MARINE SEARCH AND ATTACK BATTALION, PHASE I (1977-1982) STUDY

MARSAS WAR GAMES. VOLUME I. MAIN REPORT

MARINE CORPS DEVELOPMENT AND EDUCATION COMMAND

MARCH 1975

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This is a report of the MARSAS series of war games conducted 1 May-31 July 1974. The purpose of these games was to assist the MARSAS study group in developing a recommended interim search and attack battalion structure for the 1977-1982 time frame. The games focused primarily on the comparative surveillance and target acquisition (STA) performance of two candidate battalion models: The current infantry battalion with minor modification (Model I) versus a future version of this battalion that incorporates

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20. potential new developments in STA equipments (Model III). This report presents the findings and insights drawn from the war games and the backup analysis. Also included are the experimental design and the narrative description of game play.

This report is divided into three volumes as follows:

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REPORT OF MARSAS WAR GAMES

PREPARED BY WAR GAMES BRANCH, DEVELOPMENT CENTER

IN CONJUNCTION WITH

POTOMAC GENERAL RESEARCH GROUP

MARCH 1975

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ABSTRACT

This is a report of the MARSAS series of war games conducted 1 May-31 July 1974. The purpose of these games was to assist the MARSAS study group in developing a recommended interim search and attack battalion structure for the 1977-1982 time frame. The games focused primarily on the comparative surveillance and target acquisition (STA) performance of two candidate battalion models: The current infantry battalion with minor modification (Model I) versus a future version of this battalion that incorporates potential new developments in STA equipments (Model III). This report presents the findings and insights drawn from the war games and the backup analysis. Also included are the experimental design and the narrative description of game play.

EXECUTIVE SUMMARY

1. General. This is a report on four Landing Force War Games designed to compare the search and attack capability of two differently organized and equipped Marine Corps infantry battalions. The games were conducted during May through July 1974 by the War Games Branch, Studies and Requirements Division, Development Center, Marine Corps Development and Education Command (MCDEC). Contractual support was furnished by the Potomac General Research Group.

2. Abbreviations

a. MARSAS: Marine Search and Attack System

b. LFWG: Landing Force War Game

c. LRR: Long Range MTI Radar

d. MRR: Medium Range MTI radar

Model III: Conceptual
Model I: AN/PPS-15

e. LREO: Long Range Electro-Optic Device

f. MREO: Medium Range Electro-Optic Device

Model III: Conceptual
Model I: AN/TVS-4

g. AR: Airborne MTI Radar

h. AV: Air Visual

i. GV: Ground Visual

j. PLRS: Position Locating and Reporting System

3. Background. The capability of current surveillance/target acquisition (STA) devices severely constrains the application of combat power. The idea behind the search and attack concept is to capitalize on the advances in sensor technology, thereby closing the gap between weapons and STA capability. Such an improvement in STA capability would then allow more effective attack of the enemy at greater ranges resulting in greater attrition of the enemy prior to close combat. The study of this concept had its genesis in 1965 in MARCORPS-85. It was subsequently addressed under RCA contract and culminated in a Marine Corps Study Directive to MCDEC, CMC Project C6-53: Marine Search and Attack (MARSAS) Battalion Study, Phase I (1977-1982).

b. The MARSAS Study Group developed three time-phased versions of the Marine infantry battalion, called Models I, II, and III. Model I is the current battalion with changes approved by CMC on 6 September 1973. The principal change is the inclusion of a surveillance and target acquisition (STA) platoon in Headquarters and Service Company. Model II includes near-time-frame improvements in STA equipment. Model III, in contrast, represents a quantum jump in a new STA devices and incorporates advanced weapons systems. Models I and II were field tested at the company level in April and May 1974.

4. Comparison of MARSAS Models I and III. The significant differences between the two infantry battalion models with which this report is concerned are shown in tables i-1, i-2:

Capability by Function

Function	Capability		Expected Improvement
	I	III	
Detection of moving targets (all weather)	• MRR (PPS-15)	• MRR (conceptual) • LRR (conceptual)	70% increase in range. Better maintenance and operations.
Imaging moving and stationary targets (reduced visibility)	• MREO (TVS-4)	• MREO (conceptual) • LREO (conceptual) Pocketscope	Increase in range. Utility is improved because two complementary techniques are used. Less operator fatigue.
Measuring range to target	• Radar (PPS-15) • Visual Estimation	• Radar • Laser ranging	Radar ranging requires moving target Laser does not. Laser ranging accurate.
Measuring azimuth to target	Reference • Magnetic • Conventional Survey	Reference • Laser Gyro	More accurate. Immediately available.
Location of STA devices	• Map inspection • Conventional Survey	• PLRS	More accurate. Faster.
Remote detection of targets	• UGS	• UGS	No change.
Aimed rifle fire (reduced visibility)	---	• Riflescope	Significantly better hit probability.
Laser designation of targets	---	• Laser	Allows use of laser guided weapons.

Note: Medium range radar (MRR) for Model I is the AN/PPS-15
Medium range MREO for Model I is the AN/TVS-4

Table i-1

MAJOR WEAPONS AND STA EQUIPMENTS

Model	Strength	Mortars	Antitank/ Assault	Squad Automatic Weapons	Radars	E/O Devices
I	1231*	8-81mm 12-60mm	4-3.5 RKT 8-106mm 12-MPFW	24-M60	8-PPS-15	4-TVS-4
III	1080*	12-81mm** (improved)	12-MPFW 4-106mm 12-DRAGON	108-SAW	4-LRR 12-MRR	4-LREO 12-MREO 16-Angle measuring devices 16-Lasers

Table i-2

* These are infantry battalion strengths only.
** Improved mortar is supposed to have greater range (6200 meters vs 4500 meters, current model) and greater lethality (equated to 4.2 inch mortar in MARSAS games). NOTE: 20 PLRS user sets were also included in Model III, distributed to platoon level.

5. War Gaming Application. By letter of 20 March 1974, the Director, Development Center directed War Games Branch to war game Battalion Model III against a notional enemy force, inasmuch as not even prototype versions of the STA equipment exist, and that Battalion Model I also be wargamed for comparison purposes. By this means it would be possible to generate quantitative data and qualitative insights as to the relative combat effectiveness of the two types of battalions performing identical missions against the identical threats.

6. Experimental Design of War Games.

a. Basic Design. Fundamental was the consideration of the number of games that should be conducted. The decision taken was to conduct four short games in order to allow investigation of the relative performance of the two type battalions under a wide range of variables that influence STA performance. Each of the four games consisted of two iterations; one for the Model I battalion and one for the Model III, with the scenario, environmental variables, and threat being held constant for each game.

b. Scenarios. Since the MARSAS war games were to focus on only a relatively small element of an amphibious operation, it was not necessary to develop elaborate scenarios embracing all aspects of conflict situations. Each scenario moved an infantry battalion to a selected area and established a situation from which combat would ensue. None of these situations involved assault landings.

(1) War Game MARSAS I. This game had Red in a night attack, moving approximately 20 kilometers to close on the Blue position in a period of five hours. Red moved from an approach march formation to an attack position with two battalions abreast and a third battalion in reserve. This reserve battalion did not enter into game play. There were 53 Red platoon-equivalent target elements involved in game play.

(2) War Game MARSAS II. This game had Blue attacking at night against a one-battalion mechanized force. Prior to game start the Blue battalion had been pursing the withdrawing Red force and had stopped on an interim objective to reorganize to continue the attack. Subsequently, Blue launched a dismounted attack with three companies abreast and closed on the Red position within six hours. There were 25 Red platoon-equivalent target elements involved in game play.

(3) War Game MARSAS III. In this game the Blue battalion attacked a one-battalion mechanized force during daylight. The attack was launched with two companies abreast and one company mounted in AVTs, reinforced with a tank platoon. The reinforced company synchronized its movement with the dismounted companies and attacked around the right flank. The Blue battalion closed with Red within six hours after having advanced some seven kilometers. There were 37 Red platoon-equivalent target elements involved in game play.

(4) War Game MARSAS IV. This game had the Blue battalion in daylight defense against a three-battalion Red force. Red was dismounted in this game. (This was a change from the original plan, which called for a mechanized force. Subsequently, it was considered an oversight not to game a dismounted aggressor in at least one game). The Red force attacked with two battalions abreast and one in reserve. The game play was such that the reserve battalion had to be committed in the Model III iteration while it was not committed in the Model I iteration. There were 92 Red platoon equivalent target elements involved in game play.

c. Environmental Variables

(1) Terrain. The radars and electro-optic devices of both models require line of sight to a target as a prerequisite to detecting that target. Therefore, the performance of these target acquisition devices is very sensitive to the type terrain selected for the game. The design goal was to select a game area where the terrain is representative of the type in which the Marine Corps anticipates employment. Terrain extremes were rejected because such terrain would bias the performance results between the two models. Another factor influencing the game area selected was the availability of

"digitized terrain" — terrain for which map contour information has been converted to a set of digital data by the Defense Mapping Agency. Use of digitized terrain data greatly facilitates the determination of existence of lines of sight from any specified point. Such a determination had to be made for each potential target detection in the MARSAS games. Considering all the above, the Fort Hood Texas area was selected. The terrain in this area varies from gently rolling to broken with moderate vegetation, and digitized terrain data does exist. A computer program was developed by the Naval Weapons Laboratory, Dahlgren, Virginia to answer visibility questions using the digitized data. This program became operational during the first game and was used for all succeeding games; a manual digitized terrain algorithm was used in the first game.

(2) Visibility. Not only is the performance of radars and electro-optic devices affected by terrain, but also, in varying degrees, by weather and light level. It was important, therefore, to incorporate in the war games those conditions that significantly affect performance. The two tables which follow summarize sensor sensitivity and the scheme for incorporating varying visibility conditions in the games.

SENSOR RANGE DEGRADATION

CONDITION \ SENSOR	RADAR	E/O DEVICE THERMAL	E/O DEVICE IMAGE INTENSIFICATION
Heavy Rain	Severe	Severe	Severe
Fog/Haze	Slight	Severe	Severe
Full Moon	None	Slight	Moderate
Starlight	None	Slight	Severe

Table 1-3

GAME VISIBILITY CONDITIONS

CONDITION \ GAME	I	II	III	IV
Precipitation	No Rain	No Rain	Heavy Rain 1 Hour	No Rain
Fog/Haze	None	None	Haze in Streambeds	Haze in Streambeds
Illumination	Full Moon	Quarter Moon	Daylight	Daylight

Table 1-4

d. Force Structure

(1) Blue. In all four games the Blue force was a reinforced infantry battalion. The compositions of the Model I and III battalions were discussed in para 4, above. The battalion reinforcements were kept constant in all four games, with the one exception noted below.

(a) Artillery: One 105mm battery. In War Game MARSAS I there were, additionally, two 155mm sections.

(b) Naval gunfire: One guided missile light cruiser and two destroyers.

(c) Aircraft (disregarding medium and heavy helicopters): Twenty-four attack (6-A4M, 4-AV8A, 4-A6A, 4-F4J, 6-AH1J), six reconnaissance (4-UH1N, 2RF4B), and two electronic warfare (2-EA6A).

(d) Tank: one tank platoon

(e) Ground reconnaissance: one division recon platoon, one force recon detachment.

(f) Surveillance (other than STA units): one Sensor Control and Management (SCAM) detachment.

(g) Communications: One radio detachment.

(2) Red

(a) The Red force in War Games MARSAS I, II, III consisted of a mechanized infantry regiment or parts of such a regiment. In War Game MARSAS IV the force was similarly organized, but was motorized. Table i-5 summarizes the numbers of battalions, armored vehicles, and major weapons in each game.

(b) The Red force was augumented in MARSAS III to give it a STA capability comparable to that of the Blue Model I battalion and in MARSAS IV to give it an electronic warfare capability in order to examine the effect of electronic countermeasures on Blue STA equipment.

RED FORCE

ELEMENT \ GAME	I Blue Night Defense	II Blue Night Attack	III Blue Day Attack	IV Blue Day Defense
Battalions*				
Mechanized	2 (920)	1 (460)	1 (460)	0
Infantry	0	0	0	3 (1380)
APC	60 (BTR)	30 (BTR)	30 (BTR)	3 (BTR)
Tanks	20 (T-62)	10 (T-62)	10 (T-62)	31 (T-54)
Anti-Tank				
Sagger**	6 (BRDM)	3 (Manpack)	3 (Manpack)	6 (BRDM)
85mm ATG	-	-	-	6
73mm RG	4	2	2	6
RPG-7	81	27	27	81
Arty-Mortar				
122mm G/H	12	3	3	12
152mm G/H	6	-	-	6
122 MRL	6	-	-	6
120mm Mortar	12	6	6	18
AA				
SAM (SA-6)	2	2	2	2
23mm	4	-	-	4
14.5 MG	6	-	-	6
SA-7	27	6	6	27

Table I-5

Entry for weapons is number of weapons
* Number in ( ) is personnel strength
** Entry in ( ) is mount for SAGGER

7. Findings. These conclusions embrace the results of all games played and are grouped by study objectives.

a. Objective 1: To evaluate the relative capability of Models I and III to perform the functions of combat surveillance, target acquisition, target location, and target designation.

(1) Model III is superior to Model I in STA performance.

(a) There was a clear performance differential favoring Model III in the night games (Games I and II). In the day games, however, the performance differential did not appear to be significant; but this is not surprising, since the STA system is designed to give maximum utility under reduced visibility conditions. As visibility clears, utility decreases and under the conditions of Game III (Annex G) utility reaches a minimum.

(b) In the night games, Model III detected significantly more targets than Model I. This was a direct result of the increased range of the Model III radars and companion electro-optic devices. The following tables compare the performance of the two models. The area under surveillance in the radar coverage table is non-duplicative. That is, areas covered by two or more radars are counted only once.

RADAR COVERAGE

GAME		RADARS USED MRR	RADARS USED LRR	AREA UNDER SURVEILLANCE (KM^2)	PERCENT VISIBLE	AREA COVERED (KM^2)
I	I	8	-	56	26%	14.6
	III	8	4	165	42%	69.0
II	I	2	-	14	19%	2.7
	III	3	2	157	29%	45.5

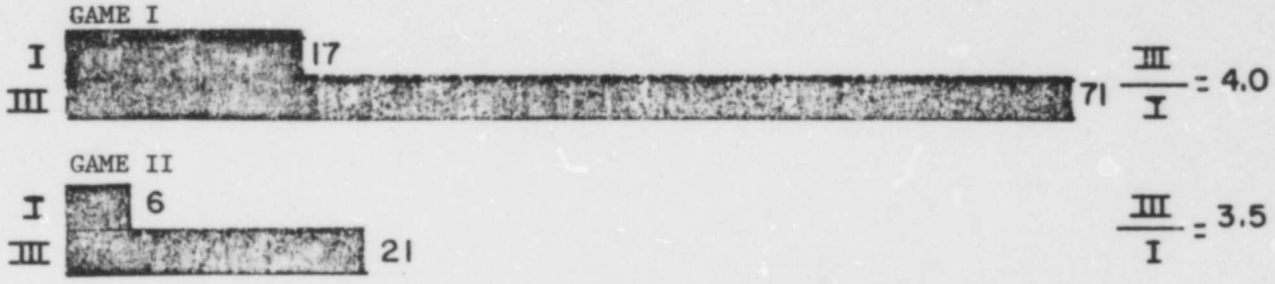
Table i-6

DETECTIONS

GAME \ SENSOR		MRR	LRR	MREO	LREO	OTHER	Σ
I	I	15	-	2	-	40	57
	III	17	20	0	34	42	113
II	I	2	-	4	-	8	14
	III	10	3	4	4	6	27

Table i-7

(c) Considering only radars and E/O devices Model III made 4 times more detections than Model I in Game I and 3.5 times more in Game II.



(d) Examining the value of increased range of Model III radars: of the 37 radar detections made by Model III in Game I, 34 or 92% were made beyond the maximum range of the Model I radar; similar result for Game II is 5 or 39%.

VALUE OF INCREASED RADAR RANGE

	Total Model III Radar Detections	Number of Detections Beyond Model I Radar Range	%
GAME I	37	34	92%
GAME II	13	5	39%

Table i-8

(2) It appears that Model III is equipped with more radars than required.

The number of radars used varied among the games, but in no game were all 16 radars used.

RADARS EMPLOYED

GAME	RADARS USED		% USED
	MRR	LRR	
I	8	4	75%
II	3	2	31%
III	2	2	25%
IV	8	2	63%

Table i-9

The full complement of radars was not used simply because a lesser number was adequate to give overlapping coverage of the battalion area of interest. Equipping each rifle platoon with a radar seems patently excessive. It is suggested that the basis of issue be reviewed, challenging the high number of radars.

(3) It appears that Model III is less sensitive to air support. That is, the STA performance of Model III does not decrease as rapidly as Model I performance as the level of air support diminshes. The significance of this is that the overall performance of the Model III STA system would not degrade as rapidly as the Model I system with increasing intensity of the enemy air defense environment. The reason Model III is less sensitive is that the greater radar range of Model III extends by seven kilometers the cut off point beyond which the battalions must rely primarily on air. In the night games the sensitivity differential was rather dramatic. In Game I the percent of Model I detections registered by air was 67% compared to 30% for Model III. Game II result was 43% compared to 15%.

b. Objective 2. The relative capability of the two models to engage enemy forces utilizing supporting arms.

There does not appear to be any signficant difference in supporting arms performance that are correlated with STA performance. The individual game analyses (Annexes E-H) do show differences in performance measures dealing with target engagement; but in general, these differences could be traced to the stochastic nature of the LFWG and to game inconsistencies. The games did expose, however, two significant points:

(1) Excepting air, neither model has a very effective indirect fire weapon against mechanized forces. If we accept the weapon effectiveness assessment rules of the LFWG that are based upon historical results and weapon tests, then cannon artillery has low effectiveness against mechanized targets, especially when moving. This emphasizes the need for continued pursuit of terminally guided homing weapons, or some other indirect fire capability against mechanized forces.

(2) The most significant difference between the two models in terms of producing casualties is the improved 81mm mortar against a dismounted force. The last game had Blue in defense against a dismounted attack. Model III produced 415 casualties, 33% more than Model I; the improved mortar's contribution to this total was 105 or 25%. The comparative number for the current mortar of Model I was 28 casualties or 9% of the total.

8. Insights and Observations

a. Potential Problem Areas. This set of insights addresses the problems that would probably emerge if Model III is adopted.

(1) Model III has an excessive number of radars which may result in platoon commanders being more occupied with STA responsibilities than

delivery of firepower.

(2) Faced with a Red regimental sized threat, saturation of the target intelligence processing system appears to be a potential problem area with Model III and the universal forward observer concept does not seem to offer an easy solution to this problem.

(3) The rapid closure of a Red mechanized offensive threat emphasizes the need for rapid intelligence processing and operational decision-making.

(4) The major role played by aircraft in making early detections and attacks highlights the need for direct communication between battalion and supporting aircraft in order to reduce intelligence processing and reaction time.

(5) In Model III the STA capability exceeded the range of the organic fire capability, which raises the question of the battalion's sphere of responsibility. This question must be considered in a total systems context.

(6) Increased search capability should call for an increase in the employment of all supporting arms. This illustrates that changing one element of the combat system may well introduce changes to other elements, such as ammunition expenditure planning factors.

(7) The effect of battlefield illumination and environmental conditions on STA equipment performance, particularly in Model III, must be fully appreciated by commanders at all echelons.

b. Current Problems Highlighted by the MARSAS Games

(1) The need for a responsive countermortar/counterbattery system.

(2) The need for direct and indirect antimechanized fires and for aerial delivered mines to counter a mechanized threat.

c. New Opportunities Introduced by Model III

(1) The PLRS introduces a level of location accuracy which allows for precise fire support planning, enhances control of attacks and patrols operating forward of the FEBA and minimizes coordination problems inherent in passage-of-lines situations. (The degree of resolution of LFWG rules did not allow play of PLRS, hence no statistical data could be collected.)

(2) Improved STA capability, as evidenced by Model III over Model II, means improved patrol patterns both in range and area of operations.

(3) Similarly, improved STA capabilities should allow for wider defensive frontages and for the positioning of outpost lines farther forward.

REPORT OF THE
MARSAS WAR GAMES

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List of Tables

I. INTRODUCTION

1. General. This is a report on four pairs of hand-played war games designed to compare the search and attack capability of two differently organized Marine Corps infantry battalions (Models I and III) in the 1977-1982 time frame. The games were conducted during the period 1 May-31 July 1974 by the War Games Branch, Development Center, Marine Corps Development and Education Command. Contractual support was furnished by the Potomac General Research Group.

2. Background

a. Search and attack involves surveillance of a known or suspected target area; detection, identification, and location of targets; and effective employment of weapons against these targets. The capability of current surveillance/target acquisition (STA) devices severely constrains the application of combat power. The idea behind the search and attack concept is to capitalize on the advances in sensor technology, thereby closing the gap between weapons and STA capability. Such an improvement in STA capability would then allow more effective attack of the enemy at greater ranges resulting in greater attrition of the enemy prior to close combat.

b. A Marine Corps study - MARCORPS-85 - conducted in 1965, outlined the very general search and attack concept. Subsequently, RCA - under contract with the Marine Corps - conducted a series of studies addressing potential increases in infantry combat effectiveness through exploitation of advances in sensor and communication technologies. The RCA effort was approved by CMC "for study purposes" and in 1972 the Marine Corps Development and Education Command was tasked to conduct the Marine Search and Attack Battalion Study (MARSAS) Phase I (1977-1982). The study was to consider different organizations, weapons, and equipment, and to include provisions for field testing and war gaming.

c. In the MARSAS study plan, three time-phased versions of the Marine infantry battalion, called Models I through III, were developed. Model I was based on the current T/O M1038 infantry battalion, with some approved modification (e.g. inclusion of a surveillance and target acquisition (STA) platoon in headquarters and service company). Model I was to serve as the baseline model for both field testing and war gaming. Model II included near-time-frame improvements in STA equipment and incorporated some organizational changes based on collateral studies (Infantry Organization and Weapon Systems (IOWS) study, for example). Contrasted with Models I and II, Model III represented a quantum jump in new STA devices. The devices selected were a subset of the new equipments recommended by the RCA Studies. Excepting the Position Location and Reporting System (PLRS), these devices are in the conceptual stage only. If development were initiated and successful it is expected the new system could be delivered in the early to mid 80's. Models I and II were field

tested at company level in April-May of this year. In this report, Models I and III are compared using war gaming techniques. Thus Model I serves as a base case for comparison of Models II and III - the former in a field experiment and the latter in a series of war games.

3. War Game Phasing. The war gaming effort was conducted in four phases. The first - 23 January-30 April 1974 - involved preparation for game play, and resulted in a study plan (Conduct, Analysis and Documentation of MARSAS War Game; Potomac General Research Group; 30 April 1974) which covered methodology, conduct of games, measures of effectiveness, data collection, and data analysis. The second phase involved actual conduct of the game - 1 May-31 July 1974. The third phase, post-game analysis, from 1 August to 2 September 1974 was a synthesis of the concurrent analysis made during each of the four games. The final phase, documentation, has resulted in this report - incorporating the salient features of the post-game analysis and additional exposition on scenarios and game play.

4. War Game Purpose and Objective

a. The purpose of the war gaming effort was to assist the MARSAS study group in developing a recommended interim search and attack battalion structure - organization, weapons, equipment - for the 1977-1982 time period. In developing a recommended battalion structure the study group would in effect be providing a basis for the statement of future R & D objectives. War Games Branch (WGB), employing the Landing Force War Game (LFWG), was to generate data and provide qualitative insights regarding the relative combat effectiveness of the Model I and III battalions performing identical missions against identical threats.

b. The game objectives were:

(1) To evaluate the relative capability of the two candidate forces to perform the functions of combat surveillance, target acquisition, target location, and target designation.

(2) To evaluate the relative capability of the two candidate forces to engage enemy forces utilizing supporting arms.

(3) To evaluate the relative capability of the two candidate forces to engage the enemy in close combat utilizing direct fire weapons organic to the infantry battalion.

(4) To evaluate the relative capability of the two candidate forces to accomplish assigned missions.

(5) To evaluate the doctrine, tactics, and techniques mutually agreed upon prior to game play by the study group and the War Games Branch for use by the two candidate forces during game play.

II. DEFINITIONS AND ABBREVIATIONS

The purpose of this section is to provide those definitions and abbreviations needed for a clear understanding of the report. It is not an exhaustive list.

1. Sensor. In some publications the term sensor is limited to mean only unattended ground sensors. In this report a broader definition applies: Sensor is defined as any element of the entire set of devices/systems (man/machine) capable of sensing targets.

2. Detection. Detection, in the context of target acquisition, is usually limited to mean that a target is sensed only and does not imply that the target is identified (type classified). For this report it was found more convenient to use a broader definition: Detection implies both sensing and identifying the target.

3. Abbreviations.

a. MARSAS: Marine Search and Attack System
b. LFWG: Landing Force War Game
c. LRR: Long Range MTI Radar
d. MRR: Medium Range MTI Radar
   Model III: Conceptual
   Model I: AN/PPS-15
e. LREO: Long Range Electro-Optic Device
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   Model III: Conceptual
   Model I: AN/TVS-4
g. AR: Airborne MTI Radar
h. AV: Air Visual
i. GV: Ground Visual
j. PLRS: Position Location and Reporting System
k. UGS: Unattended Ground Sensor

III. BATTALION MODELS

1. Purpose. The purpose of this section is to capture the essence of the difference between Models I and III. Detailed composition of the models is in Annexes A-D. The reader should be aware that, historically, the performance claims of equipment on the drawing board are generally optimistic. This is an important consideration because most of STA devices in Model III are at this stage of development. With computer simulations, sensitivity analysis of performance parameters can be conducted, but with a manual game such analysis, as was the case of this game, is usually infeasible.

2. Models. As noted in the introduction the Model I battalion is basically the current infantry battalion while Model III represents a rather significant change with the inclusion of new STA devices and weapons that perhaps could be available in the 1980's. Not only are the STA devices new but the quantity provided is greater. Model III has 16 radars and companion night vision devices compared to Model I's eight radars and four night vision devices. Model III also includes new STA devices for which comparative devices in Model I do not exist. These are: (1) Position Location and Reporting System (2) Laser Designator and Rangefinder and (3) Angle measuring devices with a Laser Gyro reference. With respect to weapons improvement the significant changes were: (1) replacing the 60mm mortars at company level and 81mm mortars at battalion with one platoon of improved 81mm mortars at battalion level (2) the inclusion of the DRAGON anti-tank missile. The result of all these changes had Model III with more than double the firepower of Model I (Based upon LFWG assessment rules), yet with 12% fewer personnel (1231 vs 1080). The tables that follow summarize the comparison of Models.

Capability by Function (Table 1)

Function	Capability		Expected Improvement
	I	III	
Detection of moving targets (all weather)	•MRR (PPS-15)	•MRR (conceptual) •LRR (conceptual)	70% increase in range. Better maintenance and operations.
Imaging moving and stationary targets (reduced visibility)	•MREO (TVS-4)	•MREO (conceptual) •LREO (conceptual) •Pocketscope	Increase in range. Utility is improved because two complementary techniques are used. Less operator fatigue.
Measuring range to target	•Radar (PPS-15) •Visual estimation	•Radar •Laser ranging	Radar ranging requires moving target. Laser does not. Laser ranging accurate.
Measuring azimuth to target	Reference •Magnetic •Conventional survey	Reference •Laser Gyro	More accurate. Immediately available.
Location of STA devices	•Map inspection •Conventional survey	•PLRS	More accurate. Faster.
Remote detection of targets	•UGS	•UGS (1)	No change.
Aimed rifle fire (reduced visibility)	—	•Riflescope	Significantly better hit probability.
Laser designation of targets	—	•Laser	Allows use of laser guided weapons.

Note: (1) The goals of the Marine Corps Remote Senor Program area to improve the accuracy and range of the UGS, but for gaming purposes, Model I and Model III equipment are considered unchanged.

Assets (Table 2)

Model	Strength	Mortars	Antitank/ Assault	Squad Automatic Weapons	Radars	E/O Devices
I	1231*	8-81mm 12-60mm	4-3.5 RKT 8-106mm 12-MPFW	24-M60	8-PPS-15	4-TVS-4
III	1080*	12-81mm** (improved)	12-MPFW 4-106mm 12-DRAGON	108-SAW	4-LRR 12-MRR	4-LREO 12-MREO 16-Angle measuring devices 16-Lasers

*These are infantry battalion strengths only. Additional assets were provided to allow battalions to be employed as separate units. See para IV, 6a below.

** Improved mortar is supposed to have greater range (6200 meters vs 4500 meters, current model) and greater lethality (equated to 4.2 inch mortar in MARSAS games).

Note: 20 PLRS user sets were also included in Model III, distributed to platoon levels.

IV. EXPERIMENTAL DESIGN

1. Goal. The purpose of any experimental design is to provide a maximum amount of information relevant to the problem under investigation, subject to the constraint of resource economy. Thus, the goal of the MARSAS game design was to shed as much light as possible on the relative performance of the Models I and III battalions stemming from their different capabilities in search and attack. The key elements of the design that followed and the supporting rationale are covered in the following paragraphs.

2. Basic Design. A fundamental consideration was the number of games that should be conducted. Basically, two options existed: One relatively long game with two iterations or, alternatively, multiple short games. Short games were chosen and the design called for four games, the number required to exhaust combinations of attack and defense with day and night visibility. The reason for this multiple game approach was to allow investigation of relative performance under a wider range of variables that influence STA performance. Incorporating a wide range of variable change in a single game would require a complex conflict structure that could well confound any comparative analysis.

a. Each of the four games consisted of two iterations: One with the Model I battalion, the other with Model III. The order of the iterations was rotated between games to help compensate for "learning" the game - that is, not run games consecutively. But, this approach was eschewed in favor of more efficient and consistent assessment that would result when the two iterations of a game are run sequentially. Excepting Blue composition, all other scenario and environmental variables were held constant within each game to allow comparison of the models. Between games, however, the variables were changed.

b. The table below defines the game identifications that are used throughout the remainder of this report.

MARSAS CAMES (Table 3)

Game Number	Title	Forces
I	Blue in Night Defense	2 Red Mech Bns vs 1 Blue Bn
II	Blue in Night Attack	1 Red Mech Bn vs 1 Blue Bn
III	Blue in Day Attack	1 Red Mech Bn vs 1 Blue Bn
IV	Blue in Day Defense	3 Red Inf Bns vs 1 Blue Bn

3. Scenarios. Since the MARSAS war games were to focus on only a relatively small proportion (one battalion) of a typical amphibious task force, it was not necessary to develop elaborate scenarios for the conflict situations. Brief scenarios placed the battalion in the conflict area in coherent fashion and set the stage for subsequent interactions between the battalion and the enemy force. These scenarios, one for each game, are contained in Annexes A through D.

a. Game I. This game had Red in a night attack, moving approximately 20 kilometers to close on the Blue position in the space of five hours. Red moved from an approach march formation to an attack position with two battalions abreast and a third battalion in reserve. This reserve battalion did not enter into game play. There were 53 Red platoon-equivalent target elements involved in game play.

b. Game II. This game had Blue attacking at night against a one-battalion mechanized force. Prior to game start the Blue battalion had been

pursuing the withdrawing Red force and had stopped on an interim objective to reorganize to continue the attack. Subsequently, Blue launched a dismounted attack with three companies abreast and closed on the Red position within six hours. There were 25 Red platoon-equivalent target elements involved in game play.

c. Game III. In this game the Blue battalion attacked a one-battalion mechanized force during daylight. The attack was launched with two companies abreast and one company mounted in LVTs, reinforced with a tank platoon. The reinforced company synchronized its movement with the dismounted companies and attacked around the right flank. The Blue battalion closed with Red within six hours after having advanced some seven kilometers. There were 37 Red platoon-equivalent target elements involved in game play.

d. Game IV. This game had the Blue battalion in daylight defense against a three-battalion Red force. Red was dismounted in this game. (This was a change from the original plan, which called for a mechanized force. Subsequently, it was considered an oversight not to game a dismounted aggressor in at least one game.) The Red force attacked with two battalions abreast and one in reserve. The game play was such that the reserve battalion had to be committed in the Model III iteration while it was not committed in the Model I iteration. There were 92 Red platoon-eqivalent target elements involved in game play.

4. Partially Open Game. Games are considered either "open" or "closed" from the standpoint of information provided the participants. If a participant (Red or Blue) is provided only that combat intelligence that he would acquire under real conditions, his participation is called "closed". On the other hand, if a participant is provided complete enemy and friendly intelligence, his participation is considered "open". In this latter case the actions taken by the participant would be closely governed by the game controllers. The advantage of a closed game over an open game is that real conditions are more closely simulated by the game, thereby enhancing game validity. The disadvantage is the difficulty faced by the controllers in systematically identifying all useful information that would, in fact, be available to the participant. Another advantage of an "open" game is that consistency of player actions between iterations of a game is facilitated by the continuous dialogue between player and controller. It was important in the MARSAS games to achieve consistency of Red play in each game so as not to confound comparison of the Models. Primarily for this reason, the design called for Red as an "open" participant. A contingent benefit was conservation of game time since "open" is faster than "closed" play. But, only Red was "open". Blue played a "closed" game since the advantages of a "closed" game were judged to prevail for Blue.

5. Environmental Variables

a. Terrain selected. The radars and electro-optic devices of

both models require line of sight to a target as a prerequisite to detecting that target. Therefore, the performance of these target acquisition devices is very sensitive to the type terrain selected for the game. The design goal was to select a game area where the terrain is representative of the type in which the Marine Corps anticipates employment. Terrain extremes, such as deserts and rugged mountains, were rejected because not only is employment in these areas less likely, but also, such terrain would bias the performance results between the two models. Another factor influencing the game area selected was the availability of "digitized terrain" — areas where map contour information has been converted to a set of digital data by the Defense Mapping Agency. Use of digitized terrain data greatly facilitates the determination of where lines of sight exist from any specified point. And, of course, such a determination had to be made for each potential target detection in the MARSAS games. Considering all the above, the Fort Hood Texas area was selected. The terrain in this area varies from gently rolling to broken with moderate vegetation, and digitized terrain data does exist. A computer program was developed by the Naval Weapons Laboratory to answer visibility questions using the digitized data. This program became operational during the first game and was used for all succeeding games; a manual digitized terrain algorithm was used in the first game.

b. Other. Not only is the performance of radars and electro-optic devices affected by terrain, but also, in varying degree, by weather and level of illumination It was important, therefore, to incorporate in the game design, in reasonable proportion, those conditions that significantly affect performance. The two tables following highlight sensor performance sensitivity and the scheme for incorporating these sensitive conditions into the games. More detailed information on sensor sensitivity can be found in Annex J.

SENSOR PERFORMANCE (RANGE) DEGRADATION (Table 4)

SENSOR / CONDITION	RADAR	E/O DEVICE THERMAL	E/O DEVICE IMAGE INTENSIFICATION
Heavy Rain	Severe	Severe	Severe
Fog/Haze	Slight	Severe	Severe
Full Moon	None	Slight	Moderate
Starlight	None	Slight	Severe

GAME ENVIRONMENTAL SCHEME (Table 5)

CONDITION \ GAME	I	II	III	IV
Precipitation	No Rain	No Rain	Heavy Rain 1 Hour	No Rain
Fog/Haze	None	None	Haze in Streambeds	Haze in Streambeds
Illumination	Full Moon	Quarter Moon	Daylight	Daylight

6. Force Composition. The study group furnished the basic organization and equipment for the Models I and III Blue battalions and guidelines for structuring the Red force. Detailed listings of the forces are included in Annexes A-D.

a. Blue Force. The composition of the Model I and III battalion has been covered in Section III above. Additional assets were also provided these battalions to enable their employment as Marine Amphibious Units (MAU). With one exception, these added combat forces were held constant through the games.* Forces provided were:

BATTALION REINFORCEMENTS (Table 6)

Artillery	1 Battery (105mm) *(additionally, 2 sections of 155mm were provided in Game I only)
Naval Gun Fire	1CLG, 2DD
Air	18 Attack, 6 reconnaissance, 6 gunships (AH-1) and 2 EW aircraft.
Armor	1 Tank Platoon
Reconnaissance	1 Div Recon Platoon, 1 Force Recon Detachment
Surveillance	1 Sensor Control and Management Platoon Detachment (SCAMP)
Communications	Radio Detachment

*Two sections of 155mm were included in Game I because of a higher level Red threat.

b. Red Force. The Red force was constituted from portions of an aggressor mechanized regiment, except that in the last game a dismounted force was used. The composition varied among the games, but was held constant within each game. The Red force that was applied against Blue by game was:

RED FORCE (Table 7)

ELEMENT \ GAME	I Blue Night Defense	II Blue Night Attack	III Blue Day Attack	IV Blue Day Defense
Battalions*				
Mechanized	2 (920)	1 (460)	1 (460)	0
Infantry	0	0	0	3 (1380)
APC	60 (BTR)	30 (BTR)	30 (BTR)	3 (BTR)
Tanks	20 (T-62)	10 (T-62)	10 (T-62)	31 (T-54)
Anti-Tank				
Sagger**	6 (BRDM)	3 (Manpack)	3 (Manpack)	6 (BRDM)
85mm ATG	-	-	-	6
73mm RG	4	2	2	6
RPG-7	81	27	27	81
Arty-Mortar				
122mm G/H	12	3	3	12
152mm G/H	6	-	-	6
122 MRL	6	-	-	6
120mm Mortar	12	6	6	18
AA				
SAM (SA-6)	2	2	2	2
23mm	4	-	-	4
14.5 MG	6	-	-	6
SA-7	27	6	6	27

Entry for weapons is number of weapons
* Number in ( ) is personnel strength
** Entry in ( ) is mount for SAGGER

It should be noted that the threat posed by the various Red forces is greater than could usually be expected against a one-battalion MAU. This high level was chosen to expose the nature and extent of problems that may exist when the STA system approaches saturation.

7. Game Resolution. Resolution with respect to tracking the activity of force elements was generally at platoon level. Higher resolution was

applied to units possessing STA devices, each device being individually accounted for. Order of battle designations were given to all platoons or formations of equivalent size and the STA devices. Target elements, referred to subsequently in this report, are generally platoon size. The close combat assessments were made using an aggregate model where the primary determinant is the summation of firepower scores.

8. Electronic Warfare. Radars and electro-optic devices are, of course, vulnerable to EW and it was desired to include this threat in the MARSAS games. However, the LFWG rules for EW play required rather extensive updating for adaptation to the new MARSAS equipment, and time constraints precluded completion of this special addendum prior to first game start. The best solution available then was to complete the adaptation as soon as possible, without jeopardizing concurrent activities, with the goal of including EW in at least one game. This was achieved by employing EW in the last game played, MARSAS IV. See Annex J for EW design.

V. GAME LIMITATIONS

1. Purpose. The purpose of this section is to call attention to those limitations of the MARSAS war game that are important in the consideration of game results. Some of these are inherent to all research war games while other apply only to the MARSAS games.

2. Inherent Limitations

a. No Final Answers. The game is a simulation and not reality, thus, the results cannot provide final answers; nor, can the game account for some intangible factors. Such factors as morale, leadership and training are difficult or even impossible to include in a game.

b. Small Sample Size. War games are time-consuming and, hence, very few iterations can be performed. This, of course, generally precludes reasonable statistical confidence levels in performance measures.

c. Sensitivity Analysis. Since it is infeasible to perform more than a few repetitions with a manual war game, sensitivity analysis of system or sub-system equipment specifications is not generally possible. Such is the case in the MARSAS game and, therefore, changes in performance measures that would result from varying the sensor specifications cannot be assessed.

3. Game Limitations

a. Position Location and Reporting System (PLRS).

(1) The LFWG models for assessing conventional survey accuracy, target location error based upon CEP, and damage assessment based upon target location error were not sufficiently precise to discriminate the

value of the improved performance (design) of PLRS. And, sufficient time was not available to refine these models. The impact on the game is that comparative performance between Models I and III with respect to measures associated with location accuracy is probably biased in favor of Model I.

(2) The communications and IFF capabilities of PLRS were not played. The LFWG rules are not designed to address this level of resolution.

b. Radar Site Selection. Radars operating at the frequency of the MARSAS radars must have "line of sight" to function. Therefore, selecting a site for these radars must be done with great care. In real situations not only would a map reconnaissance be made; but more importantly, visual reconnaissance would be performed. It was not possible in the game, of course, to make visual reconnaissance. To compensate for this the Blue team was afforded the use of the computer "digitized terrain" program, described in para IV 5a above, to assist in positioning the radars.

c. Contour Scanning. The conceptual design of the Model III radars calls for automatic contour scanning vice manual scanning required by Model I radars. Contour scanning means the radar follows the terrain contour in elevation. If the radar scans at one elevation only, dead space will exist in areas below this elevation although line of sight may exist. It was not possible to inject contour scanning in this game because the precision required exceeds the tools (maps) available. And, even if the tools were at hand, manual assessment would probably be intractable. In retrospect, the impact of not including contour scanning is considered slight.

d. Foliage Effect. The computer program described in par IV, 5a above, was used to determine radar visibility. This program did not account for foliage or other obstructions that also affect radar performance since incorporation of those aspects in a mathematical model is not yet tractable. To compensate for this in some degree, the game assessors referred to map foliage information and when a target was covered by foliage, degradation factors were applied to sensor performance.

e. False Alarms. Most sensor systems (man/machine) are subject to false alarms — that is a target is reported when, in fact, a real target does not exist. And the false alarm rate is one of the measures of performance of a sensor system. False alarms were not played however, because, in the absence of empirical data, only speculative performance differential between the two models' sensors was available, and that was not sufficient for development of objective assessment rules.

f. Laser Designation. The Model III Laser Designator did not enter into game play since laser guided weapons were not included in the new weapons of Model III.

g. Rifle Sights and Pocketscopes. Thermal riflesights and pocketscopes were not played because the game does not resolve interactions to the individual Marine.

h. Combat Power Comparisons Confounded. While the Study Group had strong rationale for including new, improved weapons in Model III, such action confounds comparison of combat power measures between Models I and III if the aim is to correlate these measures with STA system performance. The reason is that Model III is ascribed such a larger firepower margin (2.4 times greater) over Model I by the LFWG assessment rules, that the contribution of other force characteristics tend to be overshadowed.

i. Learning Curve Confounding. To achieve valid comparison between the Models, the play in both iterations of a game must be consistent. Changes made in the second iteration that are either arbitrary or due to "learning" from the first iteration would tend to confound comparison. As noted earlier, steps were taken in the experimental design to offset this bias by rotating the model to be played first. And, to some degree this was successful. However, in retrospective analysis, it was found that some changes were made that were arbitrary. This action did confound some of the performance measures in certain games. Where this occurred, comment is made in the game analyses.

VI. FINDINGS.

These conclusions embrace the games as a whole; games are dealt with individually in Annexes E thru H. The findings are grouped by study objective.

1. Objective 1. To evaluate the relative capability of Models I and III to perform the functions of combat surveillance, target acquisition, target location and target designation.

a. Model III is superior to Model I in STA performance.

(1) There was a clear performance differential favoring Model III in the night games (games I and II). In the day games, however, the performance differential did not appear to be significant; but, this is not surprising since the STA system is designed to give maximum utility under reduced visibility conditions. As visibility clears, utility decreases and under the conditions of Game III (Annex G) utility reaches a minimum.

(2) In the night games Model III detected significantly more targets than Model I. This was a direct result of the increased range of the Model III radars and companion electro-optic devices. The following tables compare the performance of the two models. The area under surveillance in the radar coverage table is non-duplicative. That is, areas covered by two or more radars are counted only once.

RADAR COVERAGE (Table 8)

GAME		RADARS USED		AREA UNDER SURVEILLANCE (KM^2)	PERCENT VISIBLE	AREA COVERED (KM^2)
		MRR	LRR			
I	I	8	-	56	26%	14.6
	III	8	4	165	42%	69.0
II	I	2	-	14	19%	2.7
	III	3	2	157	29%	45.5

DETECTIONS (Table 9)

GAME \ SENSOR		MRR	LRR	MREO	LREO	OTHER	Σ
I	I	15	-	2	-	40	57
	III	17	20	0	34	42	113
II	I	2	-	4	-	8	14
	III	10	3	4	4	6	27

(a) Considering only radars and E/O devices, Model III made 4 times more detections than Model I in Game I and 3.5 times more in Game II.

(b) Examining the value of increased range of Model III radars: of the 37 radar detections made by Model III in Game I, 34 or 92% were made beyond the maximum range of the Model I radar; similar result for Game II is 5 or 39%.

b. It appears that Model III is equipped with more radars than required.

The number of radars used varied among the games, but in no game were all 16 radars used.

RADARS EMPLOYED (Table 10)

GAME	RADARS USED		% USED
	MRR	LRR	
I	8	4	75%
II	3	2	31%
III	2	2	25%
IV	8	2	63%

The full complement of radars was not used simply because a lesser number was adequate to give overlapping coverage of the battalion area of interest. Equipping each rifle platoon with a radar seems patently excessive. At any rate, it is suggested that the basis of issue be reviewed, challenging the high number of radars.

c. It appears that Model III is less sensitive to air support. That is, the STA performance of Model III does not decrease as rapidly as Model I performance as the level of air support diminishes. The significance of this is that the overall performance of the Model III STA system would not degrade as rapidly as the Model I system with increasing intensity of the enemy air defense environment. The reason Model III is less sensitive is that the greater radar range of Model III extends by seven kilometers the cut off point beyond which the battalions must rely primarily on air. In the night games the sensitivity differential was rather dramatic. In Game I the percent of Model I detections registered by air was 67% compared to 30% for Model III. Game II result was 43% compared to 15%.

d. Electronic Warfare. As noted earlier, EW was included only in the last game and the conditions of that game minimized the impact of enemy EW; e.g., Blue in daylight defense and wire installed throughout the battalion. Under these conditions it does not appear that a reasonable threat against the radars and the communications system will significantly degrade the performance of either Model. It should be noted that Model I is less vulnerable to early enemy detection because its radar emissions do not extend as far as the Model III emissions. However, this was not a factor in the last game since Red had fixed Blue prior to detection of the radars. Refer to Annex D for Red EW performance.

e. Both Models are seriously deficient in capability to locate hostile artillery and mortars. It is not meant to imply that this is an organic deficiency. Rather, it is a deficiency in the combat system of which the battalion is an element.

The MARSAS war games confirmed the recognized deficiency in countermortar and counterbattery capability. And, although new radars are being developed

to satisfy this need it is considered important to highlight this deficiency. Consider the casualties caused by Red artillery/mortar:

BLUE CASUALTIES CAUSED BY ARTILLERY/MORTAR (Table 11)

MODEL \ GAME	I	II	III	IV
I	76/68%	85/75%	119/65%	221/78%
III	41/49%	126/94%	108/74%	312/82%

ENTRY: # Casualties/% of total casualties

2. Objective 2. To evaluate the relative capability of the two models to engage enemy forces utilizing supporting arms.

There does not appear to be any significant differences in supporting arms performance that are correlated with STA performance. The individual game analyses (Annexes E-H) do show differences in performance measures dealing with target engagement; but in general, these differences could be traced to game inconsistencies. The games did expose, however, two significant points:

a. Excepting air, neither model has a very effective indirect fire weapon against mechanized forces. If we accept the weapon effectiveness assessment rules of the LFWG that are based upon historical results and weapon tests, then cannon artillery has low effectiveness against mechanized targets, especially moving targets. In fact, the Blue team rarely fired artillery on moving armored personnel carriers. Perhaps this emphasizes the need for continued pursuit of terminally homing weapons.

b. The most significant difference between the two models in terms of producing casualties is the improved 81mm mortar against a dismounted force. The last game had Blue in defense against a dismounted attack. Model III produced 415 casualties, 33% more than Model I; the improved mortar's contribution to this total was 105 or 25%. The comparative number for current mortar of Model I was 28 casualties or 9% of the total.

3. Objective 3. To evaluate the relative capability of the two models to engage the enemy in close combat.

Model III dominated in close combat primarily because its firepower score (ascribed by LFWG rules) was 2.4 times greater than the Model I score.

4. Objective 4. To evaluate the relative capability of the two models to accomplish the assigned mission. Again, Model III dominated because of its greater firepower score.

VII. INSIGHTS AND OBSERVATIONS

1. Scope. Objective 5 of the game directive was "to evaluate the doctrine, tactics, and techniques mutually agreed upon prior to game play by the Study Group and the War Games Branch for use by the two candidate forces during game play." This objective had an accompanying measure of effectiveness which was to "derive insights and lessons learned by player and control as they pertain to or are suggested by the objectives..." The insights are summarized below, and commented on as appropriate.

2. Potential Problem Areas. This set of insights addresses the problems that would probably emerge if Model III is adopted.

a. Excessive Number of Radars.

(1) There was a feeling that the company-level medium range radar (MRR) should be organized into a company section of two radars, rather than provided on the basis of one per platoon, three per company. The 12 MRRs could not be usefully employed in the Blue attack situations. Four would have been sufficient. And in the defense, six to eight would have probably sufficed.

COMMENT: Obviously the games cannot produce findings concerning organizational arrangements. These must be addressed by experiment, test, or by analytic methods.

(2) The greatly enhanced STA capability afforded the rifle platoon commander, Model III, may result in platoon commanders more preoccupied with STA responsibilities than with delivery of firepower.

COMMENT: The introduction of any new equipment or concepts calls for an introduction of new or additional training to insure a completely effective system. The introduction of a STA capability of the magnitude of that represented by Model III should call for tests and experiments aimed at measuring resultant combat effectiveness with alternative STA organizational concepts. For example, an alternative to including a STA capability organically in all rifle platoons is to organize and control STA resources at higher echelons (e.g. regiment, division), placing them in support of maneuver units when needed.

b. Communications/Information Processing.

(1) The Red threat - a mechanized regiment - saturated the target intelligence processing system of Blue in the night defense situation. The universal forward observer concept does not seem to offer an easy solution to the problem posed in the MARSAS games - particularly with Blue in the night defense against such a threat. There were numerous cases of multiple and identical targets detected simult-

aneously by several observers. Actual target reporting and calling for fires would have taxed even the most highly trained observers.

COMMENT: Saturation of the intelligence processing system appears to be a potential problem area with Model III. Field tests or experiments should be designed to measure the effects of various levels of threats on STA system responsiveness. Present doctrine calls for overlapping coverage between sensors. While this technique increases the probability of target detection it also leads to a greater volume of reports. Therefore, the extent of overlap should be evaluated with respect to the volume of reports the system can efficiently process. Overlapping coverage is not to be confused with duplicative coverage where two or more different type devices, such as a radar and a thermal viewer, cooperatively cover an area to aid in verifying the identification of a target.

(2) Given a Red mechanized offensive threat, the rapid closure rate on the Blue positions (20 kilometers in 5 hours) emphasized the need for rapid intelligence processing and operational decision making--in other words, a very responsive search and attack system.

COMMENT: The training establishment normally develops varied situations, varied threats to insure responsiveness under an array of conditions. Development of target intelligence over a period of hours rather than days puts great demands on the communications and intelligence processing systems. Realistic training and operational planning calls for varied scenarios based on realistic intelligence assessments. Training for MAU operations in low intensity conflict is based on a scenario quite different from MAF operations in a high intensity situation.

(3) The major role played by air in making early detections and attacks highlights the need to communicate directly - battalion with supporting air - to reduce intelligence processing and reaction time.

COMMENT: In rapidly breaking, fast moving situations procedures for calling in supporting fires may well differ from those followed under less exacting conditions. The procedures should be tested in advance and then instituted as needed.

c. S-2 Section. There was some feeling that the organization of the S-2 section would need reevaluation in event a Model III STA capability was given to the battalion.

COMMENT: This organizational question is better left to other means of analysis than war gaming. The S-2 section by itself is not staffed for 24-hour continuous operation of the type developed in the MARSAS games. An alternative concept (Army) envisages the use of a battlefield information control center (BICC) furnished by division to maneuver battalions to augment the organic battalion STA capability.

d. Excessive Radar Range. The question arises with Model III concerning the mismatch between STA and organic weapons range capability. STA capability extends to 10 kilometers, but organic fire capability extends only to 6 kilometers, considering the improved 81mm mortar. Is there too much search and too little attack capability provided to the battalion? There was a feeling that such was probably the case.

COMMENT: The issue of STA capability for a battalion must be considered in a system context. Organic weapon range by itself should not necessarily set the limit of STA capability. Other weapons with greater ranges, while not organic to the battalion, are available to support the battalion and should be considered when developing the structure, doctrine and method of employment for the battalion.

e. Fire Support. Increased search capability, resulting in more target detections, should call for an increase in supporting arms fires - naval gunfire, artillery, mortars. Planning factors should take into account this probable increase in ammunition expenditures. Also, the type of fire - VT or PD - will vary with the estimated threat, and should be included in basic load considerations.

COMMENT: Introduction of change in one element of the combat system may well introduce change in other elements as well. It would seem that ammunition planning factors based to some extent on STA capability are changed when the latter is changed. Model III allows for earlier detection at greater range than heretofore, and implies greater employment of supporting arms than heretofore.

f. Use of Illumination. The effect of Blue illumination flares on Blue STA equipment performance, particularly in Model III, must be fully appreciated by commanders at all echelons.

COMMENT: The effects of all environmental conditions on STA equipment must be appreciated by users at all levels. Careful indoctrination, training, and testing is needed to establish sound standing operating procedures. Obviously a well designed development test program is essential to establish a firm data base for performance characteristics. Development of a night visibility plan is essential, coordinating the use of all night vision aids, illumination means and surveillance devices. The plan reflects the commander's concept of how and when these various aids are to be used. A major consideration in the use of illumination is its impact on friendly unit viewing devices. Employment of illumination (type, means, degree, area) is a command decision, taken in accordance with the night visibility plan.

g. Ancillary Equipment. The addition of sophisticated Model III equipment highlights the importance of providing sufficient ancillary equipment to the STA operators - e.g. binoculars, communications wire, tactical maps of 1:25,000 scale.

COMMENT: Obviously the introduction of STA equipment of the sophisti-

cation of Model III highlights the need for supporting equipment to develop full system capability.

3. Existing Problems. This set of insights concerns problems existing today that were highlighted in the MARSAS games.

a. Counter Mortar/Counter Battery. Red rocket and artillery capability highlighted the need for a responsive countermortar, counter-battery system capability.

COMMENT: Given the situations confronting a MAU in the MARSAS games, the need for countering enemy indirect fires quickly and accurately was quite apparent. See also Section VI, Findings.

b. Mechanized Threat. The Red mechanized threat highlighted the need for antimechanized fires - direct and indirect - as well as the need for aerial delivered mines and antimechanized ordnance.

COMMENT: Present development efforts are directed toward meeting this problem. Mechanized forces provide a serious threat to infantry forces unless the latter have a well-developed and integrated antimechanized capability.

c. Fire Support. There is a tradeoff involved in the range at which a target is attacked. In general, weapon effectiveness decreases as range increases. Commanders must understand well this tradeoff; otherwise, they may pay a heavy penalty in ammunition expended--particularly if targets are attacked beyond the maximum effective range of the weapon.

COMMENT: Agreed.

4. New Opportunities. Introduction of new equipment on the scale of Model III will require a comprehensive review of the entire combat system. Some initial insights on new opportunities follow.

a. PLRS. The PLRS system introduces a level of location accuracy which allows for extremely precise fire support planning, minimizes coordination problems inherent in passage-of-lines situations, enhances control in mobile situations (e.g., attack), and which increases control of patrols operating forward of the FEBA. Also, it may be feasible to eliminate fire coordination lines.

COMMENT: The full implications of a highly developed PLRS system should be understood and exploited by advance orientation and training, similar in this respect to the introduction of any new equipment into the system. With regard to fire coordination lines, it is felt there should be not change in the present doctrine. Fire control measures generally indicate areas for air, artillery, and naval gunfire to be employed without obtaining prior clearances to fire. PLRS does not change this need for free-fire zones.

b. Patrolling. The difference in STA capability between Models I and III also mean a difference in patrol patterns both in range and area of operations.

COMMENT: Current doctrine emphasizes fully integrated intelligence gathering plans. Systematic and continuous observation of large areas, of specific routes or avenues of approach, and of specific locations calls for careful selection of observation posts, listening posts, patrol routes, all coordinated with STA equipment coverage. For example radar area coverage, Model III, Blue night defense was five times greater than that of Model I. Such a radical change in STA equipment performance capability called for a reevaluation of the intelligence plan generated for Model I previously.

c. Wider Frontages. The STA capability represented by Model III should allow for wider defensive frontages as well as positioning of outpost lines farther forward.

COMMENT: Intelligence gathering means play an important role in the mobile defense or in economy of force operations. It would seem that wider frontages and greater depths should be employed when these intelligence means are dramatically changed, as in Model III. In other words, the battalion security area in the defense may well be extended.

5. Landing Force War Game Considerations. These insights address the rules and models used in the LFWG.

a. Open Game. An open game (rather than a closed game) would have allowed more opportunity to gain insights about tactics, techniques, and STA employment since it provides for participation, discussion, and assessment in open forum, minimizes the problem of communications from control to player group, and saves time.

COMMENT: An open game has advantages in that it saves time and is useful as a training or experimental tool. Its major disadvantage is in that it allows for perfect intelligence for all players, a major departure from "realistic" conditions. If time had allowed, an experimental game might well have been played initially prior to the one-sided games actually conducted.

b. Electronic Warfare. There is a need to examine the Red EW threat in some detail. It is probably more useful to the enemy when he is attacking rather than when he is defending. The limited play introduced in the Blue day defense situation was inconclusive regarding Blue performance degradation.

COMMENT: It is acknowledged that further development of EW rules for assessment is needed. Those introduced in the final MARSAS game were only a beginning. An EW environment must be accepted as the norm. What this means in terms of degradation of STA performance and combat effectiveness is a major area for further investigation.

c. Medical Evacuations. There was no attempt to play medical evacuations or to consider the various categories embraced by the term "casualty". Also there was no attempt to play the STA equipment maintenance and resupply system.

COMMENT: Game objectives and game design generated measures of effectiveness directed toward the search and attack aspects of Models I and III. For a number of reasons - time, resources available - it was felt that combat service support aspects would have to be minimized, without in any way suggesting that these functions are not important to the system as a whole. Gross casualties and ammunition resupply were in fact accounted for.