OF XM-1 VS M-60

OPERATIONAL MOBILITY	XM-1 IS OPERATIONALLY SLOWER THAN M-60 DESPITE GOOD ROAD SPEED, BECAUSE OF POOR RANGE AND CRIPPLING UNRELIABILITY.
NUMBERS	• XM-1 WILL WORSEN NATO'S NUMERICAL INFERIORITY. • TO BUY XM-1 IS TO FOREGO THE OPPORTUNITY TO ACQUIRE 3 TIMES AS MANY TANKS.
MG EFFECTIVENESS	• XM-1 HAS POORER MG FIELDS OF FIRE. • XM-1 COAX WORKS; LOADER'S MG MOUNT BREAKS: COMMANDER'S MG IS "IMPOSSIBLE TO AIM".
FIREFIGHT MOBILITY	• XM-1 ONLY SLIGHTLY FASTER IN SHORT DASHES DUE TO SLUGGISH ACCELERATION OF GAS TURBINE AND AUTOMATIC TRANSMISSION. • XM-1 SLIGHTLY POORER THAN M-60 OVER SOFT GROUND. • XM-1 SLOWER OVER ROUGH GROUND (FEAR OF THROWING TREAD)
RATE OF KILL VS TANKS	• XM-1's RATE OF KILL IS SLIGHTLY SLOWER THAN M-60 IF M-60 IS GIVEN THE 105 MM DU ROUND. • LASER FIRE CONTROL, IF USED, FURTHER SLOWS RATE OF KILL.
CREW SURVIVAL	MOSTLY UNTESTED. XM-1 FIRE EXTINGUISHING MAY PROVE A STEP FORWARD (IF FIXED). HYDRAULIC FLUID MORE FLAMMABLE THAN M-60. PROTECTION AGAINST SIDE/REAR INFANTRY ROCKET (OR CANNON) ATTACKS APPEARS TO BE POORER THAN M-60. KE ROUNDS PENETRATE CHOBHAM ARMOR EASILY.

A FEASIBLE TANK TO OUTFIGHT AND OUTNUMBER THE T-72	
MOBILITY	• 45 TONS • 1000-1200 HP DIESEL (AVAILABLE) • DIEHL TRACK, REPLACEABLE PADS • 7 WHEELS/5 SHOCKS/300 MM TRAVEL • 5 SPEED SYNCHROMESH GEARBOX • FUEL FOR TWO COMBAT DAYS
TURRET	• MERKAVA MINIMUM PROFILE TURRET • FIXED COMMANDER'S STATION • DESIGN FOR HATCH-OPEN FIGHTABILITY
MACHINEGUNS	• 7.62 COAX PLUS TWO 5.56 MM FREE MGs • 12,000 RDS FOR MGs
CANNON	• 75 MM TO 90 MM DU @ 6,000 FPS (STONER) • 85 RDS STOWAGE • COULD ACCEPT 105 MM DU • BATTLESIGHT PLUS NON-COUPLED LASER

A FEASIBLE TANK TO OUTFIGHT AND OUTNUMBER THE T-72 (CONT'D)	
CREW SURVIVAL	• SIDE/REAR FULLY PROTECTED AGAINST 12.7 MM AP AND RPG-7 (USING STANDOFF PLATES/ SKIRTS) • ANTI-SPALL LINER • ENGINE IN FRONT • ZERO SMOKE (AFTERBURNER) • MINIMUM INTERNAL FUEL (FOAM); JETTISONABLE EXTERNAL FUEL (SELF-SEALING) • NO AMMO IN TURRET; LOW SENSITIVITY AMMO, POSSIBLY IN WATER BATH • ZERO FLAMMABILITY HYDRAULIC FLUID (E.G., BRAYCO OR FREON) • AUTO FIRE EXTINGUISHERS • LAYOUT FOR ZERO MINE CASUALTIES • ALL FEATURES TESTED W/SOVIET AMMO VERSUS COMBAT-LOADED TEST TANKS
NUMBERS	• UNIT PROGRAM $ = $800,000 • PRODUCTION RATE = 2500/YR • TWO COMPETING PRODUCERS • SURGE PRODUCTION = 5000/YR • ANNUAL BUDGET = $2B (SAME AS M-1)

END RESULT

- CRUSHING SUPERIORITY OVER THE T-72
- MOVE FASTER AND KILL FASTER THAN THE M-1 WITH LESS CREW CASUALTIES
- TRIPLE THE U.S. TANK PRODUCTION WITHIN SAME BUDGET