

2

AIR WAR COLLEGE

RESEARCH REPORT

THE MARINE CORPS ARTILLERY REGIMENT:
A STRUCTURE FOR THE 1990'S

LT COL PHILIP E. HUGHES

DTIC
ELECTE
JAN 1 1 1989
S D & D

1988

AD-A202 205



AIR UNIVERSITY
UNITED STATES AIR FORCE
MAXWELL AIR FORCE BASE, ALABAMA

APPROVED FOR PUBLIC
RELEASE; DISTRIBUTION
UNLIMITED

89 1 09 282

AIR WAR COLLEGE
AIR UNIVERSITY

THE MARINE CORPS ARTILLERY REGIMENT:
A STRUCTURE FOR THE 1990's

by

Philip E. Hughes
Lieutenant Colonel, USMC

A RESEARCH REPORT SUBMITTED TO THE FACULTY
IN
FULFILLMENT OF THE RESEARCH
REQUIREMENT

Research Advisor: Colonel William H. Huffcut II

MAXWELL AIR FORCE BASE, ALABAMA

April, 1988

DISCLAIMER

This research report represents the views of the author and does not necessarily reflect the official position of the Air War College or the Department of the Air Force. In accordance with Air Force Regulation 110-8, it is not copyrighted, but is the property of the United States Government.

Loan copies of this document may be obtained through the interlibrary loan desk of Air University Library, Maxwell Air Force Base, Alabama 35112-5564 (telephone: (205) 293-7223 or AUTOVON 875-7223).

AIR WAR COLLEGE RESEARCH REPORT ABSTRACT

TITLE: The Marine Corps Artillery Regiment: A Structure for the 1990's

AUTHOR: Philip E. Hughes, Lieutenant Colonel, USMC

A brief discussion of the organization and requirements of Marine Corps artillery leads into a review of the history behind the adoption of the M198 155mm howitzer by the Marine Corps as its direct support artillery weapon system. The basis for the relatively recent return of the M101A1 105mm howitzer in a dual caliber role with the M198 in direct support units updates the historical picture to reflect the current artillery structure. An analysis of the present-day artillery structure in the Marine Corps is conducted with the conclusion that the structure should be modified to enhance the mobility of the artillery regiment, while increasing the artillery's ability to respond across the contingency spectrum. Specific recommendations address changes to both active and reserve artillery structures.



Accession For	
NTIS CRA&I	☒
DTIC TAB	☐
Unannounced	☐
Justification	
By	
Distribution /	
Availability Codes	
Dist	Avail and/or Special
A-1	

BIOGRAPHICAL SKETCH

Lieutenant Colonel Phil E. Hughes (M.B.A., University of Arkansas) is an artillery officer in the United States Marine Corps. He commanded an artillery battery supporting Battalion Landing Team 3/4 in 1975-76 and was an instructor and Branch Chief in the Gunnery Department of the United States Field Artillery School, Fort Sill, Oklahoma from 1980-82. His most recent artillery tour was as regimental operations officer for the 12th Marines in 1985-86. He attended Marine Corps Command and Staff College and is a graduate of the Air War College, class of 1988.

TABLE OF CONTENTS

CHAPTER		PAGE
	DISCLAIMER.....	ii
	ABSTRACT.....	iii
	BIOGRAPHICAL SKETCH.....	iv
I	INTRODUCTION.....	1
II	ORGANIZATION AND REQUIREMENTS.....	5
	Standard Tactical Missions.....	5
	Fire Missions.....	7
	Range Requirements.....	8
	Mobility.....	12
III	DEVELOPMENTAL ENVIRONMENT OF M198 STRUCTURE....	17
	External Environment.....	17
	Early 1970's--Low-to-Mid Intensity.....	18
	Late 1970's--Shift Toward Mid-to-High.....	18
	U.S. Army Influence.....	21
	Search for Optimal Weapon Mix.....	23
	MCDEC's Recommendation.....	29
	Final Adoption of M198.....	30
IV	RETURN OF THE M101A1.....	32
	Operational Mobility Problems.....	32
	M101A1 Decisions.....	32
	Current Structure.....	34
V	ANALYSIS OF CURRENT STRUCTURE.....	36
	Mobility.....	36
	Logistics.....	46
	Training.....	48
	Manpower.....	49
	Survivability.....	50
	Tactical Flexibility.....	52
VI	CONCLUSIONS.....	56
	Primacy of Mobility.....	57
	CH-53E Shortfall.....	59
	Strategic Airlift.....	60
	Ground Mobility and Survivability.....	61
	Mobility versus Firepower.....	62
	Future of MLRS.....	65
	Preparedness for All Contingencies.....	66
	Restructure Alternative.....	67
	Mobility Alternative.....	69
	Aggregate Firepower of the MAG1F.....	70
	M101A1 as Direct Support Weapon.....	71

TABLE OF CONTENTS (cont)

CHAPTER		PAGE
VII	RECOMMENDATIONS.....	74
	Direct Support Artillery.....	74
	General Support Artillery.....	78
	Reserves.....	80
	Conclusions.....	81
	BIBLIOGRAPHY.....	83

CHAPTER I

INTRODUCTION

In the late 1970's and early 1980's the Marine Corps made a series of decisions to both reorganize and re-equip the artillery regiment to enhance the firepower available to the division by replacing the 105mm howitzer M101A1 with the 155mm howitzer M198 as the direct support weapon of the Marine Corps. While the M198 howitzer provided a great deal more firepower, munitions selection, and range, it was significantly less mobile than the M101A1 it replaced; however, the lack of tactical mobility was considered to be only temporary since the fielding of the new CH-53Es would provide the helicopter lift required for the M198 during the amphibious assault.

The M198 was programmed to replace not only the M101A1 as the direct support weapon, but also the older 155mm howitzer M114A2 general support weapon. The reorganization plan involved the movement of a portion of the aging M114A2s to direct support organizations until the new multiple launch rocket system (MLRS) was fielded as a general support weapon. The MLRS would eventually replace the M198s in the general support battalion so that the M198s could then be used to retire the remaining M114A2s in the direct support battalions. An additional advantage of fielding the MLRS was that it would provide a

significant manpower savings, which could then be used to man other areas of the force structure.

Since the early phases of the M198 program, there have been significant changes in the planned fielding of both the CH-53E and MLRS. To fully support the combined lift requirements of both a Marine Expeditionary Force (MEF) and a Marine Expeditionary Brigade (MEB), a full six squadrons of CH-53Es would be required. (1:1) To fulfill Defense Guidance lift requirements, a total of nine squadrons would be needed, yet as recently as June 1987 only three squadrons of CH-53Es were operational. (1:1) Furthermore, no MLRS have been procured; indeed, the entire MLRS program "has been pushed to the out years due to the high costs of the system and the greater relative importance attached to other systems competing for procurement dollars." (28:4)

Since the initial decisions to incorporate the M198 into the direct support artillery, there has been a continuing series of studies, memorandums and decisions by Headquarters, Marine Corps regarding the retention of the M101A1. The return of the M101A1 was seen as a means of restoring the relative mobility that many senior leaders in the Marine Corps considered lost when the M198 was placed in service. Acknowledging this concern and recognizing the slow fielding of the CH 53E the Commandant made a decision in 1985 to return a total of 24 M101A1s to

each MEF for use in contingencies. The guidance provided at the time of the decision was that the weapons would be maintained for contingencies only, and not utilized for normal operations, such as Marine Expeditionary Unit (MEU) deployments. It was clearly emphasized that the M198 was the direct support weapon and the M101A1 was not intended to be a substitute except when absolutely required.

(15:2) In 1986 the Commandant modified the original guidance by increasing the number of M101A1s for each MEF to a total of 48 and stipulating that the 105mm would become part of the MEU artillery package. This would be accomplished by equipping each artillery battery assigned to a deploying Battalion Landing Team a mix of four 155mm howitzers (either M114A2 or M198) and four 105mm (M101A1) howitzers. (39:1)

As a result of the shift of the MLRS into the out years, the expected manpower savings did not materialize. Headquarters, Marine Corps is now studying a proposal to place the fourth battalion of each artillery regiment in cadre status in order to provide the infantry manning required for ground force structure enhancements. (28:4)

It is time for the Marine Corps to face the realities of fire support requirements and capabilities, as well as the fact that the CH-53E and MLRS programs are failing to meet original expectations. The Marine Corps should return the M101A1 as the principal direct

support artillery weapon of the artillery regiment to ensure that adequate mobility and tactical flexibility is available for heliborne contingencies during amphibious operational commitments. Additionally, with the relative decrease in firepower and range within the direct support battalions due to the return of the M101A1 the fourth and fifth battalions should be reorganized and equipped with the M198 as 3 batteries of eight howitzers each (3X8) to meet the demand for readily available augmenting fires from strategically mobile general support artillery.

CHAPTER II

ORGANIZATION AND REQUIREMENTS

The command and control of artillery is normally established through the assignment by the force commander of one of four standard field artillery tactical missions for each of the artillery units. (8:17) It is this assignment process that determines if a unit is performing a direct support, reinforcing, general support, or general support-reinforcing mission. Certain limitations (communications equipment and/or range capability in most instances) may have a major impact on a unit's capability to provide the required support at any given time; however, for the purposes of this paper a general description of each mission type will adequately serve to identify the scope of the requirements.

STANDARD TACTICAL MISSIONS

Direct Support

The direct support mission requires immediate responsiveness to the fire support requests of the supported unit. This mission is normally assigned to an artillery battalion supporting an infantry regiment. In order to accomplish this mission the artillery unit:

provides close and continuous fires in support of amphibious assaults, subsequent operations ashore, and specialized operations by destroying, neutralizing, or suppressing targets that constitute a serious threat to the supported maneuver units...provides additional depth to the battlefield

by attacking and degrading enemy forces beyond the range of direct fire weapons. (62:3-1)

The zone of fire for the artillery unit is the same as the zone of action for the supported unit. (8:17) This is the most decentralized of all artillery tactical missions. (8:17)

Reinforcing

Should an artillery unit require augmenting fires, the force commander could meet the requirement by assigning another artillery unit to reinforce. Several units could provide reinforcement to a single artillery unit; however, each reinforcing unit would reinforce only a single unit. The reinforcing unit would be assigned the same zone of fire as the reinforced unit.

General Support

The role of the general support unit is to provide immediate, responsive fires to the force as a whole. In the case of the artillery regiment, those units assigned general support missions would provide fires as directed by the division commander. The zone of fire would be the zone of action for the division and the fires would normally be controlled by the artillery regiment since general support artillery has no direct communications link to maneuver units; this is the most centralized artillery mission.

General Support-Reinforcing

The general support-reinforcing mission requires the artillery unit to provide fires to the entire force as its most immediate priority, while reinforcing the fires of another unit as a second priority. While the artillery regiment normally controls the general support fires of these units, a special communications link would be established between this unit and the unit being reinforced in order to provide the necessary communications for the reinforcing role. The zone of fire for the general support-reinforcing artillery unit would be the zone of action for the entire force, which would normally include the zone of fire for the reinforced unit.

FIRE MISSIONS

There are many different types of fire missions that may be required from artillery resources regardless of the assigned tactical mission. Close support of the maneuver force, counterbattery, interdiction, and suppression of enemy air defenses (SEAD) comprise the majority of possible requests that the artillery would be called upon to fulfill during normal combat operations. There is no clear dividing line between the various types of fire missions and the tactical mission responsible; however, there are certain generalities that can be identified. Close support fires are the responsibility of the direct support unit, although augmentation may be

required from either reinforcing or general support-reinforcing units to adequately fill the requirement. Counterbattery is a concern of all artillery units and could be conducted by any unit depending upon the nature of the threat. While counterbattery fires may be fired by any unit, the conduct of such missions by direct support units would affect the fulfillment of requested support by the maneuver forces. If possible, an artillery unit assigned a tactical mission other than direct support is the preferred alternative for conducting counterfires. Interdiction is normally a responsibility of general support or general support-reinforcing artillery due to the nature and location of the interdiction target. "Interdiction fires add depth to the battlefield and create opportunities for maneuver as they attack second echelon forces; command, control, and coordination activities; logistics facilities; and communications systems." (62:3-2) Suppression of Enemy Air Defense (SEAD) responsibility lies with all artillery units depending upon the location of the target and the number and location of SEAD targets within the zone of fire.

RANGE REQUIREMENTS

At maximum ranges the artillery would be engaging armor and mechanized targets, hostile artillery, and other high priority targets. Laser guided projectiles, dual

purpose munitions, and artillery delivered mines would provide the means to successfully engage these targets by attacking moving columns or forcing columns to slow down significantly to either clear minefields or detour around these formidable obstacles. Regardless of range all artillery assets would be called upon to fire smoke screens, conduct counterbattery missions, and provide SEAD missions in support of friendly air strikes. At closer ranges the artillery would engage dismounted infantry, fire smoke screens, and conduct illumination missions, among others.

There is no question that greater range capability is an asset to the artillery; however, the trade off between mobility of the artillery weapon and the range of the weapon forces a compromise between the two; generally, the greater the range capability, the heavier (less mobile) the weapon. Some estimates of the required range for an artillery weapon can be made based upon the principal tactical mission that the weapon will be assigned. In the Marine Corps each artillery regiment has three battalions assigned as direct support units which may be temporarily assigned other tactical missions based upon the desires of the force commander. Given the principal requirement of direct support to provide immediate, responsive fires to the supported maneuver force one study has identified a range requirement of

15,000 meters for direct support artillery. (61:8) This is the historically accepted requirement based upon the weaponry of both the Marine Corps and the Army with the M101A1 and the M102 105mm howitzers, respectively. The Army's M102 has a range only slightly greater than the Marine Corps' M101A1: i.e., 11,500 meters versus 11,000 meters conventionally and 15,000 meters versus 14,500 meters with rocket-assisted projectiles (RAP). (65:2-3) The range of 15,000 meters is comparable to the so-called "area of influence" for the infantry regiment. The supported commander does not have the acquisition means readily available to identify targets and/or influence the battle beyond this distance.

For the two general support battalions of the Marine Corps artillery regiment and for the role of either general support-reinforcing or general support, a greater range is required to engage targets at the greatest possible distance from the Forward Edge of the Battle Area (FEBA) and thus attrite the threat as much as possible prior to his arrival within the regimental "area of influence." A requirement for 30,000 meters in range is considered critical for these tactical missions with one artillery study stating the desire for force artillery [considered to be 155mm and 8-in self-propelled howitzers] to have ranges of 40,000 meters. (61:8)

Counterbattery fires place the greatest range requirement on the artillery due to the range advantage held by most of the threat artillery weapons. For example Soviet 122mm howitzers have a conventional range of 15,300 meters (21,900 meters with RAP). 152mm howitzers have a conventional range of 18,000 meters (30,000 with RAP). (62:I-11) In comparison the 105mm howitzer M101A1 has a conventional range of only 11,000 meters (14,500 with RAP). The older 155mm howitzer M114A2 has a maximum conventional range of only 14,600 meters (19,700 with RAP). (62:F-7) The 155mm self-propelled howitzer M109A3 has a maximum conventional range of 18,100 (23,500 with RAP). (62:F-9) Even the 8-inch howitzer M110A2 has a conventional range of only 22,900 meters (30,000 with RAP). (62:F-11) The relatively new 155mm howitzer M198 provides a weapon with a conventional range of 18,100 meters (30,000 meters with RAP). (65:2-3) Excluding the self-propelled howitzers and the M198, the Soviets have a significant range advantage in a gun to gun match-up.

It is apparent that the weapons currently available to the artillery only marginally attain the commonly accepted range requirements. The traditional Marine Corps perception regarding this shortfall in the maximum artillery ranges is that in many cases it is covered by the availability of close air support within the Marine Air-Ground Task Force (MAGTF). (53:46-53)

In reality, with the exception of counterbattery fires, the range capabilities are not as critical as the ability to deliver a variety of effective ammunition at a rapid enough rate to effectively counter the advance of the threat force.

MOBILITY

The Marine Corps takes pride in its reputation of being the nation's "force in readiness." The Commandant recently said:

Our forte is preparedness. We must be mentally and physically prepared at anytime to go by air, to go by sea, and to do it right. It is the aggregate usefulness of our Corps to the Nation and to the free world that counts. (22:18)

The Marine Corps must be prepared for any contingency that may require response by rapid deployment to worldwide trouble areas and to deal with the full spectrum of military threat from light infantry to mechanized/armor ground forces. This contingency requirement demands both strategic and tactical mobility from Marine Corps weapons systems, while at the same time requiring a substantial amount of aggregate firepower from the force as a whole.

A viable amphibious warfare capability is, in essence, an economy of force measure, which uses mobile, extremely capable, relatively small forces which can be moved quickly to any spot in the world where military force might be required. (68:1)

The amphibious nature of the Marine Corps dictates that its forces be structured based upon the absolute necessity of winning the amphibious assault.

The Marine Corps is inexorably linked to the Navy for strategic mobility; however, the Corps must maintain the capability to deploy at least in part by strategic airlift, if required.

Amphibious Assaults

Mobility during the amphibious assault is a critical requirement for both combat and combat support assets of the MAGTF.

A MAF requires the capability to land the assault elements of two RLT's by vertical envelopment over a distance of up to fifty miles from the launching area while landing one RLT in a complementary surface assault across the beach. The helicopterborne RLT's are to be ashore by L+90 minutes and the surfaceborne RLT by H+45 minutes. Conversely, the MAF should have the capability with maximum use of amphibious vehicles and landing craft to land two RLT's by surface and one by air. (67:33)

However, the mission area analysis for indirect fire support recently completed at Quantico identified a less demanding standard for amphibious surface assaults. The stated requirement was to land an artillery battery "debarked from amphibious shipping in a transport area no more than 20 miles from designated landing beach" on-call using a mix of LCM-8, LCU, and LCAC assets within a 4 hour timeframe. (62:G-25)

Heliborne Assaults

The mission area analysis also stated a relaxed requirement for heliborne assaults in that batteries "embarked aboard amphibious shipping at a distance of 25 miles...[were] to be delivered to the preselected landing zone within a 5-mile radius of the beach 30 minutes or less from time of launch." (62:6-27)

MEU (SOC)

With the advent of the Marine Expeditionary Unit (Special Operations Capable)--MEU (SOC)--mobility for the artillery becomes even more critical. Some of the missions of the MEU (SOC) involving artillery capabilities include:

- Commitment as an advanced force of a larger, follow-on MAGTF.

- Conduct of amphibious raids.

- Reinforcing role by surface or airlift. (34:69)

A recent article on MEU (SOC) highlighted some of the expectations and requirements for the artillery battery assigned to the MEU to be the flexibility to conduct artillery raids and support long-range helicopter operations. (34:69) Still another example of the expectations for artillery mobility can be seen in the following statement:

- Ambitious standards have been set for the MAU in the conduct of amphibious raids. The goal for the unit is to be able to conduct three simultaneous company-sized raids by air assault, surface assault, or a combination of the two....(34:70)

Ground

The capability of traversing all types of terrain and soil is an extremely important aspect of artillery employment and the ability of the artillery unit to match the mobility of the supported force either by fires or physical displacement is a critical requirement.

Strategic Lift

Strategic mobility of the combat support assets of the Marine Corps is essential to the ability of the Corps to remain a responsive "force in readiness." While the advent of geo-prepositioning in Norway and the Maritime Pre-positioned Ship (MPS) programs have significantly reduced the overall requirement for strategic lift, they are dependent upon the unopposed offload of equipment and/or the airlift of personnel to form operational units. The necessity to rapidly respond in contingencies that require combat units to be airlifted to various points of entry, as well as the requirement to maintain the capability to reinforce or augment previously deployed MAGTF's in a timely manner forces the Marine Corps to maximize its strategic mobility. Combat equipment that is limited by either size or weight to only one type of airplane for its strategic mobility is not going to be readily available to the operational forces in times of crisis when strategic lift aircraft sorties allocated to the Marine Corps will be extremely limited.

With this background information on artillery tactical missions coupled with the requirements for both range and mobility the stage is set for examining the development of the current artillery structure.

CHAPTER III

DEVELOPMENTAL ENVIRONMENT OF M198 STRUCTURE

The United States Army has the primary responsibility for developing both artillery doctrine and weapons for U.S. ground forces. Marine Corps artillery equipment, doctrine, and tactics normally follow Army developments unless they are incompatible with the amphibious mission. In order to more fully appreciate the decision-making environment within which the artillery structure of the Marine Corps was modified to accept the M198, a review of the studies and decisions contributing to the current artillery structure is in order.

EXTERNAL ENVIRONMENT

In retrospect it appears that the Marine Corps artillery structure adopted during the late 1970's and early 1980's that incorporated the newly developed M198 155mm howitzer as a direct support weapon resulted from a number of factors, most notably the overriding concern of both the Army and Congress regarding the European threat environment. Studies such as the Brookings Institute's, Where Does the Marine Corps Go from Here? (4:--) and the Congressional Budget Office's, The Marine Corps in the 1980's: Prestocking Proposals, the Rapid Deployment Force, and Other Issues, (54:--) were extremely critical of the overall force structure of the Marine Corps and were highly publicized examples of the

widespread concern of military analysts regarding the Marine Corps' capability to fight and win in a European (NATO) environment.

EARLY 1970's--LOW-TO-MID INTENSITY

The force structure of the Marine Corps in 1976 had been shaped by the recommendations of the Armstrong Board of 1969. (67:1) That Board found "the Marine Corps should be oriented towards the mid and low intensity conflict considered most probable." (67:1) Furthermore, the Board felt that the forte of the Fleet Marine Force (FMF) should be "the performance of acts of immediacy by amphibious forces." (67:1) In other words a requirement existed for deployed Marine units to maintain flexibility [mobility] in the performance of the various responses that might be necessary during rapidly developing contingencies.

LATE 1970's--SHIFT TOWARD MID-TO-HIGH INTENSITY

In March 1976 a Marine Corps study group headed by Major General Fred Haynes published the results of an effort to "study...the Marine Corps' mission and peacetime force structure in the mid-range period." (24:1) The study group outlined the threat as follows:

the USSR and its Warsaw Pact allies remain the greatest threat....United States reluctance to employ land forces for combat in Asia, Africa, and Latin America will likely persist. The probability that United States forces will be engaged in the Middle East and Persian Gulf areas will remain comparatively high." (67:1v)

It went on to more clearly define the expected threat capability: "the enemy most probably will be a mobile armored force of combined arms capable of employing effectively an array of sophisticated weapon systems."
(67:204)

The Haynes study group arrived at a consensus that:

...a reorientation away from low intensity combat in Asia and other less developed countries to other more critical areas of national interest is in the long term interest of the Marine Corps.

The future of the Marine Corps depends upon its capability to conduct amphibious operations and subsequent operations ashore in a mid-to-high intensity conflict. (67:1)

The study group found that the:

mission of direct support artillery is designed to focus the fires of the artillery unit almost exclusively on the fire requirements of the supported units. There is need for rapid reaction and fast rates of fire, a mobility equal to the supported units and a range capability which not only permits attacking deep targets, but also to mass across wide fronts. The 105mm system fits these requirements adequately. (67:210)

At the time of this study the 105mm system addressed in the above quote described the structure of the direct support battalion. Each of these battalions had three M101A1 105mm batteries and one M114A2 155mm battery. (67:205)

Regarding the mobility of artillery, the 105mm weapon was judged to be superior to the 155mm weapon, "especially when helicopter lift is considered." (67:211)

The relative mobility of the M198 using the CH-53E was recognized as a concern in that the "helicopter lift [of the M198] will be constrained because it will be limited to the CH-53E whose population in the force will be quite small." (67:211)

The group identified the necessity of correcting deficiencies in the artillery's capability of supporting the division as a whole by recommending the addition of an entire general support battalion to the artillery regiment. (67:212) Additional recommendations addressed three possible alternatives for restructuring the Marine Corps towards two divisions equipped for high intensity conflict, while one division remained equipped for low intensity contingencies. (67:vii-xi)

While the recommendations of the Haynes group were not fully implemented, their finding that "the probability of US military intervention will diminish, but warfare itself will be of a higher intensity" (67:xvii) was representative of the military thinking at the time.

It was within this context that the Marine Corps made the initial decision in July 1976 to replace its aging M114A2 155mm general support [one battery was in each direct support battalion also] howitzer in both active and reserve units with the new M198 155mm howitzer. (52:1) While this decision was based to a large extent on the fact that the M114A2 was nearing the end of its

service life and the M198 provided a considerable range advantage; there is little doubt that this decision also was looked upon as addressing the perception that the Marine Corps lacked adequate ground firepower given the nature of the Warsaw Pact threat.

The fact that the Marine Corps normally follows the developmental lead of the U.S. Army played an inordinately large part in the decisions being made by the Marine Corps during this time frame.

U.S. ARMY INFLUENCE

In August 1977 the U.S. Army published a study entitled, Field Artillery Organization and System Requirements, 1981-1986 (Short title: Legal Mix V) for the purpose of determining:

...the preferred mix of the field artillery system for ...a light division slice....Specifically, the study was to determine the numbers and types of field artillery units,...and the major systems they employ to provide adequate...fire support to sustain division-level combat operations. (58:xv)

"Legal Mix V" was based upon "mid-intensity combat conditions utilizing current equipment...for US Forces and Warsaw Pact Forces" (58:xv) within a conventional Central European scenario. The study's conclusions were instrumental in the M198 155mm howitzer replacing the M102 105mm howitzer in the Army's infantry division. Airborne and airmobile divisions were considered to be "special cases" and fell outside the scope of the study. (58:1-2) The M198 was found to be "both more effective and cost

effective" (58: xxiii) than the 105mm weapon and the report concluded that "The 155mm, M198 howitzer is the best direct support weapon for the light division."

(58:xxv) One of the specific recommendations of "Legal Mix V" was that "The division artillery supporting infantry divisions should be reorganized to contain three each 155mm M198 direct support battalions...." (58:xxvii) It also recommended that they should be organized as three batteries of six weapons each. (58:2-11)

The analysis pointed out that in terms of strategic transportability the 155mm M198 was preferred over the 155mm M109A1 self-propelled howitzer due to the latter's dependency upon the C-5 for strategic lift. (58:E-IV-15)

"Legal Mix V" considered a variety of caliber mixes and organizations and found that "the composite 105/155mm direct support battalion was neither as operationally effective nor as cost effective as the 155mm direct support battalion. (58:xxiii) While the variety of mixes considered included eight weapon batteries, the findings and recommendations were to provide eight gun batteries to the general support M198 battalions of the "heavy" division, not the "light" division. [The term "light" in this context is used to identify the Army's standard infantry division in the late 1970's, not the current "Light Infantry Division" concept.]

As a result of "Legal Mix V" the Army re-equipped the field artillery for the infantry division to replace the six gun M102 105mm howitzer battery with a six gun M198 155mm howitzer battery.

Both the Haynes study group and "Legal Mix V" portrayed a threat within the NATO and Central Europe context that was significantly different from that upon which the Corps had been structured prior to these studies. It was in this Central European/Warsaw Pact threat atmosphere in 1978 that the Marine Corps modified the original M198 decision and expanded the fielding of the weapon as a replacement for the aging 155mm M114A2 general support weapon to include replacing the 105mm M101A1 howitzer as the direct support weapon in the 1st and 2d Marine Divisions. The 3d Division would retain the 105mm howitzers. (52:1)

SEARCH FOR OPTIMAL WEAPON MIX

Two years later the Marine Corps Development Center at Quantico initiated the Marine Corps Artillery Force Structure Analysis. This analysis was conducted in order to determine "the best mix of a given number of weapons to best perform the wide variety of Marine Corps missions." (65:1) The environment in which the study was made can be seen in the following:

Current programming plans are to replace all current 105mm (M101A1) and 155mm (M114A2) howitzers with the

M198 howitzer in the direct support (DS) battalions of the 10th and 11th Marine Regiments, and to replace all M114A2 howitzers in the 12th Marine Regiment with the M198 howitzers. The analysis in this study was specifically directed toward developing and evaluating alternatives which might supplement the M198 howitzers in DS artillery battalions. (65:i)

The analysis considered a total of eleven options using M101A1s, M114A2s, and M198s in various mixes. The base case was the then current structure with M101A1 direct support battalions, each of which had a battery of M114A2s. The scenario used to conduct the study was based upon anticipated employments. Both I and II MAF were evaluated using Jutland, while III MAF was evaluated based upon Korea. (65:8-23)

The recommendation of the analysis was to retain 90 M101A1s, eliminate all of the M114A2s, and add 126 new 155mm M198 howitzers. (65:iii) These weapons would have been organized into single-caliber direct support battalions. Two battalions of four batteries each equipped with six M198s and one battalion of four batteries with six M101A1s each. This recommendation was actually an interim step based upon several criteria within the analysis, such as the limited availability of the CH-53E and the stated requirement for adequate mobility to allow the landing of two-thirds of the assault force by air during an amphibious assault. The study found that to deliver two battalions of artillery to landing zones during an amphibious assault would take

between six to ten hours; (65:7-8, 7-9, 7-10) however, the final report concluded with the finding that the "ultimate force structure goal should be to have only M198 howitzers in the DS battalions." (65:iii)

The study pointed out the ramifications of the U.S. Army's decision to equip its infantry units with the M198 in direct support, replacing both the M102 105mm and the M114A2 155mm howitzers. These ramifications were significant to a Marine Corps artillery community traditionally tied to the Army. Two critical aspects of the Army's decision to equip its infantry divisions with the M198 were that (1) Army funded research and development for 105mm ammunition was being eliminated (65:2-28) and, (2) due to the lack of Army participation the end of service lives for both the M101A1 (1990) and the M114A2 (1986) were thought to be unavoidable. (65:2-15) As pointed out in the "Legal Mix V" discussion the U.S. Army retained their lightweight 105mm howitzer (M102) in the airborne and airmobile divisions due to the need for both tactical and strategic mobility. This apparently was not a factor in the Marine Corps decision regarding the fate of the M101A1 [at least no discussion of the matter is contained in any of the historical studies included in this paper].

The study group used ten separate indicators each of which was given a value between one and ten for each of

the options. While no weighting factors were assigned to each indicator the study pointed out "that certain characteristics are manifested indirectly in more than one indicator, e.g. performance capabilities and maximum force firepower." (65:8-4) The indicators used were: transportability, versatility, performance, training/support, costs, future support, MAGTF supportability, firepower at H+2 1/2, firepower at H+5, and firepower at Maximum. (65:8-27)

Before the analysis and recommendations of this study could be finalized the Commandant directed that a Corps-wide analysis be conducted to determine optimal levels of combat power. (66:ES-1) The recommendations of this inclusive study were published in December 1980. The threat basis for this analytical effort was that of a Soviet-styled enemy in the Persian Gulf, Middle East, or Central/South America, with the caveat that consideration of other possibilities would not be excluded. (66:ES-6)

The study evaluated only four different options including the then current organization as the base case. This base case was three direct support battalions each comprised of three M101A1 105mm howitzer batteries, and a battery of M114A2 155mm howitzers. The base case regiment also had two general support battalions, one of which had three batteries of M109A1 155mm self-propelled howitzers. The remaining general support battalion had three

batteries of M110A1 8-inch self-propelled howitzers.

(66:II-24) The other three options were evaluated using combinations of M198s, M109A1 155mm self-propelled howitzers, M110A1 203mm self-propelled howitzers, and 230mm multiple launch rocket systems.

This analysis recommended that all 105mm howitzers should be replaced with the M198 and that the M114A2 should be retained for mobility while implementing the addition of the M198 to the artillery structure. There would be two direct support battalions each of which would have three eight gun batteries of M198s, while the third direct support battalion would have three eight gun batteries of M114A2s. (66:ES-9) Two general support battalions would remain, one of which would be equipped with three six gun batteries of M198s. The other would be a composite battalion made up of three six gun batteries of M109A1 155mm self-propelled howitzers, and two six gun batteries of M110A1 203mm self-propelled howitzers.

(66:ES-9) This recommendation was made in spite of the relatively limiting end of service life expectancy [1986] of the M114A2 identified in the earlier Development Center study and was a result of the firepower advantage of the 155mm over the 105mm howitzers.

The recommendation for retaining a battalion of M114A2s was based upon the expected procurement of the Multiple Launch Rocket System (MLRS) for General Support

Rocket System in Marine Corps nomenclature] that would replace the general support battalion of M198s. The replaced M198s would then go toward replacing the M114A2s being used for direct support. (66:II-29)

The conclusion that the optimal direct support artillery battalion should have three batteries of eight weapons organized into two firing platoons of four weapons each was based on a need for increased survivability. (66:II-36) This would permit a total of six firing positions for the direct support battalion, result in more firepower and potentially allow the engagement of more targets. It would also be more difficult for the Soviets to locate and engage the larger number of firing units. (66:II-36)

While recommending the replacement of the M101A1 105mm with the M198 155mm howitzer, the study pointed out that the best option in terms of strategic mobility and logistical supportability included the 105mm howitzer. (66:II-50)

Another conclusion of the study was that, compared to the M198 the then current organization of 105mm howitzers offered less firepower and area coverage; however, it also required fewer Marines to operate and represented less weight and square footage to transport than any of the other options. (66:II-50)

The adoption of the M198 as the direct support weapon of the Marine Corps, together with the recommendations to increase the number of general support weapons, resulted in an increase in the total number of howitzers in the Marine Corps from 276 to 360. (66:ES-27) The manpower ramifications of this increase were that eleven men were required to crew an M198 versus seven for the M101A1. The end result of these changes, when consolidated with the previously adopted addition of a Target Acquisition Battery in each artillery regiment, was at least partially responsible for the cadre of three 916-man infantry battalions. (66:ES-27)

In arriving at the above conclusions and recommendations the study used a weighted value and ranking system. The weights used in evaluating the various options were: firepower-.267, tactical mobility-.130, survivability-.160, maneuver-.109, area coverage-.080, command, control, and communication-.074, strategic mobility-.061, logistics support-.05, manpower requirements-.039, and other-.030. (66:C-13)

MCDEC'S RECOMMENDATION

Because of the divergent conclusions of the artillery structure analysis and the overall force structure study the Commandant directed the Marine Corps Development and Education Command (MCDEC) to review both and make a recommendation for "artillery force structure

alternatives to provide flexible and responsible artillery fire support to the ground commander." (11:1)

MCDEC's recommendation in November 1980 essentially concurred in the overall force structure conclusions that for the near and mid-range period the artillery regiment should be structured with 66 M198s (two direct support battalions of 3X8 and one general support battalion of 3X6), 24 M114A2s (one direct support battalion of 3X8), 18 M109A1s (three general support batteries of six weapons each), 12 M110A2s (two general support batteries of six weapons each), and a Target Acquisition Battery. (11:2,3) For the long-term the Development Center recommended that the MLRS (27 launchers) be procured to replace the M198s in the general support battalion. (11:3) The M198s would then be used to replace the M114A2s in the direct support battalion. An additional six M198s would have to be procured for each regiment in order to outfit the direct support battalion with a full 24 weapons (3X8). MCDEC preferred the M114A2 weapon to the M101A1 because of its "greater range, lethality, and volume of fire, as well as greater variety in types of ammunition." (11:2)

FINAL ADOPTION OF THE M198

In April 1982 the Commandant and the Chief of Staff's Committee were briefed on the Development Center's structure proposals and the impending obsolescence of both

the M114A2 and the M101A1. The proposal to fully adopt the M198 was approved and was published to the field in July 1982. Additionally, the decision was made to mirror-image the reserve direct support battalions to those of the active force in FY87. (52:2) The consolidated Acquisition Decision Memorandum for the M198, which was signed in November 1983, detailed the acquisition history of the M198 and served as the documentation for the M198 acquisition program.

Program Objective Memorandum (POM)-1983 established the following artillery force structure: two direct support battalions of M198s (3X8) and one direct support battalion of either M101A1s or M114A2s (3X8); a general support battalion of 18 M198s would form the basis for the MLRS battalion when fielded. After the MLRS was fielded, the M198s would be moved to the third direct support battalion. Programming action would then be necessary to provide the additional M198s so that the third direct support battalion could organize into a 3X8 unit. (52:2)

CHAPTER IV

RETURN OF THE M101A1

After fielding an artillery force structure built upon the M198 the Marine Corps found itself confronted with artillery that provided a great deal more firepower, however, it was significantly heavier and larger. It also presented rather dramatic operational shortfalls in mobility that were not easily overcome.

OPERATIONAL MOBILITY PROBLEMS

The historical dilemma for artillery, as well as the Marine Corps has always been the trade-off between mobility and firepower. Stated another way: "...light enough to go where they must, yet heavy enough to win once committed." (55:5) This was the greatest shortfall of the M198 howitzer from the Marine Corps perspective. The M198's major disadvantage was that it lacked the tactical mobility of the M101A1, which significantly reduced the operational flexibility of the commander. The lack of mobility within direct support artillery created significant problems for the operational forces.

M101A1 DECISIONS

As the operational forces identified the mobility deficiencies of the M198, Headquarters, Marine Corps took corrective action. In February 1985 a Decision Memorandum was approved by the Commandant authorizing the retention of 24 105mm howitzers per Marine Expeditionary Force as an

additional weapon for operational contingencies. (15:2)

The memorandum pointed out that "There is a deficiency in the capability to air lift artillery until additional CH-53E helicopters have been fielded." (15:2) It went on to state that "The 155mm howitzer is the Marine Corps' direct support weapon, and the 105m howitzer should not be considered as a substitute for normal operations, such as MAU deployments." (15:2) Each MEF would be authorized 90 days of ammunition (DOA) and the retention period would terminate at the end of 1987. (15:3)

Problems encountered within the units deploying as part of Landing Force Sixth Fleet (LFSF) directly reflected the increase in size and weight of the M198 and its prime mover over the M101A1. Due to the restricted space available on amphibious shipping, various combinations of ships, weapons, and vehicles were attempted. Most importantly, attempting to match helicopters and howitzers resulted in the 3d Battalion, 10th Marines going through several reorganizations of M198s, M114s, and M101A1s in order to provide the expected mobility for the deploying artillery units. (19:26) As an example of the difficulty that the artillery community was having trying to support the MEUs, an article written in June 1986 revealed the fact that of the "last three batteries to deploy with LFSF, one was a six-gun M114 battery,...one was an eight-gun M114 battery,...and one

was a composite battery of six M198s and four M101A1s...."

(19:26)

In August 1986 the Commandant reaffirmed his decision regarding the M198 structure for the artillery regiment; however, he also altered the policy established in February 1985 regarding the retention and use of the M101A1 howitzer. Due to the continued mobility shortfalls encountered by deploying units he made the decision to configure Marine Expeditionary Units with an artillery battery of four 105mm howitzers and four 155 howitzers.

(39:1) The Commandant also made the M101A1 retention issue an agenda item to be discussed at the next General Officer's Symposium.

Following the Symposium the Marine Corps announced the decision to increase the number of M101A1s to 48 per MEF (total of 144) by the close of FY90 with 15 days of ammunition at a cost of approximately \$13,803,000 for weapon refurbishment and ammunition rework. (36:2)

CURRENT STRUCTURE

There have been few changes in the 1982 decision regarding the M198 artillery structure with the exception of the return of 48 M101A1 howitzers per MEF as a contingency package and that four M101A1s are now part of the MEU artillery package. The POM-1987 artillery regiment was made up of a Headquarters Battery, Target Acquisition Battery, and three direct support battalions.

each of which had three eight gun M198 batteries. In addition there were two general support battations, one of which was made up of three batteries of six M198s each. The other battalion was comprised of three batteries of six M109A3 155mm self-propelled howitzers and two batteries of six M110A2 8-inch self-propelled howitzers. (8:19) At present due to the fact that no MLRS was fielded as originally expected and has therefore not replaced the M198s in the fourth battalions that were to be released to direct support units, there is an M114A2 battery in each direct support battalion in both 10th and 11th Marines. 12th Marines direct support units are made up entirely of M198s.

CHAPTER V

ANALYSIS OF CURRENT STRUCTURE

The M198 is currently the principal direct support weapon; however, the number of M101A1s being retained for contingencies has increased from 24 to 48 and they are being integrated into MEU deployments with major implications for mobility, logistics, training, manpower, survivability, and tactical flexibility.

MOBILITY

The trade-off between mobility and capability is a continuing dilemma, even though the pendulum did swing in favor of capability during the period of concern regarding the Marine Corps' ability to fight in NATO. Part of the mobility problem can be explained by the following assessment:

Because of slipping delivery schedules and retardation in obligation authority, ships, planes, and helicopters are not yet in hand while the bulk of the new ground equipment has entered service. The dichotomy of "heavier" equipment such as HMMWV, M-198, M-1, M-923 lined up with the landing craft and helicopters of the previous generation has created an aura of discouragement and discontent over the program at large. (42:1)

The problem with the lack of mobility of the M198 clearly lies in the uncoordinated completion of various equipment and mobility-enhancing support programs over the past ten years; however, with the changing environment since the early 1980s the national concern is shifting towards conflict in the so-called Third World and low

Intensity Conflict (LIC). The pendulum appears to be swinging back in favor of mobility and can be seen by the decisions of the Marine Corps leadership to return the M101A1 to the artillery regiment as a contingency weapon and as a part of the artillery package for deploying artillery batteries assigned to MEUs.

Amphibious Assault

A study conducted in 1980 addressed the surface mobility difficulties of the M198 as follows:

It suffers a comparative loss of mobility (to the 105mm weapon) in two critical areas because of its increased size and weight. Carrying the weapon to the beach in landing craft involves more time and assets. Additionally, the need for an auxiliary mover to position the howitzers in the absence of their prime movers increases the time necessary to prepare the battery to fire. (35:33)

The M198 requires a Landing Craft Utility (LCU) in an amphibious assault (65:3-4) since it cannot be tactically loaded with its prime mover on the LCM-8, the most prevalent landing craft available in the beach assault. The recently completed mission area analysis for indirect fire support found that only 75 per cent of an M198 howitzer battery could be landed within four hours of being called during an amphibious landing conducted 20 miles from the beach using Landing Craft Utility (LCU) assets. In order to meet a four hour requirement the movement ashore would have to be accomplished using the Landing Craft Air Cushion (LCAC). (62:6-25) The same analysis found that the M101A1 battery could meet the four

hour requirement using any combination of landing craft, including the LCM-8. (62:6-25)

The questionable portion of these figures lies in the basic requirement. As previously discussed a requirement was identified in the late 1970s for a surfaceborne RLT to be landed by H-45; however, the four hour requirement in the 1987 mission area analysis mentioned above presents a radically different set of standards. There is no readily available explanation for this divergence; however, one possible answer lies in the fact that the capability no longer exists to meet the more demanding requirement. Therefore, a more relaxed standard was established given the relative loss in overall mobility due to the lag in fielding helicopter and surface mobility assets.

Dependence upon LCUs for landing the heavy assets of the combat and combat support units reduces the Landing Force Commander's flexibility to land his combat power in the sequence and timelines he may desire. The introduction of the LCAC is hailed as the answer to the M198 dilemma by some individuals; however, only two M198s with prime movers can be carried by either an LCAC or an LCU. (62:I-15) In fact the M198 battery requires exactly twice the amount of surface lift than a battery of M101A1s. The M101A1 battery can be landed with either four LCM-8s, two LCUs, or two LCACs, while the M198

battery doubles this requirement. (62:1-16) The mission area analysis found that "there is inadequate capability for artillery units to conduct a surface assault landing from over-the-horizon [OTH]...[due to] lengthier transport time from ship-to-shore and increased turnaround time."

(62:1-15) In any case the additional time required by both the LCM-8 and the LCU compared to the LCAC due to their much slower speed is a major limitation for any surface assault. Comparatively the increased number of landing craft required for the M198 unit could result in a much longer delay for fire support to the assault force, than that provided by the M101A1 unit. Still another consideration with placing too much dependence upon the LCAC is that conceivably the Marines will encounter the same fielding problems with the LCAC program that were encountered with the CH-53E program, due to the significant cost of the LCAC and the declining level of defense spending. Any slowdown in the fielding schedule will reduce the number of LCACs available for use during the amphibious assault and will further reduce the flexibility of the commander to land his forces in the sequence he desires in the length of time he requires. There is no guarantee that the program goal for 90 LCACs will be met. The procurement objective of 90 is a result of the number required to support both a MEF and a MEB as required in the Defense Guidance; (63:1) however, the

fiscal austerity ramifications on future POMs bring into question the completion of many programs as presently scheduled.

The commander will also be confronted with the traditional dilemma of setting priorities for the equipment he desires ashore. Tanks, amphibious tractors, and engineers, among others will be competing with the artillery for the use of available assets (LCACs and LCUs).

Heliborne Assaults

During helicopter operations the M198 is transportable only by the largest and least available helicopter in the Marine inventory, the CH-53E. (65:3-11) The CH-53E is not yet available in the quantities necessary to provide adequate and timely helilift capability to the direct support artillery in an heliborne assault. The helicopter mobility of the M198 was found deficient in the mission area analysis due to the inability of eight CH-53Es to lift a battery of M198s and the equivalent of a day of ammunition (DOA) within the specified time limit of 30 minutes after launching from amphibious ships no more than 25 miles from the landing zone. The M101A1 requirement was met without difficulty, principally due to the fact that it is transportable by the CH-46E, CH-53D, and the CH-53F. (62:6-27) There are 10 CH-53 helicopters required to lift the weapons, crews,

and fire direction centers of an M198 battery. In comparison 13 CH-46E helicopters or 10 CH-53D helicopters could transport the equivalent equipment of an M101A1 unit. (62:I-18) These findings are more important for comparison of mobility between the two weapon systems than they are for specific time requirements. The importance of helicopter lift capability to the Marine Corps was pointed out in a study conducted in the mid-1960s that concluded with the recommendation that if Vertical Take Off and Landing (VTOL) capability was a requirement then a 105mm howitzer should be selected for direct support, if VTOL was not a requirement then a 155mm howitzer should be adopted. (61:19) In essence the study acknowledged the absolute requirement for artillery mobility in the Marine Corps, even at the expense of firepower capability. The currently accepted concept for conducting the amphibious assault is to land two-thirds of the assault force by helicopter. Still another aspect of helicopter lift is the M198s "inadequate capability to occupy position areas by helicopter and prepare to fire" due to the "size and weight of direct support artillery (M198)" and the fact that "movement of weapons is labor intensive, as is preparation of ammunition for firing." (62:I-14)

When the decision was made to restructure Marine Corps artillery with the M198, the planners were under the impression that the CH-53E was going to be fielded much

more rapidly and in far greater quantities than has actually occurred. The Department of the Navy (DON) Lift Study called for a requirement of six squadrons of 16 aircraft each to provide the lift for the assault echelons (AE) of a MEF and MEB. (1:1) With the advent of the Maritime Pre-positioned Ships (MPS) the requirement grew to nine squadrons of sixteen aircraft. By the end of Fiscal Year 1988 the Marines will still not have attained four squadrons of sixteen aircraft and is considering an interim objective compromise of six squadrons with only twelve aircraft each. (70:--) As recently as June 1987 there were only three operational squadrons of CH-53Es. (1:1) With such a significant shortfall in vertical lift capability, the mobility of the M198 is dramatically less than that envisioned by the force planners, with little basis for expecting the availability to increase rapidly in the future. At best, the Marine Corps plans to have four operational squadrons by the end of Fiscal Year 90; however, with the recent budget cuts even this goal may be overly ambitious. (49:46)

Ground

The evaluations of mobility that were incorporated into the various studies used in this analysis favored the M101A1 over the M198 in virtually every geographical area considered. The most recent study available, completed in 1986, found that the M923 [5-ton truck] towing the M101A1

was capable of negotiating much more terrain than when towing an M198. (7:44) This greater trafficability was for hard surfaces, dry sand, and mud typical of that found in Southern Norway, Korea, Iran, and El Salvador. (7:44) These reports confirm the expectation that the M101A1 would be superior to the M198 in mobility over various types of soil and terrain worldwide since both use the same 5-ton prime mover and the M101A1 weighs less than a third of the M198.

The factor of ground mobility is also important in that the sheer size and weight of the M198 combine to require the use of a MC4000 forklift to move the weapon around and position it within the battery position. This requirement significantly delays the speed of emplacement and the ability to rapidly prepare to fire from new positions.

Strategic Lift

The existence of land pre-positioning in Norway and Maritime Pre-positioned Ships has significantly reduced the Marine Corps' requirement for strategic airlift in times of crisis. When the M198 decisions were being made in response to challenges to the Marine Corps' capability to fight and win in the Warsaw Pact environment, neither of the pre-positioning programs were operational. In order to counter the projected threat, the only recourse was to re-configure the ground force

artillery structure. Both the Army and the Marine Corps responded to this need for increased range and firepower by adopting the M198 as the direct support weapon for the infantry division. While the Army retained the lightweight 105mm M102 howitzer as the direct support weapon for its airborne and airmobile divisions (58:1-2) the Marine Corps made no such provisions until deciding to return limited numbers of the M101A1 to the artillery regiment as contingency weapons.

The 105mm howitzer weighs significantly less and requires much less square footage to transport than any other artillery option. (66:11-50) An additional consideration lies in the fact that the number of weapons for each direct support battery increased from six to eight and "coupled with the M198's size and weight increases and the need for more trucks, the storage space aboard ship for these batteries has doubled over the six-gun M101A1 battery." (49:46) While this doubling of space would not hold true if the M101A1 battery was equipped with eight weapons the increased space requirement remains a major consideration given the relatively constrained limits of the MAGTF assault echelon footprint that drives the DoN lift model.

In terms of airlift requirements the eight gun M198 battery requires at least 20 per cent more C-130 lift than does a six gun battery of 105mm howitzers.

(66:11-15) Perhaps more importantly, a comparison of eight gun batteries requires 28 C-130s for an M101A1 unit and 29 sorties for the M198. The increase is more striking for C-141 lift requirements in that the M101A1 battery requires 13 sorties to the M198's 16. (62:I-13)

The M109A2/3 and the M110A2 self-propelled howitzers of the fifth battalion can be carried only by the C-5 aircraft, which significantly restricts their strategic mobility in time of conflict due to the numerous requirements that would be placed on these aircraft. (62:I-13) As was pointed out in the "Legal Mix V" study, the M198 was preferred by the Army over the M109A2/3 due to the latter's dependence upon the C-5 for strategic airlift. This dependency significantly reduces the reliability of having these weapons readily available during contingencies requiring their presence. The availability of these critical assets to the deployed force would be totally dependent upon the airlift priorities established by the Joint Chiefs of Staff and the theater Commander in Chief responsible for the conflict. Marine Corps self-propelled artillery would be competing for limited airlift assets with all Army and Air Force outsized cargo. The relatively few C-5 aircraft would be heavily tasked in any foreseeable contingency.

LOGISTICS

Logistically, the ammunition for the M198 is more burdensome than the M101A1 in that it is much heavier and larger. (32:57) The ammunition requirement for the M198 was one of the factors used for justifying an increase in the number of trucks for a direct support artillery battery. The sheer size and weight of the ammunition for the 155mm weapon system in terms of tonnage and cubic feet required to be lifted/transported severely tasks the organic capability of the direct support battery even with the increase in trucks. (62:6-12) The 155mm projectile weighs approximately 92 pounds and is 27 inches long without the propellant since it is a separate loading ammunition. (65:2-12) In contrast the 105mm projectile weighs 40 pounds and is 31 inches long including propellant since it is a semifixed ammunition. (65:2-12) This problem is made even worse for separate loading ammunition by the requirement that projectiles, fuzes, and propellants be separated. (62:6-12) An example of the weight problem is that a skid of eight 155mm projectiles in a normal shipping configuration weighs 814 pounds. (62:6-13) Due to the variety of projectiles available to the 155mm weapon system the resupply of ordnance for a M198 battery would be significantly more challenging than the resupply for a 105mm battery, although neither would be an easy task. In general the M198 battery, because of

its greatly increased range compared to the M101A1, will be capable of engaging targets that are normally not within the range capability of the smaller caliber weapon. As a result the potential for a much greater volume requirement for ammunition exists in addition to the size and weight considerations.

As a result of the decision to maintain dual caliber weapons (105mm and 155mm) within the direct support structure and to deploy MEUs with a mix of 155mm and 105mm howitzers in the artillery battery the L-form ammunition requirements for deploying MEUs, MEBs, and MEFs must be configured with a composite mix of ammunition.

(29:4) This requirement creates a significant problem with the deployed units concept of operations. Availability of ammunition for each caliber is approximately half of what would normally be available for a single caliber organization. The employment of the M101A1s in a highly maneuverable environment with high rates of fire coupled with the possible difficulty in landing the M198s could result in an imbalance of ammunition between the calibers. This would force the commander to alter the employment of his fire support for the force.

The retention and active employment of dual calibers within the artillery battalions requires the regular maintenance of two separate weapons systems. This

maintenance requirement is above and beyond the normal maintenance requirement for the primary weapon system of an artillery unit, which is in itself a highly demanding task. Artillery has historically been a maintenance intensive organization and the decision to retain the M101A1 in an operational status within the M198 structure will significantly increase maintenance time requirements for the artillery.

TRAINING

The decision to dual caliber deploying batteries with both 105mm and 155mm howitzers serves to complicate the training requirements for both cannoneers and fire direction personnel within the direct support battalion. Crew training on both weapons systems will substantially increase the amount of training time required to insure crew proficiency on both weapon systems. Safety procedures and testing will be doubled for the battery since the contingency of shifting crewmembers from one weapon to another must be planned for. Training of the fire direction personnel will also require duplication of plotting equipment and computers given the dual caliber mix within the battery. Fire orders, commands and procedures between battalion and battery fire direction centers and the gun lines will be more time consuming and complicated because of the dual caliber environment. Massing of artillery units will be significantly slowed

due to the necessity to compute two sets of data for the weapons. While none of these factors are "war stoppers" each will have to be addressed at a significant cost in terms of training time and effort. These factors complicate a difficult process of maintaining proficiency in a training environment that is already over-burdened.

MANPOWER

The fielding of the M198 and the increase in numbers of weapons per battery from six to eight resulted in a significant increase in manpower required by the artillery regiment. The direct support battery grew from nine officers and 112 enlisted [T/O 1104M] to 10 officers and 173 enlisted [T/O 1113C]. This is equivalent to three officers and 183 enlisted for a direct support battalion and nine officers and 549 enlisted for an artillery regiment. Marine Corps-wide the manpower cost amounted to 27 officers and 1642 enlisted for direct support artillery alone. Of course these figures reflect the added firepower of 54 155mm howitzers and because of their distribution among each of the batteries reflect a relatively cheap method of increasing firepower, since there is no overhead cost for a headquarters battery that would be necessary for a separate battalion organization. The increased manpower requirement of the 11-man M198 crew over the seven-man M101A1 crew is a major factor in the current dilemma at Headquarters, Marine Corps regarding

force structure manning. The need to identify existing ground force structure manning in order to fill current structure requirements is the principal driver in the proposal to cadre the fourth battalion of the artillery regiment. The resulting 1500 manpower slots would be transferred to Light Armored Vehicle (LAV) battalions, infantry battalions, and MEU(SOC)s to fill existing vacancies. (28:4) These shortages in the manning of ground force structure billets are at least partially a result of the failure of the MLRS program in the Marine Corps POM process. The MLRS simply could not effectively compete with other programs that had higher cost-benefit ratios during the program development process. The Marine Corps had expected to field the MLRS as a general support artillery weapon at a substantial savings in manpower over the artillery weapons it would replace. (28:4) Without this manpower savings the Marine Corps found itself short of people.

SURVIVABILITY

In the early 1980s the U.S. Army was heavily involved in the development of doctrine in order to enhance survivability of the artillery on the modern battlefield. In order to determine the best alternatives, the two most recent battlefield environments were examined, Vietnam and the 1973 Middle East war. In both cases the survivability alternatives were essentially

identical; however, the preferred method was different for each due to the nature of the conflict and the terrain. In both Vietnam and the Middle East the alternatives available to enhance survivability of the artillery consisted of avoiding detection, dispersal of artillery units, hardening of artillery positions, and conducting moves frequently enough to prevent the enemy from locating and engaging artillery units. In Vietnam both the Army and the Marines relied primarily on the use of hardened firebases to provide protection for the artillery. In the Middle East however, the principal defense against counterbattery fires was mobility. This mobility was in the context of an artillery structure that was primarily equipped with self-propelled 155mm howitzers (56:5-17) and was highlighted by the requirement to displace battery-sized units as many as 12 to 15 times per day. (56:5-20) Since the bulk of Marine Corps artillery is made up of towed weapons the requirement for mobility is even more critical, although hardening remains an option. Unfortunately, there are inadequate earth-moving assets available within the artillery structure to harden numerous artillery positions in a timely manner. Considering the nature of the rocket and heavy artillery threat in the Middle East, mobility would most likely be the principal means of survival for Marine artillery. This is especially true in an environment where threat

weapons have a range advantage and Marine artillery would be at a disadvantage in unit against unit counterbattery fire.

Another means of improving survivability on the battlefield is to increase the number of targets that the threat must locate and engage. Given the fact that the preponderance of Marine artillery is towed, the planners adopted the two platoon organization [each battery would have eight howitzers organized into two separate firing elements, rather than six weapons in a single firing element] in the direct support battalions in order to increase their survivability. This creates twice the number of firing units that the threat has to locate and destroy compared to the old single battery concept. The structure study conducted in the early 1980s recommended the increase in weapons from six to eight in a direct support battery based upon increased effectiveness and survivability, despite the increased manpower requirements. (66:1-36) While units are not required to operate in the two platoon configuration, the capability does add a significant tactical advantage to the artillery commander.

TACTICAL FLEXIBILITY

Range

Although the M198 has problems with mobility, it has a major strength in its range capability. It has a

range of 30,000 meters when using the rocket-assisted-projectile and more than 18,000 meters when using conventional projectiles and propellants. This range capability allows artillery units to engage more targets at greater distances than ever before, which serves to overcome some of its mobility shortfall during sustained operations ashore. It also allows mutual support among artillery units to an extent never before possible. The acknowledged problem of United States artillery being out-ranged by Soviet or Chinese artillery is significantly reduced and U.S. artillery units no longer have to fire a higher caliber weapon system to engage the artillery units of the threat at stand-off distances. The additional flexibility in role assignments for artillery units allows a unit to more easily adapt to the role of reinforcing or general support than was possible with the relatively limited range of the M101A1.

Given the range of the M101A1 and the requirement of direct support artillery to engage targets within the "area of influence" for a brigade--approximately 15,000 meters--the M101A1 doesn't quite reach, while the M198 well exceeds the standard.

However, the placement of both 105mm and 155mm weapons systems in the same battery and to a lesser extent dual caliber battalions has significantly increased the problem of coordinating fires and controlling the

computation of firing data within the various fire direction centers. The inability of the M101A1 to match the last 7000 meters of the M198's conventional range essentially means that half of the battery will be able to engage targets at greater distances, but that the effectiveness of the fires will be greatly reduced from that achieved by a full battery. The same would hold true of a battalion of dual caliber weapons in that massing fires would be less effective than those of a single caliber unit firing at a common target. Still another consideration of a dual weapon organization would be the implication of a deployed MEU serving as the lead force for a MEB employment. What weapons would the remaining elements of the artillery battalion or regiment be equipped with? With the L-form configured for dual caliber batteries the sustainability of the artillery battalion with only M198s would be significantly degraded.

Munitions

The variety of projectiles available to the M198 weapon system is superior to that of the M101A1. The 105mm ammunition selection is primarily oriented towards anti-personnel, although it does have an Dual Purpose-Improved Conventional Munition (DP-ICM) round, while the M198 ammunition is much more anti-material oriented. The relatively small size of the 105mm projectile restricts it from effectively being used to

deliver mines or other variations of projectiles. In contrast the 155mm ammunition selection is relatively unlimited. Projectile choices range from the highly effective Dual-Purpose Improved Conventional Munition (DP-ICM) to both anti-personnel [Area Denial Artillery Munitions -- ADAM] and anti-armor [Remote Anti-Armor Mines -- RAAM] mines, and includes laser guided anti-armor projectiles such as Copperhead. The 155mm also has a nuclear projectile capability.

Lethality

A comparison of high explosive projectiles lethal areas demonstrates the significant difference between the 105mm and the 155mm effectiveness. The 105mm projectile weighs approximately 40 pounds, carries 4.8 pounds of TNT, and has a lethal area of 463 square meters against standing troops when armed with a proximity fuze. The 155mm projectile weighs 92 pounds, carries 14.6 pounds of TNT, and has a lethal area of 788 square meters against the same target with the same type fuze. (65:2-12)

CHAPTER VI

CONCLUSIONS

The Marine Corps is today confronted with a different perception of the conflict spectrum than that used as a basis for adopting the M198 into the direct support structure. The acceptance of the M198 by the Marine Corps was a result of several significant influences: the fielding of the M198 by the Army and the effect of that decision upon the M114A2 and the M101A1; the pressure placed upon the Marine Corps by external forces to prepare for a highly mobile armored threat in a NATO scenario with its requirement for longer ranges and heavier munitions; and the perception that the Marine Corps had little recourse since there were no readily available alternatives for weapons systems. In addition to being placed into a position with few choices the Marines were confronted with the fact that virtually every study conducted by either the Army or the Marine Corps had stated a preference for the 155mm weapon system in terms of firepower, munitions variety, lethality, and range. Each study had emphasized a caveat; that whenever mobility became a consideration the 105mm howitzer was the preferred weapon.

The net effect of the decisions to retain the M101A1 as a contingency weapon system, as well as incorporating it into the MEU artillery, and the proposal

to possibly cadre a general support battalion in each artillery regiment has been to raise serious questions about the viability of the resulting structure in providing adequate fire support to the maneuver forces.

The integration of the smaller caliber 105mm howitzer back into the direct support artillery units greatly improves the mobility of the artillery; however, it also significantly increases the need for augmenting firepower from the general support battalions of the regiment. The proposal to cadre one of the two general support battalions and the only battalion with truly strategic mobility runs counter to the apparent need. These decisions have the potential to significantly degrade the ability of the artillery to effectively perform its mission.

PRIMACY OF MOBILITY

The current configuration of artillery with the M198 as the principal direct support weapon and the M101A1 as a part-time weapon for deployments and contingencies has many flaws. The use of dual caliber batteries on deployments is apparently an attempt to be prepared to go anywhere, at any time, for any fight. "Unfortunately, the logic of this century suggests that being prepared to go anywhere, at any time, against anyone, means in practice being ill-prepared ...and ill-positioned for any specific contingency." (50:8)

Put bluntly, the Marine Corps procurement decisions in recent years are giving rise to a military institution that is too heavy to deploy enough quickly into the Third World where it will doubtless have to fight, but that will forever be too light to prevail against Soviet forces which its major weapons systems are intended to counter. (50:12)

Perhaps the most important limitation of the current structure is the M198's overall lack of mobility. The return of the M101A1s to the artillery regiment as contingency weapons and their employment in deploying MEU artillery packages is evidence of the need as determined by senior leaders in the Marine Corps to retain highly mobile artillery assets. Capabilities, as well as deficiencies have changed substantially since the mid-to-late 1970s. The Commandant recently stated that "It is the Third World, the so-called low-intensity conflict arena, where we are most likely to be committed in this decade....You had better break out the manuals and books about how to fight in this arena." (22:18) This statement sounds strikingly similar to what would have been said by a member of the Armstrong Board in 1969.

A Marine Air-Ground Task Force (MAGTF) assessment provided during the Warfighting Assessment conducted at Headquarters, Marine Corps in 1987 made the following point:

The greatest challenge to the Marine Corps remains that of providing forces of combined arms for operations with the fleet that can be projected on to a hostile shore and execute missions ashore required for naval campaigns. Accordingly, we must provide the capability to fight the crucial break-in battle

in the amphibious assault and destroy the enemy within the beachhead. Emphasizing sustained operations ashore at the expense of priorities calculated for the assault forces may prove counterproductive. (42:1)

Another assessment provided during the same time period addressed ground/air mobility with the following comment:

The MAGTF must be a rapidly deployable, flexible and decisive element supporting the national military strategy....Our priority must be to project sufficient assault forces ashore in order to establish a foothold and hold it until the heavy sustaining forces can come ashore, primarily by waterborne means. (41:1)

Mobility appears to be an absolute requirement for direct support artillery on the part of the senior leaders in the Marine Corps. As highlighted throughout this paper the artillery force structure studies conducted in the last 20 years identified the M101A1 howitzer as the preferred weapon when high mobility was a requirement. Even those studies recommending an all M198 structure caveated the recommendation on the eventual existence of adequate numbers of CH-53Es to provide the necessary lift for the M198.

CH-53E SHORTFALL

Unfortunately, the CH-53E program is at a point where there is significant doubt as to whether it will ever reach the program goal. This is the single most critical deficiency of the current artillery structure with the M198 as the direct support weapon and the

principal reason for the retention of the M101A1 by the Marine Corps. With only three operational squadrons at present and Defense Guidance specifying a requirement for nine squadrons of 16 helicopters each, the future does not look promising. Especially considering the recent cuts in defense programs that is only expected to worsen. One of the most draconian measures that has been mentioned is the elimination of the CH-53E program entirely. (10:23) While such an extreme measure is not likely, the CH-53E will probably not reach the interim requirement of six squadrons for quite some time.

STRATEGIC AIRLIFT

The overall requirement for strategic airlift has been significantly reduced through the implementation of both Norway pre-positioning and the MPS, but the need cannot be entirely eliminated. The possibility of contingencies requiring the reinforcement of deployed MEUs and MEBs demands the continuation of the Air Contingency Battalion Landing Team (ACBLT) concept, which has historically been task organized and configured for compatibility with theater airlift assets. For example as recently as 1986 the 3d Marine Division maintained a six gun M101A1 battery as the primary ACBLT artillery unit. The Marine Corps continues to strive for the most mobile force structure consistent with the requirement for adequate combat capability. Additional contingency

requirements exist for the strategic airlift of Marine Corps general support artillery units to insure timely availability of a critical portion of the MAGTF firepower.

GROUND MOBILITY AND SURVIVABILITY

Certainly the ability to displace rapidly enhances survivability regardless of the location of the conflict, especially considering the counterbattery threat. The M198 has a distinct advantage over the M101A1 in counterbattery fires due to its significantly greater range; however, in environments where position hardening is not feasible, mobility is critical. In tactical mobility on the battlefield, the M101A1 greatly surpasses the M198 due to its much lighter weight and smaller size.

If mobility is the key to survival and a potential requirement exists for an artillery unit to conduct survivability moves from 12 to 15 times per day, the size of the artillery weapon is going to play a significant part on the success of the operation. The M198 weighs over 15,000 pounds and requires a crew of eleven men. What effect will moving a dozen times a day over prolonged periods of time have on the effectiveness of the crew? Logically, the size and weight of the M198 will be a significant disadvantage in this type of environment. On the other hand the relatively lightweight 105mm howitzer with a crew of seven, while not having the range

of the M198, is a great deal lighter and easier to move on the battlefield.

MOBILITY VERSUS FIREPOWER

With the return of the M101A1 into the M198 artillery structure the senior leadership in the Marine Corps has demonstrated the fact that it is convinced that the requirement for mobility overrides the requirement for firepower, at least for direct support artillery.

It should be readily recognized that the Marine Corps faces a fundamental problem in providing sufficiency in any capability. Often the ideal level of capability must be compromised in order to accommodate the constraints of strategic lift and the need for responsiveness. (67:204)

This statement was made in 1976 in an analysis that recommended the Marine Corps alter its programs to prepare to fight in a mid-to-high level conflict. It is important to note that given such a bias the study still acknowledged the trade-off between mobility and capability. The same study considered the M101A1 to be adequate for the direct support tactical mission in the mid-to-high level conflict.

Each of the artillery studies reviewed in this paper conducted an analysis of the artillery structure within a specified framework using various factors which were given a relative weight in order to provide some quantitative measure to the report. The result was that each analysis used both different factors and different weights in evaluating the artillery structure that

reflected the environment within which the evaluators were working while the study was being conducted.

The Marine Corps Artillery Force Structure

Analysis (65:--) considered nine capabilities in its analysis, three of which were directly related to firepower. Force firepower at H+2 1/2, H+5, and Maximum were all treated as separate factors and accounted for one-third of the overall evaluation. (65:8-3) The end result was that even though the capabilities were equally weighted the fact that three were directly related to firepower during an amphibious assault provided substantial weight to options with heavier weapons and consequently more firepower. Even with this firepower bias the study recommended that the M101A1 be retained for mobility until the M198 and the CH-53E were fully fielded.

The Mission and Force Structure Study (67:--)

conducted in 1976 used different primary factors and weighted unit values were applied only to Ground Combat Capability. (67:405) This study found that the direct support battalion equipped with three six gun M101A1 batteries and one six gun M114A2 battery was adequate to meet firepower requirements in mid-to-high intensity conflicts. (67:210) It also recommended the addition of a general support battalion to the artillery regiment. (67:212)

The Marine Corps Force Structure (1980-1989)

(66:--) completed in 1980 conducted used ten separate elements of analysis in evaluating the artillery structure with firepower weighted .267 percent of the total, while the next most heavily weighted element was survivability which was weighted .160 percent. (66:II-49) Not surprisingly this study recommended that the M114A2 should be retained during the transition into the M198 and CH-53E. (66:ES-?)

The most recent study--Marine Corps Artillery Structure Study (1986-1995)--completed in 1986 used still another set of factors for evaluation. These factors and their weights were: life cycle costs-.10, operational effectiveness-.30, force structure implications-.10, amphibious shipping requirements-.20, and tactical flexibility-.30. (7:48) This study recommended two different alternatives, one with MLRS in the structure and the other without. In both alternatives the most highly ranked direct support battalion structure was three, eight gun batteries of M101A1 105mm howitzers. (7:65) The variation came in the composition of the general support battalions. With MLRS the current structure of the fourth battalion (3X6 M198) would remain, while the fifth battalion would become 3X6 M109A3 155mm self-propelled howitzers and 2X6 MLRS. (7:65) Without MLRS the recommendation was for both the fourth and fifth general

support battalions to have three eight gun batteries of M198s. (7:66)

The point to this discussion is that regardless of how quantitative each of the study groups have been, each has made a subjective determination regarding the various factors to be included and the relative weighting of those factors. In the Fleet Marine Force the concern is not in such things as ten year life cycle costs or political factors, but on whether or not a weapon can adequately support the ground scheme of maneuver. When a MAGTF commander has to conduct a landing without heliborne artillery to support the two-thirds of his assault force landing inland, he rightfully complains that his artillery forces (M198 and/or CH-53E) are not giving him the flexibility he requires. The decisions regarding the retention of the M101A1 and its inclusion in deploying MEUs essentially portray mobility to be the critical factor for both the Fleet Marine Force and Headquarters, Marine Corps.

FUTURE OF MLRS

Like that of the CH-53E, the future for the MLRS program does not look bright. Again due to the recent reductions in defense programs, it is truly doubtful if a program that could not compete with other Marine Corps programs during the less fiscally constrained times will fare any better now that funds are scarce. With the

Marine Corps taking cuts in the number of M1 tanks it expects to buy, there is little hope for the MLRS, at least near term.

PREPAREDNESS FOR ALL CONTINGENCIES

In 1978 then Lieutenant Colonel John Grinalds, USMC wrote a monograph while at the National War College regarding the inconsistencies [principally between the desire for mobility in the amphibious role and the requirement for firepower in a Central European threat environment] with which the Marine Corps was being confronted:

The Marine Corps structure is being pressured to change to a form not readily applicable to the kinds of expeditionary capability which will be required of the United States in the international environment of the 1980's and 1990's.

On the other hand, Marine force structure must remain adaptable to employment in a NATO conflict against growing Warsaw Pact conventional strength, as well as in peripheral contingencies, furthermore, the structure must be prepared to contest the sophisticated weapons and doctrine increasingly evident in probable contingency areas. (23:23)

Grinalds is not alone in his feeling that the most probable employment of the Marines will more than likely be in a Third World environment requiring highly mobile artillery support rather than a high-intensity direct Soviet confrontation. Dr. Alan Ned Sabrosky makes a persuasive argument that it:

...would be imprudent in the extreme to allow a preoccupation with the admittedly dangerous but highly improbable anti-Soviet contingencies to obscure the far more real requirement to be able to counter

challenges to US interests and US allies in the Third World. (50:2)

The existence of the Soviet threat is ever-present and must be accounted for, however, the likelihood of such a confrontation remains extremely low.

The environment today with its current perception of the spectrum of conflict has essentially come full circle to that of the late 1960s and early 1970s. There is a great deal of emphasis on the need for mobility, even when firepower or combat capability must be sacrificed. Both tactical and strategic mobility are considered critical: tactical to ensure success in the amphibious assault, and strategic to remain capable of reinforcing, and/or augmenting previously deployed MAGTFs, as well as, meeting strategic requirements for matching personnel to pre-positioned assets.

If the most likely event is conflict in the Third World and the least likely that of direct confrontation with the Soviets, it appears that the artillery force structure in the Marine Corps should be altered.

There is no doubt that even though the pendulum has swung from a perceived need for firepower to one for mobility, the absolute necessity for being prepared to respond to all levels of the conflict spectrum remains.

RESTRUCTURE ALTERNATIVE

One alternative that would allow for both mobility and firepower would be to maximize the mobility of the

active forces by equipping the direct support units with highly mobile artillery weapons, increasing the number of weapons in the general support battalions with strategically mobile artillery weapons, and moving the heavy artillery that has relatively poor strategic mobility to the reserve establishment. This would allow active forces to respond immediately via practically any means of transportation to any foreseeable contingency. It would also increase the amount of general support artillery readily available due to the increased numbers of weapons that would be strategically mobile. For conflicts requiring heavy artillery or additional firepower beyond that of the active forces the reserves would have the assets available. For any conflict of that magnitude it is likely that mobilization would allow full participation of the reserves.

The necessity to maintain the capability of supporting the contingency of a NATO engagement remains as a major factor in the decision-making process of the Marine Corps regarding the equipping and training of Marine forces. Lieutenant Colonel Grinalds argued for the retention of these NATO assets in the reserve components, while maintaining an "amphibious" force structure in the active force:

The Marine Corps should retain its current "amphibious" force structure design [1978 timeframe] as best suited to the evolving defense environment. Force structure initiatives that would enhance

effectiveness of this design include:

--Increase the proportion of reserve...self-propelled artillery, and tank units as a hedge against employment in Central Europe...(23:32)

This concept of placing certain assets and capabilities in the reserves was also voiced by the Commandant in a recent interview:

...we're looking at the potential for moving active structure of heavy armor, engineer, and maintenance capabilities into the reserve. That contributes to a truly "total force" concept in which the active forces are prepared for those contingencies short of general war, and, on mobilization, reserve forces contribute individuals and units for depth of capability. (55:25)

The concept of using reserve structure to provide "heavy" or "depth" type assets to active forces appears to be viable in today's environment.

MOBILITY ALTERNATIVES

Few alternatives are available for providing mobile artillery weapons to the direct support units.

The Army is in the process of procuring the new M119 105mm howitzer to replace its M102 as the direct support weapon for the Light Infantry Divisions; however, its conventional range of 14,000 meters and RAP range of 18,000 meters at a unit cost of \$362,000 at present [and expected to grow to \$400,000] is simply too expensive for the relatively small gain in range. (45:--)

The developmental work on a new lightweight 155mm continues at Picatinny Arsenal, although it is on a much reduced scale due to the recent budget cuts. The

requirement for a 8000 to 9000 pound 155mm howitzer with the range capability equal to the M198 is apparently only valid for the Marine Corps and unfortunately the Army has the lead for new weapon development. (52:2) The Army's purchase of the M119 effectively eliminated their need for the lightweight 155mm at the present time.

Some developers have suggested the 120mm mortar might be the answer for the direct support artillery units; however, its limited range of just over 7000 meters falls significantly short of the direct support requirement. The cost of the 120mm is significantly higher than that associated with the rebuilding of the M101A1 and reworking its ammunition. (40:--)

AGGREGATE FIREPOWER OF THE MAGTF

Some critics may argue that the Marines suffer from a lack of firepower (54:xii); however, the combat structure of the Marine Corps provides a significant amount of aggregate firepower that is frequently not taken into account. A substantial amount of firepower is provided to the MAGTF by aviation assets:

Firepower. Since heavy, ground-based firepower is often reduced to facilitate transportability, the aviation combat element supplies the offset. The range and speed of aviation firepower extend the reach of the Marine air-ground task force and allow responsive engagements over great distances. (53:46-53)

It is this aggregate firepower concept that provides the capability to modify a portion of the ground

firepower in direct support artillery in order to enhance the tactical and strategic mobility of the artillery regiment by fielding the M101A1 as the direct support weapon. Adopting the M198 as the principal general support weapon, while increasing the total numbers in each general support battalion would return a large percentage of the relative loss of firepower associated with the M101A1 replacing the M198 in direct support units.

M101A1 AS DIRECT SUPPORT WEAPON

The advantages of the M101A1 over the M198 have been discussed throughout this paper. It is more mobile in every situation, it is much more easily supported logistically, the manpower requirement is significantly less, it is as survivable as the M198 given the same battery organization (3X8), it has a very high rate of fire during sustained operations, and it provides the tactical commander an extremely high degree of operational flexibility.

On the other side of the coin the M101A1 has much less range capability than the M198 and it is not capable of firing the large payload munitions that are available to the 155mm weapon system. The list of available munitions for the 155mm weapon system is certainly impressive; however, for weapons filling the direct support role, the most likely use of munitions would probably not require the full range of munitions available

to the 155mm. Indeed, a strong argument can be made for the absolute necessity of the general support weapons to fire all types of munitions with the preponderance of them anti-material, while direct support artillery would require a smaller variety, predominately anti-personnel, based upon the proximity and nature of targets. The research and development efforts in 155mm ammunition promise a much more flexible and opportunistic selection than that of 105mm munitions, although the research and development efforts for 105mm ammunition are being re-energized due to the recent Army decision to purchase the M119 105mm howitzer. (17:--)

While there is no question that the 155mm projectile has a much larger bursting radius and lethal area, the ability of the 105mm weapon to maintain a rapid rate of fire ensures its ability to place an equal amount of projectile weight [steel on target] as the larger 155mm. The weight of conventional high explosive ammunition that an M101A1 can place on a target in a ten minute period is 2,035 pounds, compared to 2,024 pounds by the M198. (65:2-14) The same study pointed out that during an amphibious assault the artillery organizations with at least some M101A1s were capable of a much more rapid buildup of firepower, although the total firepower attained during sustained operations was reduced compared to an all M198 organization. (65:7 17)

As has been pointed out the M101A1 has a shorter massing fan than the M198; however, this shortfall in ranging the "area of influence" can be overcome to an extent by the increased availability and use of the M198 in the reinforcing or general support-reinforcing role.

Overall the relative differences between the M101A1 and the M198 can be placed into a subjective basket. There is no question that the greater range of the M198 and its greater variety of munitions make it an excellent artillery weapon; however, the mobility and rate of fire of the M101A1 make it extremely attractive for direct support artillery. The senior leaders in the Marine Corps have already established the priority for direct support artillery as mobility. Given that as a requirement, the M198 can best be used in the general support and/or general support-reinforcing roles to augment the firepower of the M101A1 in direct support and provide a strategically mobile general support capability to deployed forces.

CHAPTER VII

RECOMMENDATIONS

The most obvious recommendations that would resolve the majority of problems identified in this research effort would be to either field a lightweight 155mm howitzer that could be lifted by the CH-53D or MV-22, or speed up the CH-53E program to ensure adequate lift assets are available for the M198. Unfortunately, neither of these options appears likely to materialize within the foreseeable future. The thrust of this paper is to identify an interim artillery structure that will meet the mobility requirements that have been established by the senior Marine Corps leadership over the past several years while adequately supporting the operational forces, until a viable alternative is available. A secondary objective is to recommend possible modifications [some of which may be outside the specific scope of this research effort, but that are closely related] to the artillery structure that will provide improved capability to the active forces, while releasing excess manning for use within the overall force structure, as well as modifying the traditional role of the reserves.

DIRECT SUPPORT ARTILLERY

Recommendation: Equip the first, second, and third battalions of each regiment with the M101A1 in a 3 by 3 configuration.

Discussion: The Marine Corps owns 337 M101A1s of which 58 are on temporary loan to the Army. To equip the artillery with 3X8 direct support units would require 216 weapons. Additionally, 12 per MEF (36 total) would be allocated to Operational Readiness Float, a total of 35 would be reserved for Maintenance Float, 41 would be Pre-positioned War Reserves, and there would be nine remaining. (5:--) This structure was the highest ranking option in the previously discussed Marine Corps Artillery Structure Study (1986-1995) the most recent structure analysis. (7:66) It was the cheapest option of all considered, required the smallest amount of manpower, and required the smallest footprint on amphibious shipping. This structure would provide the strategic and tactical mobility required to support virtually any operational contingency encountered by Marine units, including MEU(SOC). Retaining the 3X8 configuration would enable the artillery to utilize the same tactics and doctrine as has been used for the M198 and retain the highest degree of survivability possible, while providing an adequate amount of firepower. The adoption of a single caliber artillery organization eliminates the difficulties associated with dual calibers in areas such as training, maintenance, logistics, and L-form composition. It also provides an increase in firepower over the M101A1 direct support battalions that were replaced by the M198 in the

early 1980's. In other words this organization would provide the mobility of the M101A1 and result in a 25 percent increase in firepower over the previous 105mm direct support units. The current decision to field 48 M101A1s per MEF by FY90 could easily be modified to support this recommendation. This would also effectively end the responsibility of the direct support units for nuclear missions. This requirement was incurred in the early 1980s after the M198 was fielded and should not be considered a hard and fast obligation. If nuclear capability is a justifiable requirement, it could be placed entirely in the fourth and fifth battalions. Finally, it would allow the active forces to train daily and routinely with the weapon they are most likely to employ, at least initially in the next conflict. The M198 would be placed in a contingency role for the direct support battalions in case they were required to man one of the pre-positioned programs (Norway or MPS). Units deploying for routine MEUs and training exercises would be equipped with the M101A1. The artillery units assigned to the MPS commitments would be responsible for maintaining proficiency with the M198 on a contingency basis.

Recommendations: Retain eight M198 howitzers in each artillery regiment for training purposes (not contingencies).

Discussion: This would permit each direct support battalion to maintain proficiency on the M198 weapon system by scheduling regular battery training sessions with the weapon. This would also minimize the impact of two different weapons calibers for maintenance. The need for proficiency exists because of the Norway and MPS artillery structures. There is no need to replace the M198s in these programs, since there is no requirement for them to augment or support amphibious assaults. This need would be met by the M101A1s with the amphibious force.

This re-ordering of weapon system priority would allow the artillery to use the weapon most likely to be required in an amphibious assault, the most demanding of the potential requirements. The less likely requirement of engaging a force with the MPS artillery could be met through the proficiency level of training.

The M198s released from the direct support battalions would be used to provide the weapons for the increased number of weapons in the fourth battalion, and the total equipping of the fifth battalion. Additional weapons could be provided the reserves to flesh out their battalions with all M198s. Remaining M198 howitzers would be stored at depots or perhaps traded with the Army for 105mm ammunition.

Recommendation: Retain the current 3XB direct support M198 Table of Organization; however, redesignate

it for the 105mm units and provide 100 percent manning of the seven man M101A1 crew.

Discussion: This would ensure that if required to deploy onto an MPS set of artillery the unit would have the contingency structure necessary for the increased manning requirements. A seven man crew for an M101A1 would be able to effectively handle an M198 until additional manpower was made available. This would effectively man the 105mm units at 100 per cent for the weapon crews and still equate to a saving for the force structure as a whole. There would be an immediate manpower savings of at least 288 enlisted for each regiment as a result of the shift from 155mm to 105mm howitzers in crew size differences alone. Across the Marine Corps there would be a savings of 864 enlisted. A more detailed study is required in order to ensure critical manning positions are covered; however, a minimum of the 864 billets would be realized.

GENERAL SUPPORT ARTILLERY

Recommendation: Reorganize the fourth and fifth battalions into 3X8 M198 units.

Discussion: This general support structure was the most highly rated option assuming that MLRS was not available in the Marine Corps Artillery Structure Study (1986-1995). (7:) This general support recommendation when combined with the recommended direct support

organization was considered to be the cheapest of all the evaluated alternatives. (7:66) This option would provide significant improvements in strategic mobility for the general support artillery requirement. The Army has a strong preference for the 198 versus the self-propelled 155mm howitzer due to its greater strategic mobility. Both of the current weapons within the fifth battalion are transportable only by the C-5, as has been previously discussed. The M198 can be transported by both C-130 and C-141 and would be more easily transported to a conflict to augment the fires of the direct support units than either of the weapons currently in the fifth battalion. By increasing the numbers of general support M198s within the artillery regiment there would be an additional amount of firepower available to help offset the relative loss of firepower due to the return of the M101A1. The increase in manpower requirements would be minimal since the fifth battalion as currently organized has a requirement for 25 officers and 504 enlisted in the firing batteries alone. The fourth battalion currently requires 15 officers and 351 enlisted in the firing batteries. A 3X8 M198 general support battalion would require 18 officers and 472 enlisted in the firing batteries [figures reflect a direct support unit minus liaison personnel]. The effect of this recommendation would be 36 officers and 855 enlisted available and 36 officers and 944 enlisted required to man

the new 3X8 general support battalions. The increase of approximately 89 enlisted could be filled from the savings in the direct support reorganization and still have approximately 775 enlisted spaces to augment manning for infantry force structure.

The negative aspect of this recommendation is that for those proponents of mechanized task forces, there would be no mechanized artillery to support the effort, short of mobilization. Again while outside the scope of this specific paper, adequate artillery support could be made available by the M198 general support units using extended range munitions and aggressive positioning tactics.

RESERVES

Recommendation: Equip the first, second, and third battalions with 3X8 M198s.

Discussion: There is no apparent justification for the reserve to be equipped for the amphibious assault contingency. Therefore they have no requirement for the M101A1. Direct support for the reserve division could be adequately provided by the M198s in almost any foreseeable contingency.

Recommendation: Replace the present fourth and fifth battalions with mirror-imaged general support units equipped with the current active fifth battalion equipment.

Discussion: This would provide a substantial amount of augmentation artillery for both the active force and the reserve force. Not directly a throw-back to the old "Force Troops" concept, but a pool of heavy artillery that would not be mobilized except in contingencies where it was obviously required, i.e. NATO. This would allow the active force to be equipped with strategically mobile weapons, while at the same time ensuring that two battalions of heavy artillery assets would be available for assignment as necessary.

The mobility provided by this organization allows for virtually any operational contingency that could be encountered by a deployed force.

CONCLUSION

Adoption of the above recommendations would serve to strengthen the Marine Corps combat capability. The artillery would possess the mobility to support the maneuver forces in virtually any foreseeable contingency. The direct support artillery would be highly effective during amphibious operations, and when joined by the restructured general support battalions would be capable of conducting sustained operations across the spectrum of conflict. Proficiency would be maintained by artillery units for MPS and Norway contingencies. Manning would be released for the support of the increased requirements

within the infantry and MEU (SOC) and a basis would be established for future improvements, whatever they may be.

In the final analysis the answer to the firepower versus mobility dilemma lies in the development and fielding of a lightweight--8000 to 9000 pound-- 155mm howitzer capable of being helilifted by the MV-22. Until that time, these recommendations provide the most reasonable and effective use of Marine Corps assets.

BIBLIOGRAPHY

1. APW-51 over PP860801/APW-51 point paper prepared for Top Level Schools Briefing Book, Subj: CH-53E Program, 1987. HQMC, Washington, D.C.
2. AU, USAF, Employment of Naval and Marine Forces, AU-16 (Maxwell AFB, 1985) pp. 81-110.
3. Bailey, Thomas A., Maj, USMC. "Over-the-Horizon Assault by LCAC." Marine Corps Gazette (January 1986).
4. Binkin, Martin, and Jeffrey Record. Where Does the Marine Corps Go from Here? The Brookings Institute, Washington, D.C., 1976.
5. Brumbach, William, Major, USMC. Code CBGF, Fire Support Branch, Ground Weapons Program Management Office, Marine Corps Research, Development, and Acquisition Command. Interview, 1 March 1988.
6. Center for Naval Analysis. Independent Cost Estimate for the Marine Corps Multiple Launch Rocket System (MLRS). Alexandria, Virginia, 1986.
7. Center for Naval Analysis. Marine Corps Artillery Structure Study (1986-1995). Alexandria, Virginia, 1986.
8. Center for Naval Analysis. Marine Corps Artillery Structure Study (1986-1995): Examples of Scenarios, Targets, and Tactical Dispositions used in the Effectiveness Analysis. Alexandria, Virginia, 1986.
9. Chellman, Warren C. "The Allocation of U.S. Army Field Artillery Forces at the Division Level." Master's Thesis, Naval Postgraduate School, Monterey, California, 1986.
10. Chicago Tribune. 21 February 1988, p. 23.
11. Commanding General, Marine Corps Development and Education Command ltr to Commandant of the Marine Corps (Code PDG), Subj: Marine Corps Artillery Forces Structure, dtd Nov 19, 1980. Quantico, VA.

12. CMC ltr RD/PO634:JSS:my over 5320, RDS-41-gta, 29 May 1981.
13. Dean, David J., LtCol, USAF, (ed). Low-Intensity Conflict and Modern Technology. Center for Aerospace Doctrine, Research, and Education, Air University, 1986.
14. Department of the Army. Tactical Mobility Study. Vicksburg, Mississippi: Geotechnical Laboratory, Waterways Experiment Station, Corps of Engineers, 1984.
15. Deputy Chief of Staff for Plans, Policies and Operations memorandum, Subj: Decision Memorandum for the Retention of the 105mm howitzer, M101A1, dtd 25 Feb 1985. HQMC, Washington, D.C.
16. Donovan, James A., Col, USMC(Ret). "What Kind of a Marine Corps?" Marine Corps Gazette (December 1987).
17. Doran, Major Terry. Marine Corps Liaison Officer to Army Research and Development Center, Picatinny Arsenal. Interview, 30 November, 1987.
18. Estes, Kenneth W., LtCol, USMC. "What is Heavy, What is Light?" Marine Corps Gazette (July 1987).
19. Funk, R.C., Maj, USMC. "M198: Good Weapon-Wrong Choice." Marine Corps Gazette (June 1986).
20. General Accounting Office. Marine Amphibious Forces: A Look at their Readiness, Role, and Mission. Washington, D.C., 1979.
21. Gordon, Michael R. "Light Doesn't Mean Easy." Military Logistics Forum (May 1985).
22. Gray, A.M., Gen, USMC. "29th Commandant Speaks to Corps." Marine Corps Gazette (September 1987).
23. Grinalds, John, LtCol, USMC. Structuring the Marine Corps for the 1980's and 1990's. National Defense University, Washington, D.C. 1978.
24. Haynes, Fred, MajGen, USMC. Memorandum for the Commandant of the Marine Corps. Subj: Marine Corps Mission and Force Structure Study, dtd 29 March 1976. HQMC, Washington, D.C.

25. Karr, Thomas W., LtCol, FA. "Fire Support for a Modernized Brigade." Study project, US Army War College, Carlisle Barracks, PA 1985.
26. Kelly, P.X., Gen, USMC. "Statement on Posture, Plans, and Programs for Fiscal Years 1988 through 1992." Marine Corps Gazette (April 1987).
27. Linn, Thomas C., Maj, USMC. "Challenges to the Marine Corps." Marine Corps Gazette (October 1987).
28. "Manpower Realignments Proposed for Ground Force Structure." Marine Corps Gazette (January 1988), p. 4.
29. "Marine Corps Will Keep Its Light Artillery." Marine Corps Gazette (December 1986) p. 4.
30. "Marine 'Status' Report." Defense Week (July 20, 1987).
31. MCDEC, USMC, The Marine Air-Ground Task Force, OH-2 (MCDEC, 1987).
32. Moore, Richard H., LtCol, USMC, Maj. Larry L. Weeks and Capt Dennis A. Morga. "Learning to live with the M198 howitzer." Marine Corps Gazette (July 1980).
33. Moore, Richard H., LtCol, USMC, Maj. Larry L. Weeks and Capt Dennis A. Morga. "Why the Marine Corps is adopting a new howitzer." Marine Corps Gazette (April 1979).
34. Murdock, Harry M., Maj, USMC. "MAU(SOC) A Powerful Maritime Force." Marine Corps Gazette (August 1987).
35. Palm, Leslie M., Maj, USMC. The M198 Howitzer As A Direct Support Weapon During Amphibious Operations. Fort Leavenworth: U.S. Army Command and General Staff College, 1980.
36. POG-34 over 10740 background paper for briefing to Commandant of the Marine Corps. Subj: Discussion of and recommendation for possible readoption of light artillery into artillery structure, undated. HQMC, Washington, D.C.

37. POG-34 over 1379D talking paper for use during 1987 USMC General Officer Symposium, Subj: Light Artillery, undated. HQMC, Washington, D.C.
38. POG-34 over 1379D talking paper for use during 1987 USMC General Officer Symposium, Subj: M198, undated. HQMC, Washington, D.C.
39. POG-34 over 0786B point paper, Subj: M101A1 105mm Howitzers, undated. HQMC, Washington, D.C.
40. POG-34 over 0866B point paper, Subj: 120mm Mortar, undated. HQMC, Washington, D.C.
41. PON-30B18 background paper prepared for use during 1987 MAGTF Warfighting Assessment, Subj: Ground & Air Mobility, undated. HQMC, Washington, D.C.
42. POM-11C26 background paper prepared for use during 1987 MAGTF Warfighting Assessment, Subj: Modernization, undated. HQMC, Washington, D.C.
43. POM-11C29 background paper prepared for use during 1987 MAGTF Warfighting Assessment, Subj: Force Structure Allocation, undated. HQMC, Washington, D.C.
44. POM-21K05 background paper prepared for Top Level Schools Briefing Book, Subj: Maritime Prepositioned Ships, 1987. HQMC, Washington, D.C.
45. Pryor, LtCol Robert. Marine Corps Development and Education Command Liaison Officer to U.S. Army Field Artillery School, Fort Sill, Oklahoma. Interview, 1 December, 1987.
46. Record, Jeffrey. "The Marines and the Amphibious Mission." Amphibious Warfare Review (Summer 1987).
47. "Right or Wrong." Defence Update International (May-June 1987) pp. 9-19.
48. Robnick, S.A., LtCol, USMC. Ground Requirements Validation Officer, RPK-6, Requirements and Programs, Memorandum, Subj: General Support Rocket System (GSR5), Apr 1986. HQMC, Washington, D.C.
49. Russel, James A. "Marines: How Heavy Is Too Heavy?" Military Logistics Forum (March 1987).

50. Sabrosky, Alan Ned. "The Use of Marine Forces in Third World Interventions." As yet unpublished article, cleared for open publication by Army War College, Carlisle Barracks, PA, July, 1987.
51. Schmaltz, Major Royce. Supporting Arms Officer (POG-34), Operations Division, Plans Policies and Operations, Headquarters, Marine Corps. Interview, 7 December, 1987.
52. Secretary, Marine Corps Systems Acquisition Review Council ltr to Commandant of the Marine Corps, Subj: Acquisition Decision Memorandum for the 155mm Howitzer, M198, dtd 15 Nov 1983. HQMC, Washington, D.C.
53. Smith, Keith A., LtGen, USMC. "The Posture of Marine Aviation in FY88-FY89." Marine Corps Gazette (September 1987).
54. Superintendent of Documents. The Marine Corps in the 1980's: Prestocking Proposals, the Rapid Deployment Force, and Other Issues. Congressional Budget Office. Washington, D.C: Government Printing Office, 1980.
55. Thomas, Vincent C. "Gen. Gray discusses Corp's future." Marines (January 1988).
56. U.S. Army C&GSC, USA, Reference Book 100-2, Volume I, (Fort Leavenworth, 1976).
57. U.S. Army. Division 86 Final Report Oct 81 with June 83 Addendum. Fort Leavenworth, Kansas: CACDA, 1981.
58. U.S. Army. Field Artillery Organization and System Requirements, 1981-1986 (Short Title: Legal Mix V). HQ, US Army Training and Doctrine Command, Fort Monroe, Virginia, 1977.
59. U.S. Army. US Army Operation Concept: The Light Infantry Division. Fort Leavenworth, Kansas: CACDA, 1984.
60. U.S. Marine Corps. Amphibious Warfare Study XXIV. Education Center, Marine Corps Development and Education Command, Quantico, Virginia, undated.

61. U.S. Marine Corps. Artillery Fire Support Systems 1970-1980 (C). Marine Corps Landing Force Development Center, Marine Corps Schools, Quantico, Virginia, 1966.
62. U.S. Marine Corps. Indirect Fire Support Mission Area Analysis. Quantico, Virginia: MCDEC, 1987.
63. U.S. Marine Corps. Landing Craft Air Cushion (LCAC) Information Sheet prepared for Top Level Schools Briefing Book, 1987. HQMC, Washington, D.C.
64. U.S. Marine Corps. M198 Information Sheet prepared for Top Level Schools Briefing Book, 1987. HQMC, Washington, D.C.
65. U.S. Marine Corps. Marine Corps Artillery Force Structure Analysis. Quantico, Virginia: MCDEC, 1980.
66. U.S. Marine Corps. Marine Corps Force Structure 1980-1989. Quantico, Virginia: MCDEC, 1980.
67. U.S. Marine Corps. Mission and Force Structure Study, Vol. I. Quantico, Virginia: MCDEC, 1976.
68. U.S. Marine Corps. Mission Area Analysis and Amphibious Warfare (Secret NOFORN). Marine Corps Development and Education Center. Quantico, 1980.
69. Voigt, Suzann W., Captain, USA. "Much Ado About Something." Field Artillery Journal (Jul-Aug 1986).
70. Watson, LtCol David. Aviation Requirements Validations Officer, Requirements and Programs, Headquarters, Marine Corps. Interview, 21 January, 1988.
71. Webb, James H., Capt, USMC. "Roles and missions: time for a change." Marine Corps Gazette (March 1972).
72. Wheeler, James R., Maj, USMC. "Fire Support for Over-the-Horizon Assault." Marine Corps Gazette (December 1986).
73. Williams, Jason M. 2dLt, USMC. "3XB and the 155mm Howitzer." Marine Corps Gazette (October 1984).