Transport Helicopters: The Achilles Heel of Maneuver Warfare

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EXECUTIVE SUMMARY

Title: Transport Helicopters: The Achilles Heel of Maneuver Warfare

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Thesis: The Marine Expeditionary Force (MEF) can not effectively conduct operational level maneuver against a medium to high intensity threat with its current mix of assault transport helicopters.

Discussion: FMFM 1 describes the Marine Corps' doctrine on warfighting. Using the Marine Air Ground Task Force (MAGTF), the Marines hope to conduct maneuver warfare in the littorals of the globe. This paper reviews the concept of maneuver warfare and examines the ability of current Marine transport helicopter assets to support this concept. The paper also looks at the threat which faces today's helicopterborne forces and the future potential of heliborne forces to support the concept of maneuver against the threat. Historical examples are cited to illuminate the threat and reiterate the logistical sustainment requirements inherent in maneuver warfare.

Conclusions: The future of Marine Corps rotary wing aviation is not bright. Even support of rear area operations on a linear battlefield is questionable after the year 2005. The Marine Corps can not conduct operational level maneuver warfare (as advertised in FMFM 1) with its current and projected inventory of transport rotorcraft.

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Introduction

Marine Corps' publication FMFM 1 describes Marine Corps doctrine on warfighting. In very broad terms, chapter 4 of *Warfighting* attempts to identify the challenges and realities of the modern battlefield. Marine Corps' doctrine attempts to exploit "the time-competitive rhythm of war, generating and exploiting superior tempo and velocity in an uncertain, chaotic, fluid environment."[1] The Marine Corps employs a combined arms team to generate the combat power needed to suceed in this environment.. This combined arms team is the Marine Air Ground Task Force (MAGTF). The largest deployable MAGTF is the Marine Expeditionary Force (MEF). The MEF is normally employed as a maneuver element for a larger Joint Task Force (JTF).

Like the U.S. Army, the Marine Corps selected maneuver warfare as its warfighting philosophy. In theory, the MEF Commander could be a JTF Commander and could conduct operational level maneuver with his MEF and any other assigned forces. Unfortunately, the MEF can not *effectively* conduct operational maneuver against a medium to high intensity threat with its current mix of assault transport helicopters. Simply stated, the Marine Corps transport helicopter fleet is not capable of supporting maneuver warfare as envisioned in *FMFM 1* or *Forward ... From the Sea*. Based upon the current Five Year Defense Plan (FYDP) and the current Marine Aviation Plan, our transport helicopters will remain the *Achilles Heel* of maneuver warfare in the 21st Century.

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1 FM FM 1, *Warfighting*, p. 57.

This paper will review operational level maneuver and will examine our current transport helicopter fleet and the ability of these helicopters to support maneuver warfare. It will also review the threats which faced helicopter maneuver forces in the latter half of this century. The purpose of this historical examination is to establish the premise that heliborne forces could not and did not conduct *classic operational level maneuver* because of the threats they faced. In light of this (premise), current maneuver doctrine will not change the fact that history has shown helicopters to be impotent against a formidable air threat. This paper will also examine the current threat to our rotary winged fleet and the ability of our current transport helicopters to counter these threats in a maneuver warfare scenario.

What is Operational Maneuver?

JCS Pub.1-02 defines maneuver as:

> Maneuver - (DoD, NATO) ... Employment of forces on the battlefield through movement in combination with fire, or fire potential, to achieve a position of advantage in respect to the enemy in order to accomplish the mission.[2]

Therefore, *operational* maneuver is the movement of operational level (sized) forces to gain a position of advantage over the enemy. The term *operational* is used here as a reference to the level of war (vice strategic or tactical). The Marine Corps considers the MEF as its smallest operational unit while the Army considers a Corps as its base operational unit. FM100-15 defines a Corps as "the largest tactical unit in the U.S. Army and as the link between the operational and tactical level of war."[3]

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[2] Joint Publication 1-02, *Department of Defense Dictionary of Military and Asscoiated Terms*, U.S. Government Printing Office, Washington, D.C., 1989, 218.

[3] FM 100-15, *Corps Operations*, Ft. Leavenworth, KS, 1989, 1-0.

The Operational Commander conducts or orchestrates operational maneuver in order to position his forces to overwhelm the enemy. Napoleon was a master of operational maneuver:

> Historians often find the supreme model for maneuver warfare in the campaigns of Napoleon, and with good reason. The endless combinations and recombinations by which he employed his *corps d'armee*, alternately disbursing them in order to carry out operational movements and bringing them together to confront the enemy, has never been equaled.[4]

The modern Marine Expeditionary Force has not (to date) been employed as an independent maneuver force in a major regional conflict.[5] While global warfare is not envisioned in the current national military strategy of the United States, those who argue that the Marine Corps can conduct operational level maneuver simply do not appreciate the magnitude of the term *operational.* Moreover, under the current two Major Regional Contingencies (MRC) strategy, the Marine Corps will undoubtedly function as part of a Joint Task Force (JTF). In any of the envisioned MRC's, a MEF would be a maneuver element for the JTF Commander (the operational level commander). Therefore, the preponderance of maneuver undertaken by the MEF will occur at the *tactical* level (division and below).

Historically, operational maneuver has always involved army or corps sized units. One need only examine *Operation Barbarossa*, Germany's Campaign in Russia during 1941, to get an appreciation for the size of the forces involved. This operation had three army groups (117 divisions) in action. Army Group North (Field Marshal Wilhelm

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4 Ibid., 1.

5 The MEF employed in the Persian Gulf War operated as a tactical maneuver element within the Coalition Force. Author's note.

von Leeb) had 26 divisions, including three armored and three motorized divisions. Army Group Center (Field Marshal Fedor von Bock) had 50 divisions, including nine armored and six motorized divisions. Army Group South (Field Marshal Gerd von Rundstedt) had 41 divisions, including five armored and three motorized divisions. These totals do not include 16 divisions held in reserve at the beginning of the operation!

To support *Operation Barbarossa,* the Luftwaffe was task organized into three aircorps or *Luftflotten*. Each aircorps was in direct support of one of the army groups. In the North, Gen. Alfred Keller possessed 592 transport and combat aircraft combined with 176 reconnaissance and liaison aircraft. In the center, Field Marshal Albert Kesselring was much stronger with 1,367 transport and combat aircraft and 224 reconnaissance and liaison machines. South Army Group was supported by Gen. Alexander Loehr's *Luftflotten 4.* It consisted of 694 operational transport and combat aircraft, plus 239 reconnaissance and liaison craft.

> Overall, the 579,150 square miles of Soviet territory west of the Leningrad-Moscow-Rostov line gave both sides almost unlimited room to maneuver. For that very reason, it was only by rapid and successful maneuver that the Germans could hope to prevent the enemy from withdrawing and to overcome him in a blitzkrieg campaign.[6]

The above facts and figures are intended to give the reader a sense of the enormity of the forces which have successfully conducted operational maneuver in the past. While the size and breadth of this effort is difficult to comprehend, *Operation Barbarossa* pales in comparison with the scale, sweep and rate of advance of Russian operations in 1945. For example, during the *Vistula-Oder Operation,* the 2nd Guard Tank

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[6] Martin van Creveld, 64.

Army advanced 705 km at a maximum rate of 90 km per day.[7] Here the Soviet Army deployed 560 divisions along a front of 3,200 kilometers. As with the Luftwaffe, the Red Air Force supported the Russian scheme of maneuver.

Maneuver Warfare and the Marines

Marines embraced maneuver warfare in the late 1980's when, then Commandant of the Marine Corps, General A. M. Gray, formalized Marine Corps' doctrine with the publication of FMFM-1. In *Warfighting*, General Gray wrote, "It is the Marine Corps' doctrine and, as such, provides the authoritative basis for how we fight and how we prepare to fight." FMFM 1 clarifies the term *maneuver*,

> The traditional understanding of maneuver is a spatial one; that is, we maneuver in space to gain a positional advantage. However, in order to maximize the usefulness of maneuver, we must consider maneuver *in time* as well; that is, we generate a faster operational tempo than the enemy to gain a temporal advantage. It is through maneuver in both dimensions that an inferior force can achieve decisive superiority at the necessary time and place.[8]

The aim of this philosophy is to create an environment within which the enemy can not cope. The goal is to "shatter the enemy's cohesion through a series of rapid, violent and unexpected actions which create a turbulent and rapidly deteriorating situation..."[9] This process will ideally paralyze the enemy - rendering him unable to fight as an effective, coordinated whole. The Marine Corps' intent is then to destroy these smaller, out-maneuvered, uncoordinated units.[10]

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7 Ibid., 110.
8 FM FM 1, p 58.
9 Ibid., 59.
10 Ibid., 59.

The use of maneuver principles by the Marine Corps in future conflict will certainly depend upon the level of conflict. Martin van Creveld, in *Air Power and Maneuver Warfare*, wrote:

> The most likely type (of threat to American security and interests) ... will come from non-state actors or from those states which, impressed by the enormous American capacity for conventional warfare so recently demonstrated in the gulf, will resort to other means. To counter a threat of this kind - be its name guerrilla war, terrorism, low-intensity conflict (LIC)... both air and ground forces will probably be required. The former will consist principally of helicopters...[11]

Operational Maneuver from the Sea envisions the employment of Marines in highly populated urban littorals. These built-up areas will severely restrict a commander's ability to maneuver a large tactical force. Washington, DC, for example, has some of the most modern transportation corridors in the world. Yet, during rush hour, the highways, beltway and bridges are virtually impassable because of the volume of traffic. Imagine similar corridors jammed with refugees or disabled vehicles. Commanders who hope to conduct large scale urban operations will undoubtedly require transport helicopters to provide maneuver for forces in these urban areas. Unfortunately, terrorists, guerrillas and other non-state actors can operate threat systems (AAA, SA-18's, lasers, etc.) with virtual impunity within urban population centers. Every rooftop, window and back alleyway can easily conceal today's threat. As we learned in Somalia, helicopters and urban environments don't mix. There are simply too many potentially lethal threats to our transport helicopter fleet. If we plan to win in the urban environment, enhanced transport helicopter survivability must become a high priority. Funding for new helicopter

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[11] Martin van Creveld, xiii.

survivability equipment may become available as a result of the Marine Corps's second *Sea Dragon* experiment called ***Urban Warrior.***

Phase two of the Commandant's Warfighting Lab Experiment (***Urban Warrior***), scheduled for February of 1999, will focus on the development of operational concepts and procedures for fighting in the littorals.[12] Part of the experiment will examine aviation operations in urban areas, aerial mobility and survivability. The plan is to build upon the lessons learned from the ***Hunter Warrior*** experiments held in the spring of 1997. Unfortunately, any *aviation* equipment solutions will require upfront funding before ***Urban Warrior*** begins.

The need to rapidly field and exploit commercial technologies has never been greater. The Warfighting Lab should go into ***Urban Warrior*** asking questions like; What technologies are police and other military organizations around the world using to counter the urban threats? The British have flown against an urban terrorist threat in Northern Ireland for several decades. What precautions do they take? Can we exploit commercial technology? Will it meet military specifications? Are military specifications required to meet our needs? Can we get Advanced Concept Technology Demonstration (ACTD) funding from the Department of Defense to rapidly test and field promising systems or upgrades?

Any additional funding from the Department of the Navy, Office of the Chief of Naval Operations, Air Warfare Division (N88) is going to be extremely difficult to obtain. Simply put, the Department of the Navy is "fiscally unable" to support new start upgrade programs. Moreover, if funding were available, getting an upgrade on a Marine

helicopter (as a result of ***Urban Warrior)*** within the "normal" Pentagon Bureaucracy would take 10 years (best case). This lag time, added to the ***Urban Warrior*** schedule, takes us out to the year 2010.[13] The sobering reality is that much of our current transport helicopter fleet will be retired or grounded by 2010.[14] Unfortunately, if the Commandant's Warfighting Lab does not work closely with Department of Defense acquisition executives to get a robust portion of the ACTD budget, Marines will go to war equipped with the same transport helicopters they have in today's inventory well into the next century.

Thus, the MEF will continue to focus on JTF objectives in the littoral (ports, airfields, and key terrain features). Moreover, until the V-22 is fully operational (2015-2020 timeframe),[15] the MEF will have a reach of only 75 nautical miles for battalion and (occasionally) regimental sized forces.[16] **As in Desert Storm, our impotent transport helicopter fleet will continue to limit our ability to maneuver and will force us to fight on a linear battlefield.** This does not support the non-linear, maneuver concepts found in our doctrine.

> One of the Marine Corps' most critical weaknesses is its inability to conduct helicopterborne operations while fighting the Marine Expeditionary Force... The Marine Corps must reexamine its heliborne operations, tactics, techniques and and procedures if it is to execute these operations success-

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12 Sea Dragon Brief, (given at C&S College on 9 Jan 96), slide N22.

13 There are currently no "new start" transport helicopter programs funded in the current Navy Program Objective Memorandum (POM).

14 There is an unclassified analysis on the material condition of our transport helicopter fleet beginning on page 13 this paper.

15 MCBUL 3125 (USMC Aviation Master Plan), dtd 27 JUN 1996.

16 75 NM is the range of a CH-46E equipped with bull frog fuel tanks.

fully when fighting in a major conflict.[17]

Understanding Linear Battle Space

The linear battlefield can be described in terms of an American style football game. Each side lines up on one side of the ball or the other (along fairly straight lines). Upon the snap of the ball, the players crash into one another (mingle) to advance or stop the advance of the ball. At the end of each play, the players realign based upon the ball's new location and prepare for the next play. Similarly, on a linear battlefield, the opposing forces are aligned facing one another, at what is referred to as the forward line of troops (FLOT) or forward edge of the battle area (FEBA). Trench warfare in France during World War I was an example of linear alignment. On a linear battlefield, one force will launch an attack to gain an advantage (breakout) over the opposing force. Here, local superiority is usually accomplished by the attacker *maneuvering* forces behind his FLOT (in the friendly rear area) to gain combat superiority at one location or flank, (much like the power sweep in football). (Coalition Forces used this technique during Desert Storm to position forces for the ground phase of the war). After the attack, the forces will again align themselves, based upon the new FLOT or FEBA. In this linear style of combat, firepower and mass are critical. On the defense, a mobile reserve is required to counter enemy success.

As was the case in Desert Storm, Marine Corps transport helicopters will be unable to operate forward of the FLOT, in direct support of advancing (breakout)

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[17] Captain John D. Manza, "Helicopterborne Operations in a Major Regional Contingency," *Marine Corps Gazette*, October 1995, 26.

maneuver forces. This is because of their inability to counter today's threat.[18] Yet, **because of our increasing dependence upon transport helicopters for logistics, especially fuel resupply, Marines will be forced to continue planning linear battlefield operations** (despite their maneuver warfare doctrine). While Marine Corps CH-53E Super Stallion helicopters have the speed, range and payload to keep the logistic supplies (fuel, water, ammunition) flowing to breakout maneuver forces,[19] they are not properly equipped to counter the threats which face them on a non-linear, maneuver style battlefield.

> The Marine Corps is not designed to be a second land army, yet it must have the organic capability to exploit (success during) an amphibious operation. In Desert Shield/Storm it (the Marine Corps) simply did not have sufficient line fuel haul -- fuel transport trucks -- for subsequent operations ashore... We were able to get some precious line haul from the Army, but that support will certainly not be available early on in an amphibious operation.[20]

Unfortunately, there is no rear area on a maneuver battlefield. During a maneuver warfare scenario, some units will constantly be in contact, while others will bypass the enemy to gain spatial advantage. These bypassed units could be lethal to our transport helicopters. The following look into recent air defense threats will document why today's Marine transport helicopter fleet is so vulnerable to the threat.

The Threat to Heliborne Forces

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[18] An unclassified discussion of the current threat facing transport helicopters follows in this text at "The Threat to Heliborne Forces."

[19] For additional information on the subject of keeping the maneuver forces refueled, see the January 1997 edition of *Marine Corps Gazette*. Note articles by Col. Charles O. Skipper and Capt. David J. Dowling.

During the Yom Kippur War of October 1973, the Egyptian air defense barrier was a "multi-lateral and multi-altitudinal, combination of surface to air missiles... and guns."[21] The missiles were a combination of SAM-2, SAM-3 and SAM-6, the last being completely new to the West. The static SAM-2 and SAM-3's had a range of up to 30 miles and had been used extensively by the North Vietnamese against the United States. By the late 1960's, Americans had developed electronic countermeasures (ECM) against the SAM-2 and SAM-3. By 1970, however, the Egyptians received SAM's with a newer type of terminal guidance radar to keep the missiles on target. These missiles had a greater range of frequencies than the American-supplied Electronic Counter-measures (ECM) held by the Israelis.[22] Thus, it was impossible to maneuver helicopter forces around the Egyptians.

> ...the Egyptian air defense consisted of 180 radar sites, 50 control centers and 400 different radars... It was stated at an Israeli Symposium that the Egyptians had 146 SAM batteries. The (Egyptian) engineers had constructed 650 individual launcher platforms... with at least as many dummies.[23]

This formidable air defense umbrella of SAMs wreaked havoc on the Israeli Air Force during the first few days of the campaign. But the greater danger came from the anti-aircraft guns. The Egyptians had 800, four barreled Soviet ZSU-23-4's. The ZSU-23-4 is capable of firing 4,000 rounds per minute. The ZSU-23-4 can be operated optically or with radar, as part of an Integrated Air Defense (IAD) network. When several are fired together, a solid wall of lead blankets the sky. No commander can possibly expect a flight

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20 Col. Charles O. Skipper, *Can We Fuel OFMTS?* 47.
21 Edward O'Bannon. *No Victor, No Vanquished.* 280.
22 Ibid., 281.
23 Ibid., 281-282.

of helicopters (or V-22's) to pass through this kind of air defense unscathed. Additionally, the Egyptians had 37mm anti-aircraft guns and 14.5 mm heavy machine guns for use against low flying jets and helicopters.[24]

To compound the dilemma for Israel, the Egyptians had hundreds of short range, shoulder fired SAM-7 missiles. The SAM-7 was used successfully by the Vietnamese against American helicopters in Southeast Asia. (American jets quickly countered the SAM-7 with heat flares and jinking maneuvers). Unfortunately for the Israelis, the Egyptians had newer SAM-7's with infrared filters that did not react to flares. Additionally, the Egyptians fitted (modified and attached) multiple SAM-7's to tracked vehicle chassis and fired them in salvos. This proved extremely effective against low flying aircraft.[25]

> By the end of the first day of the 1973 Yom Kippur War, the Israelis had lost from both missiles and ZSU's at least thirty A-4 Sky Hawks, ten F-4 Phantoms and a portion of their best pilots, the cream of their hunter squadrons... The Israelis then tried extremely low-level flying tactics... but the Sam-7 missiles proved a magnificent success in bringing down the attackers.[26]

The above analysis is critical because the Israeli aircraft were electronic counter-measures (ECM) equipped "fast movers," flown by some of the best trained pilots in the world. The Egyptian forces were, for the most part, poorly trained, fighting with simplistic Soviet equipment. **Tragically, nothing has changed over the past 24 years which would prevent similar catastrophic losses to U.S. Marine transport helicopters attempting to execute maneuver warfare against a similar air defense**

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24 Ibid., 284.
25 Ibid.
26 Ibid., 293.

network.[27] Admittedly, no credible commander would attempt to conduct maneuver warfare with heliborne forces in this environment. Yet, even the use of transport helicopters in a logistical support role in this environment could be fatal. Thus, if Marine transport helicopters (as currently equipped) are going to survive, they must be restricted to the secure rear areas of a linear battlefield.

In the Persian Gulf War, the Coalition Forces faced a very similar threat. The Iraqi's air defense was mixed with numerous layers of surface to air missile systems, plus many large, medium and small caliber anti-aircraft cannons and an extensive ground-based radar control system.[28]

> Iraq had 600 surface to air missile sites (with one or more launchers) and over 10,000 antiaircraft artillery pieces (mostly 23-57mm effective up to 12,000 feet).[29]

Each Iraqi division doctrinally had one or two anti-aircraft battalions of about 100-300 men each. Therefore, each division had up to 36 anti-aircraft artillery guns (23-57mm). The mechanized units had all or most of their anti-aircraft guns self-propelled.[30]

> Low-altitude anti-aircraft cannon, machine gun fire and mobile surface-to-air missile fire continued to cause most (actually all) of the aircraft losses in the Gulf War.[31]

The Iraqi threat made it impossible for Marine Corps transport helicopters to maneuver forces behind Iraqi defenses. Our doctrine, developed in the 1980's, emphasized employment of helicopters in a manner that utilizes terrain, vegetation, and

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[27] For additional information, see MCM 3-1 Threat References and Countertactics Guide. This publication describes the current and projected Integrated Air Defense System (IADS) threat that helicopters will likely encounter.

[28] James F. Dunnigan and Austin Bay, *From Shield to Storm, 146.*

[29] Ibid., 147.

[30] Ibid., 81.

manmade objects to enhance survival by degrading the enemy's ability to visually, optically, and electronically detect or locate the aircraft.[32]

> The current method of self-defense is the use a combination of terrain masking, covered by the darkness of night, and flying at very low altitudes in addition to the antiquated, non-integrated aviation survival equipment.[33]

The problem in the gulf was that there was no significant terrain or vegetation to mask large flights of transport helicopters which would attempt to maneuver on the battlefield. Any movement forward of the FLOT would have been suicidal. This was an important reason why the Marines did not attempt an amphibious assault with the 4th and 5th Marine Expeditionary Brigades.

U.S. Army transport helicopters faced similar threats in their sector. However, the H-47 and H-60's flown by Army pilots were equipped with helicopter night vision systems (FLIR), armor, engine exhaust suppressors, IR jammers, and upgraded automatic countermeasures suites. Once the initial air defense network was disabled by Coalition airpower, these transports were able to operate in direct support of the Army thrust into Iraq. Marine transport helicopters, without similar equipment, only operated ***behind*** the FLOT to provide logistical support on a linear battlefield. Can the Marine Corps realistically hope to maneuver combat forces by helicopter and conduct logistical sustainment forward of the FLOT against a credible threat?[34]

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[31] Ibid., 167.

[32] CH-53 Tactical Manual, (NWP 55-9-CH-53, Vol.. 1), 3-1.

[33] Mission Needs Statement for Assault Support Aircraft Survivability Enhancements (NO. AAS 34.3), 1.

[34] For more detailed information on the future threat see the Defense Intelligence Center AIM-9X System Threat Assessment Report (#043-94) and the Tactical Strike and Air Warfare System Threat Assessment Report (#017-94). Additional information is

Marine Corps Transport Helicopters

Our current fleet of transport helicopters consists of the following; the medium lift CH-46E "Sea Knight", the medium lift CH-53D "Sea Stallion" and the heavy lift CH-53E "Super Stallion." The following is a brief description of the missions of each of these helicopters and an update on the future material readiness of the transport helicopter fleet. **The inventory status, material readiness, and obsolescence of this fleet have been criticized repeatedly in the *Marine Corps Gazette* the last few years.**[35]

The CH-46E's primary mission is troop transport. Its secondary mission is the transport of cargo and supplies. Today's CH-46E has a combat radius of 75 nautical miles (NM) and can transport 15 combat loaded Marines or 4,000 pounds of payload. Now approaching 35 years of service, the CH-46 is a modified commercial helicopter that is used extensively by the logging industry. Although the CH-46 has been upgraded several times over its service life, the aircraft has been plagued by material failures during its three decades of service. Cracked rotor heads, pitch shafts, extensive corrosion, and metal fatigue have often grounded the entire CH-46 fleet.

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found in the DIA validated USAF Special Operations Aviation Forces Threat Description, DST-2660F-276-93 of 3 Sept 93 and in the Tactical Air Combat Threat Environment Description (U), DST-2660F-730-94 of 25 Jul 94.

[35] For further reading on this subject see the following articles in the *Marine Corps Gazette:* The Decline of Marine Helicopter Aviation, Capt. James L. Cox, December 1994; Helicopter Operations in a Major Regional Contingency, Capt. John. D. Manza, October 1995; 21st Century Medium Lift; The CH-46 in the 1998-2005 Timeframe, Capt. David W. Coffman, May 1994, The CH-53E Super Stallion: Alone, Unarmed, and Unafraid, Capts. Larry Fulwiler and Roger N. Hinkle, May 1994.

The 1996 Marine Corps plans to replace the CH-46 with V-22 no later than the year 2020.[36] However, the CH-46 should have been replaced during the Reagan Administration's defense build-up when both the U.S. Army and Navy procured newer, more capable combat helicopters. Together, the Army and Navy saved the Department of Defense untold millions of dollars by procuring a common helicopter, the H-60. This "jointness" resulted in an aircraft with a common logistical and technical support base. Moreover, as the Defense Department continues to downsize, the Army and Navy will continue to enjoy the benefit of acquisition reform initiatives which will combine training and logistics bases (to save the taxpayers additional millions). Of note, the Navy elected to replace its entire CH-46 fleet with the H-60 during this budget cycle in order to further modernize and mirror image its helicopter fleet.[37]

> During the early 1980's, the Army purchased UH-60's as the backbone of its air assault capability. In conjunction, the Navy funded R&D to make the aircraft shipboard compatible. The result was the SH-60 Sea Hawk, used primarily for anti-submarine warfare (combat search and rescue, vertical replenishment) and for over the horizon surveillance capability. The UH-60, altered with Navy modifications (is) an excellent replacement for the CH-46E.[38]

With its current force structure, the Marines require an inventory of 425 medium lift helicopters. Today, there are only 237 CH-46E's in the inventory. Considering the 40 CH-53D's in Hawaii, the Marine Corps is 148 medium lift airframes below requirement. Of note, all of the CH-46E airframes must be upgraded with new dynamic components (rotor heads, drive shafts, pitch shafts, etc.) in order to remove current operational

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[36] 24 AC/YR Profile Sequential, MV-22 Squadrons/PAA Inventory Plan, N880G. Note that this profile is not currently funded in the President's budget submission.

[37] POM 96 included $300 million for a new Vertical Replenishment Helicopter.

restrictions. This effort, known as the Dynamic Component Upgrade (DCU), will extend the service life of the CH-46E's critical components out to the year 2020. Unfortunately, after committing nearly $1 billion, DCU is currently running over budget and behind schedule.[39] **If the V-22 program is slipped or canceled again (because of technical failure or budget cuts), our ability to conduct assault support in the MEF's rear area will be seriously degraded by a shortage of medium lift airframes.**

The other (far more capable) Marine medium lift helicopter is the CH-53D. The primary mission of the Sea Stallion is troop transport during an amphibious assault. It has a secondary mission of moving cargo and supplies. Capable of lifting 36 combat loaded Marines[40] or 12,000 pounds of cargo, the CH-53D has a 200 NM combat radius. Unfortunately, the Sea Stallion has been "put out to pasture" in Hawaii, where four squadrons now act as little more than place holders for the V-22. These squadrons do not deploy with the Marine Expeditionary Units or the Unit Deployment Program. The CH-53D's are, however, the MEF commander's "hip pocket" medium lift assets in the Pacific (on paper at least).

According to the Marine Corps Aviation Plan, the CH-53D will remain in service until the year 2015![41] Unfortunately, Marine CH-53D's have over 25 years in service and they have never had a comprehensive airframe assessment. Additionally, an analysis of the airframe changes (modifications and upgrades) required to extend the aircraft to 2015

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38 Capt. James L. Cox, "The Decline of Marine Helicopter Aviation," 47.

39 Telephone interview with APP-23, Aviation Plans, Programs & Budget, HQMC, on 21 January 1997.

40 CMC policy limits the CH-53D\E to 24 passengers during peace time operations.

41 AVPLAN'96 Consecutive East West Coast V-22 Standup (pipe and attrition not considered).

has not be funded. These aircraft were designed with a 20 year, 10,000 hour service life. Many of the components, especially the avionics systems, suffer from parts obsolescence.[42] **Despite a formal request for a service life analysis on the CH-53D from the Assistant Deputy Chief of Staff for Aviation (Headquarters Marine Corps), to the Chief of Naval Operations, Air Warfare (Code N88), the service life analysis has not been funded. Restated, N88 has not placed a high enough priority on sustaining theCH-53D fleet.** N88 should provide adequate funding for a service life analysis and/or extension, adequate aircraft survivability equipment, avionics and cockpit modernization and helicopter night vision system (FLIR).[43] Ironically, these Hawaii based aircraft are now the last aircraft in line to be replaced by V-22.

Significant savings are available if the CH-53D type/model/series (TMS) is retired soon. The TMS unique engines, parts, publications, and training can be eliminated to yield an immediate return in the millions of dollars. **The CH-46E should be replaced by V-22 last as we have just invested nearly $1 billion into the Dynamic Component Upgrade Program and a new Communications and Navigation Upgrade.**

The Marine Corps' heavy lift helicopter is the CH-53E. This aircraft entered the fleet in the early 1980's. Designed to carry up to 32,000 pounds of cargo, the Super Stallion's primary mission is the transport of cargo and supplies. Aerial refuelable, the CH-53E is the prime mover for the M-198 Howitzer, the Light Armor Vehicle and the High Mobility Multi-purpose Wheeled Vehicle (HMMWV). Additionally, the CH-53E is the prime mover for all of the Marine Corps' heavy trucks, bridging assets, bulldozers,

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[42] Telephone interview with the Assistant CH-53 Program Manager, (PMA-261), Naval Air Systems Command, February 23, 1997.

forklifts, and tactical bulk fuel and water delivery systems. Of note, the HMMWV is the only asset mentioned above which weighs less than 10,000 lb.. **Any item in the Department of Defense inventory above 10,000 lb. will not be V-22 compatible.**[44]

As the first production lots of CH-53Es approach 20 years of service in FY00, they too will need a service life extension and a mid-life upgrade. The CH-53E is expected to be in service until the 2025 timeframe. Unlike the CH-46 or CH-53D, however, the CH-53E has a 6,000 hour airframe. Some of the key structural areas that will fail because of metal fatigue include the main gear box support structure and the tail pylon folding hinge (these areas need replacement before 6,750 flight hours).[45] Like the CH-53D, many of the Super Stallion's avionic components are already obsolescent.

The Marine Corps' stated heavy helicopter requirement is 198 CH-53E's (including the Reserves). Yet, only 168 airframes are in the inventory (including the aircraft now under contract for the Marine Corps Reserves). Therefore, the Marine Corps is currently 30 heavy helicopters short of its stated requirement in an aircraft community which is scheduled to serve another 28 years! **Accounting for the fact that the first production lots will be forced into retirement because of airframe fatigue by the year 2000 (only three years from now), the Marine Corps' ability to conduct heavy lift assault support behind the FLOT will be grossly degraded by 2005**. In FY05, the **Marine Corps will go below programed aircraft allowance (PAA) in its Heavy**

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43 Telephone interview with N880F03, Air Warfare Staff, on February 18, 1997.

44 The list of 10,000+ items (Table of Equipment) certified for lift by the CH-53E is very extensive. For further information see the *Department of Defense Cargo Loading Manual*, published by the Department of the Army.

45 Telephone interview with the Assistant CH-53 Program Manager (PMA-261) on 23 February 1997.

Helicopter Squadrons.[46] Yet, funding for a Service Life Extension Program or a Midlife Upgrade has been cut or eliminated in recent budget submissions. The funding that remains in the out years of the budget *is not adequate* to address the total CH-53E airframe upgrade/modernization requirement. Once again, all of the material factors confronting the current fleet of Marine Corps transport helicopters will have a direct impact on the Marine Corps' ability to conduct ship-to-shore and ship-to-objective maneuver and sustainment. With this understanding of the material condition of our transport helicopter fleet as a foundation, let us now look at aircraft survivability.

Aircraft Survivability

There are four ways that a rotorcraft can be detected by the enemy. It can be detected visually, acoustically, thermally (infrared) or electronically. Thus, the challenge to the designers of combat aircraft is to reduce the chance of detection and still meet a service's performance specifications. Any reduction in the "chance of detection" by an enemy is referred to (by threat analysts) as a reduction in the "susceptibility" of the aircraft. The services delineate performance specifications in their Operational Requirements Document (ORD).

Visual signature is a function of size, shape, coloring (paint scheme), glint (glare) created by moving parts (rotors, props, flaps), the exhaust gas trail and sand, dust or snow disturbances (caused by rotor downwash). For transport rotorcraft, the mission specifications in the ORD will drive size requirements. Examples of mission specifications are the numbers of troops to be carried, types of equipment or cargo to be transported and the necessity for shipboard compatibility. The V-22, for example, is

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46 Ibid.

required to carry 24 combat loaded Marines or 10,000 pounds of cargo (internally or externally). It must also be compatible with the projected inventory of amphibious assault ships. Thus, V-22 must be large enough to carry 24 combat loaded Marines or a HMMWV externally and still be small enough to fit on an LHA or LPD class ship.

The type of paint applied to the fuselage of an aircraft will affect its IR signature and may help reduce glint. An appropriate color scheme will also reduce the visual signature of an aircraft to the naked eye. For overwater operation, the Naval Air Systems Command has mandated a light gray, low-infrared (IR) paint. The Army, which does most of its operations over land, uses a dark green, low-IR paint. In the Persian Gulf area, most forces elect a low-IR sandstone color. The idea is to camouflage the aircraft for the most likely operating environment.

Glint is the glare or reflection produced by the sun (or moon) as an aircraft moves or jinks through the air (or when rotor blades or props are turning on the ground). Helicopters with worn (bare metal) rotorblades can reflect the sun for miles (like a signal mirror). The design engineers mitigate this by using composite materials in the rotors and putting low reflective plastics in the windscreen and canopy. Newer generation low-IR paint has eliminated most airframe glint problems.

Exhaust trails, produced by the engine, can be a problem. The ambient conditions, the type of fuel and the efficiency of the aircraft engine play a big part in the production of exhaust trails (emissions). While this is more of a problem for fixed wing aircraft, some helicopters can leave a very noticeable exhaust trail. Operating at night helps to eliminate this type of detection.

The last visual detection problem is the dust or snow clouds created by the powerful rotor downwash of large transport helicopters. Some rotorcraft create dust clouds that, in some environments, can be seen for miles. These dust clouds compromise friendly positions and allow the enemy to target our forces. Again, operating at night will help minimize this problem.

Acoustics are critical to rotorcraft design today. The noise produced by the engines, rotors and drive systems produce an unmistakable signature. Some helicopter rotor systems, like the CH-53E's, produce incredible shock (sound) waves. These shock waves, moving at the speed of sound, can announce the arrival of slow flying helicopters well in advance of the actual arrival of the craft. This can have deadly consequences for the arriving force. In Vietnam, the unmistakable "wap, wap, wap" (sound) of the UH-1 Huey helicopter always announced its arrival to both friendly and enemy troops.

Advanced technology can be used to detect the acoustic signature of a helicopter. One current threat which uses advanced acoustic technology is the acoustic land mine. These mines are programmed to explode if subjected to the acoustic signature of a helicopter. Acoustic mines will allow a defender to deny landing zones to heliborne assault forces. **Just as shallow water mines have placed the entire concept of amphibious assault in question, acoustic mines have placed the future of heliborne assault in doubt.**

All aircraft emit infrared energy. Thermal (infrared) detection is *the* major problem facing today's transport helicopter fleet. Radiation from the engines, rotating dynamic components and the airframe structure (which absorbs heat from the engines

and transmissions) are the most dominant IR contributors.[47] Depending upon the ambient surface temperature, an aircraft with a high infrared (IR) signature can easily be detected several miles away. **In this case, operating at night may exacerbate the IR problem. Cooler terrain will make the hot aircraft more detectable.**

Electronic or electromagnetic detection is accomplished by the transmission of radio waves through the air or from space. Radars emit and focus a powerful RF[48] beam and display a target's range, altitude, distance, azimuth, and velocity using reflected RF energy. Generally, three types of radar are found on the battlefield; continuous wave radar (used to illuminate a target for missile homing), pulsed-Doppler radars (used by aircraft and advanced ground systems), and pulsed radars (used for area search and target acquisition).[49]

Aircraft Survivability Equipment

Electronic warfare equipment is designed to make an aircraft more survivable in a high threat environment. This equipment provides the operator with threat information (warning) and countermeasures expendables. The warnings, deployment of counter-measures, and evasive maneuvering by the crew are critical to the survival of the aircraft (and crew). It must be noted, however, that in a high threat environment, the best tactics are to deny enemy acquisition (of the friendly aircraft) by executing terrain flight

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47 See NWP 55-9-CH-53, Vol I, Chapter 8 for additional IR signature considerations.

48 RF is the abbreviation for radio frequency and is used to differentiate that portion of the electromagnetic frequency that is not visible light, infrared, ultraviolet radiation or X-rays.

49 NWP 55-9-CH-53, Vol. 1, 8-2.

profiles, deception, and getting support from a dedicated ECM platform (like an EA-6B). **EW equipment alone will not protect transport rotorcraft.**[50]

The race to maintain technical superiority over the threat has produced a plethora of survivability equipment. The following design features can be engineered or retrofitted into an aircraft to enhance its chance of survival against a specific threat. This list is intended to inform the reader of the types of survivability enhancements that are available from the defense industry today.

(a). Radar Detectors - Systems which detect the emission of RF (radio frequency) energy normally associated with radar equipment. Systems will normally provide the crew with a warning that the aircraft has flown into an area being covered by a threat radar.

(b). Infrared (IR) Missile Warning Systems (MWS) - MWS's are designed to protect an aircraft from surface-to-air and air-to-air missiles. MWS's are usually passive systems which will detect the IR signature of an inbound missile (fired at the aircraft). The MWS is intended to operate in a dense battlefield environment where multiple friendly aircraft are operating in close proximity to one another. The missile warning system may be tied to an automatic counter-measures dispensing system as reaction time is usually beyond the aircrew's capabilities.

(c). Automatic Countermeasures (ACM) - ACM systems are designed to automatically dispense onboard chaff or flares in response to a detected threat. These systems must be engineered into existing onboard system hardware and software architectures. The benefit of an ACM system is the reduced response time for

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50 NWP 55-9-CH-53, Vol. 1, 20-1.

deployment of countermeasures. Often, human response time is too slow to counter the threat. A big negative associated with automatic countermeasures is the potential for false alarms which *inadvertently* fire defensive countermeasures. This can give away an aircraft's position and degrade friendly night vision devices and radar. Additionally, when automatic countermeasures systems are installed on an aircraft, system software must be upgraded whenever there is a change to threat or friendly EW systems. This causes an almost impossible systems engineering/logistics burden on the acquisition community. Thus, false alarms and inadvertent firings are minimized by operating the countermeasure suite in the manual mode (which of course defeats the purpose of having an automatic countermeasures system).

(d). Laser Warning Devices - Laser technology is expanding rapidly. Many countries now employ lasers on the battlefield for targeting and range-finding. Unfortunately, their effect on humans and equipment is often immediate and permanent. A laser warning device alerts the crew that their aircraft is receiving laser energy. The crew must then take evasive action.

(e). IR Suppressers- The engines produce most of an aircraft's IR signature. IR suppressers, attached to the exhaust section of an engine, will dissipate heat by mixing the hot engine exhaust with cooler ambient airflow. The IR suppresser also blocks the direct line of sight (of an inbound missile warhead/seeker) into the gas turbine of the engine. The gas turbine is the hottest (exposed) part of the engine. Infrared suppression is desired to reduce the heat signature of the aircraft, thereby making infrared detection (target acquisition) less probable.

(f). IR Jammers - Infrared jammers are active systems which transmit modulated infrared energy in the wave lengths used by known infrared homing missiles. Radiated emissions are usually controlled by high-intensity IR source lamps (transmitters) located near the aircraft engines. The jammers are intended to overload and overwhelm the inbound IR seeker, causing it to lose the target and fly harmlessly off course. Obviously, the jammers must be programmed to the IR frequency band of the inbound missile. (This is where intelligence data is absolutely essential). If the jammers are programmed to the wrong frequency, they can actually act as a magnet, attracting the missile to the aircraft! Thus, fielding the appropriate jammer for the expected threat is critical. Unfortunately, the time delays inherent in our rotorcraft budgeting, programming, procurement and installation cycle (normally seven years) guarantees that transport rotorcraft will be several years behind the most current threat.

Aircraft Survival Equipment on Marine Transport Helicopters

Our transport helicopter fleet is woefully ill-equipped to operate in the medium to high-intensity threat environment. FM 100-5 defined the mid-intensity to high-intensity battlefield as follows:

> The high to mid-intensity battlefields are likely to be chaotic, intense, and highly destructive... Potential enemies of the United States can be expected to field large quantities of high quality weapons systems whose range and lethality equal or exceed our own. Potent ground and air systems, complemented by precision guided munitions, will be able to concentrate enormous combat power, especially at decisive points... Wide ranging surveillance, target acquisition sensors, and communications that will provide information almost immediately will increase the range and scope of battle.[51]

[51] FM 100-5, *Operations*, Headquarters, Department of the Army, Washington, D.C., 1986, 2&3.

Both the CH-46E and CH-53D helicopters are only equipped with the following; the AN/APR-39 (V) 1 radar signal detecting set, the AN/ALE-39 countermeasures dispensing set, and the AN/ALQ-157(V) infrared countermeasures set and aircraft/engine armor kits.

The CH-53E has all of the above equipment except the aircraft/engine armor. Additionally, the CH-53E has been equipped with an AN/AAR-47 missile warning system. All Marine transports helicopters continue to carry two of the Vietnam era MX-218, crew operated, .50 caliber machine guns. The following is an unclassified description of these survivability systems.[52]

The AN/APR-39(V)1 radar signal detection set provides the helicopter aircrew with bearing and mode of operation of radars that operate in the E-,F-,G-,H-,I-, and J-bands and portions of C- and D-bands for radar associated signals. A radar signal indicator displays strobes and is accompanied by audio tones in the aircrew headset. The strobes are displayed on a radar signal indicator (cathode ray tube) that displays the possible threat. The indicator is divided into four quadrants. Each quadrant represents the area scanned by one of four spiral antennas located on the aircraft.[53]

The AN/ALE-39 countermeasures dispensing system is used to dispense counter-measures expendables from the helicopter. The approved expendables includes metallic chaff and flares. Dispensed expendables are intended to deceive enemy radars and infrared sensors. Helicopter crews "buy time" with expendables in order to evade the

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[52] For a more detailed, unclassified description of the ASE systems, see CH-53 Tactical Manual NWP 55-9-CH-53, Vol. 1. Classified information on these systems is in Vol 2 of the same NWP series.

enemy air-to-air or surface-to-air threat. The AN/ALE-39 is capable of dispensing single or programmed sequences of chaff (RR-129, RR-129T, RR-144) and flares (MJU-27/B, MJU-8, MJU-32, and MK-46).[54]

The AN/ALQ-157(V)2 infrared countermeasures set is an active IR jamming system that transmits modulated infrared energy in the wave lengths used by infrared homing missiles. The system radiates continually while active. Radiated emissions are controlled, pulsed, high-intensity, infrared energy from two IR source lamps.[55] The system is completely automatic once initiated and requires no inputs from the pilot or aircrew. Advanced, vastly improved versions of this system have been developed for use on commercial airliners, and other high IR source aircraft. Unfortunately, after testing and failing the AN/ALQ-157(V)2 on the CH-53E, the Marine Corps has not obtained funding for the development of an adequate infrared counter-measures jammer for the CH-53E.[56]

The AN/AAR-47 missile warning set is currently fielded on the CH-53E. This is a passive electro-optical threat warning system designed to detect the exhaust plume radiation emissions that emanate from a missile fired at the helicopter. It discriminates against false targets and those missiles not fired at the helicopter. The system will automatically trigger countermeasures by sending command signals to the AN/ALE-39

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53 NWP 55-9-Ch-53E, Vol. 1, 20-1,2,3.
54 NWP 55-5-CH-53, Vol. 1, 20-18.
55 Ibid., 20-40.
56 Telephone interview with APW-51, January 21, 1997.

countermeasures dispensing set. The system is designed to operate in a threat environment which will exceed aircrew reaction time.[57]

Existing Shortfalls

Current and forecasted Laser/IR/Radar/AAA threats negate prevailing helicopter active and passive countermeasure capabilities.[58]

> (a). The currently fielded ALQ-144/157 IR jammers employed on USMC transport helicopters are ineffective against second generation or later IR surface-to-air and air-to-air missile systems.
>
> (b). The MK-46, MJU-8B, MJU-27B and MJU-32 decoy flares can not counter new generation missiles, to include the latest semi-automatic command to line of sight guided antiarmor/anti-helicopter weapons, which employ infrared countermeasures. These flares, which also operate in the IR and visible light spectrum, severely degrade the employment of night vision devices. Adversely, the brightness also highlights the flare user to a variety of non-IR weapon systems.
>
> (c). Current chaff bundles do not provide sufficient protection against threat radars which are typically employed against low/slow flying helicopters. Currently employed chaff is inadequate in both radar cross section and threat frequency coverage.[59]
>
> (d). Active radar jammers are severely degraded when employed at low altitudes. This limitation adversely affects the development of tactics which support the air assault mission. Moreover, the firing squibs, used to initiate ejection of various expendables (flares, chaff, jammers) all operate in the visual spectrum and present similar limitations as described above for flare usage at night.
>
> (e). The ALE-39 dispensing system has the following deficiencies:
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> 1. Limited quantity of expendables.
> 2. Lack of integration with other Defensive Electronic Counter-

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[57] NWP 55-9-CH-53, Vol. 1, 20-8.

[58] Existing shortfalls are taken from the Mission Needs Statement for Assault Support Aircraft Survivability Enhancements (NO. AS 34.3), 1 & 2.

[59] For further study of expendables, see OPTEVFOR Tactics Guide AZ343243.90-01-86, conducted by naval Warfare Center China Lake.

measures/Electronic Warfare Equipment.
3. Non-user friendly programming system.
4. Inability to increase the number of events per second.

CNO Project 0806B NTIC TA# 01790 and the *MCM 3-1 Threat References Guide and Countertactics Guide* highlight the current helicopter survivability deficiencies against low, medium, and high threats. **...these studies indicate that currently fielded USMC helicopters passive and active electronic survivability equipment fails to provide adequate protection against modern threat systems... These studies concluded that changes to doctrine, tactics, and employment methods alone are no longer adequate to counter the increasing capability of threat detection/ acquisition radars...**[60]

The V-22 Osprey

Technologically, V-22 will be a quantum leap over our existing transport helicopter fleet. The *Osprey* will be the most survivable transport rotorcraft ever built. V-22's increased speed, range and maneuverability will far outpace conventional helicopters. The Osprey can travel at twice the speed of a conventional helicopter. (This speed advantage may cut exposure time to the threat in half). Increased range and altitude capabilities will allow the V-22 to fly above or around known threats. This will help minimize exposure (to threat systems) and will reduce attrition.

V-22 is engineered with a lower visual, acoustic and infrared signature than our current fleet of transport helicopters. This will also reduce detection and attrition in the high threat areas of the battlefield. Advanced aircraft counter-measures equiment (IR jammers, chaff, flares, EW suites) have been included in the design to reduce susceptibility to the threat. A major advantage is that these new systems are fully

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60 Mission Needs Statement for Assault Support Aircraft Survivability Enhancements (NO. AAS 34.3), 3. **"Bold emphasis"** added by this author**.**

compatible with the digital architecture of the V-22 avionics suite and are incorporated into the mission software. The counter-measures systems used by Marine transport helicopters today are analog kits that were not customized for the aircraft on which they are employed.

Most importantly, V-22 has been designed from the ground up to be a combat aircraft. It is not a commercial helicopter derivative. This aircraft is ballistically tolerant. It has a triple fly-by-wire flight control system, composite airframe structure, redundant flight control surfaces (rudders and flaperon actuators), self-sealing fuel bladders, hydraulic ram protection, fire suppression systems and armor. Moreover, all critical flight systems are isolated, redundant and well separated (disbursed) throughout the aircraft. This "systems protection effort" and increased ballistic tolerance reduces the vulnerability of the V-22 to small arms fire, shrapnel and flak. (V-22 was even designed with an overpressure and filtration system to provide protection for an NBC environment). This will undoubtedly increase mission success and lower attrition.

Additionally, night, all weather, low-level performance capability via Forward Looking Infrared Systems (FLIR), moving map displays, integrated day/night Heads Up Display (HUD) will improve navigation and allow the operator to use more advanced tactics in a high threat environment. Because transport rotorcraft are so susceptible to visual detection, most modern armed forces have elected to pursue night fighting tactics to mask their movement. Obviously, operating at night significantly reduces the chance of a rotorcraft being visually acquired by the enemy. Unfortunately, night time operations require much more detailed planning, rehearsal and coordination. Additionally, the

enemy may be equipped with night vision devices.[61] There are operational issues regarding the employment of V-22 which remain.

Because of the threat, V-22 may be the only transport rotorcraft capable of flying forward of the FLOT to resupply, sustain and maneuver forces. Unfortunately, V-22 is a medium lift aircraft. It is only designed to lift 10,000 pounds of cargo (about the same as an H-60). This is less payload than a CH-53D and a mere fraction (less than 1/3) of the heavy lift CH-53E's payload. Worse yet, when carrying external cargo, a HMMWV for example, the V-22 loses most of its fixed wing speed advantage due to the aerodynamic tolerance of the external load. Patuxent River conducted high speed external load testing on the HMMWV and found its maximum airspeed to be a mere 169 knots calibrated air speed.[62] In other words, **the V-22 may not significantly improve the logistic tonnage or the speed at which maneuver units are sustained.** This is because V-22 will have to make additional (multiple) trips to carry the equivalent of what other transport rotorcraft carry today. For example, a CH-53E can carry 2 HMMWV's and 24 passengers per sortie (22,000 LB) or up to 32,000 lb. of fuel, water, ammunition or equipment per sortie. **V-22 would have to make three round trips to accomplish the same sortie equivalent (wasting valuable time and repeatedly exposing Marines to the threat) .** What initiative is lost to the enemy while the Ground Combat Element and Combat Service Support Element waits for V-22 to build up combat power ashore?

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[61] During Desert Storm, the Iraqis simply started multiple oil well fires. This negated our ability to fly on night vision goggles. The bright light from the oil well fires "washed out" the goggles (which are designed to shut down if there is too much light) and the smoke took away the ambient lux (star light and moon light) for which the goggles were designed.

Finally, V-22 may already be technologically obsolete (in light of the most advanced anti-aircraft threat systems).[63] New generation surface to air missiles, anti-aircraft artillery, anti-helicopter land mines, and the lack of a "funded" long range, low altitude reconnaissance aircraft or remotely piloted vehicle may hamper and restrict the use of *all* rotorcraft in the near future. Moreover, the extended production profile (long term delivery schedule) for V-22 (a 20 year period) virtually assures that it will not be a "player" at the operational level of war for the next 15 years.[64] Unfortunately, even after V-22 is fully operational, logistical constraints (fuel resupply) and the chronic shortfall of escort aircraft, tanker aircraft and heavy lift helicopters will continue to negate MEF level maneuver as envisioned in FM FM-1 (Warfighting).

Conclusions and Recommendations

Today, U.S. Marines can not train for maneuver warfare at the operational level of war because of our impotent transport helicopter fleet. We are restricted to 75 nautical mile *tactical* ship-to-shore or ship-to-objective movements with assets that are totally unsuited for today's threat environment. Integrated air defenses make any helicopter maneuver beyond the FLOT a dangerous gamble for our commanders which could eventually result in a catastrophic loss of life. Moreover, Marine Corps transport helicopters are chronically deficient in night fighting capability. Every Marine Corps transport helicopter should be equipped with FLIR, NVG HUD, and a moving map display. We are light years behind the U.S. Army in this regard. Of note, none of our CH-

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62 Patuxent River, Rotary Wing Directorate, CH-53E External Load Evaluation of the HMMWV, Capt. Curtis Haberbosch and Mr. Bob Steinbach, dtd 12 Nov 1993.

63 Mission Needs Statement for Assault Support Aircraft Survivability Enhancements (No. AAS 34.3).

46E's or CH-53D's are equipped with forward looking infrared sensors (FLIRS) and only a small fraction of our CH-53E fleet will have a Helicopter Night Vision System (FLIR).[65] These night fighting upgrades are required because **Marines will need to fly at night** to survive most scenarios (even on a linear battlefield).[66]

The future of rotary wing transport helicopter aviation is not bright. MEF level ship-to-shore and rear area operations (behind the FLOT) will be questionable after the year 2005. Not only is the material readiness of the transport helicopter fleet now in question, but the inventory of available airframes will soon become critical. MEU(SOC) squadrons are generally the only units with all of the airframes they rate. The CH-46E squadrons (including the Reserves) are normally well below their authorized allowance of airframes. Once again, the Marine Corps is 148 medium lift airframes below requirement and all of the CH-46E airframes are awaiting the Dynamic Component Upgrade. The "other" medium lift airframes in Hawaii, the CH-53D's, are in dire need of a service life extension. The CH-53D's airframe, electrical wiring and avionics survivabilitiy, reliability and maintainability are questionable. Unfortunately, the funding needed to do a CH-53D service life analysis has not been allocated by N88, despite a formal request from Headquarters Marine Corps in 1996.[67]

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64 Marine Corps Aviation Plan, dtd 1996.

65 Funding for the CH-53E HNVS (FLIR) was terminated by HQMC in 1995. These funds were diverted to support the 4BN/4BW Program which is an initiative to upgrade Marine UH-1N and AH-1W helicopters.

66 This is a moot point if the N88 will not fund the required CH-53E SLEP.

67 Letter from the Assistant Deputy Chief of Staff for Aviation, Headquarters Marine Corps, to N88 requesting that funds be allocated for a CH-53D SLAP, 10 JUN 96.

The one bright spot in the medium lift equation is the V-22. This superb platform will be the most survivable combat rotorcraft ever built. But its slow rate of production (12-24 per year) will insure that we continue to have a medium lift inventory shortfall for the next 20 years. Obviously, increasing the production rate to 36 airframes per year would help ease the burden on our medium lift fleet and would put a much more survivable front line aircraft in the inventory 5 years earlier. Moreover, increasing the production rate to 36 aircraft per year could save the taxpayer several billion dollars (via economies of scale) over the life of the V-22 Program.[68] In any event, the Marine Corps can save the taxpayers millions of dollars by merely replacing the CH-53D with the first production lots of V-22's (vice first replacing the CH-46E's). Keeping the CH-53D type/model/series in Hawaii for another 13 years is unconscionable. How do we explain to Congress (and the taxpayers) that we are retiring the CH-46E's we just spent millions of dollars on (DCU and COMNAV Upgrades) while keeping a small, unique fleet of aircraft in Hawaii with no apparent mission? Four 12 plane CH-46 squadrons or one 16 plane CH-53E squadron could be sent to Hawaii to satisfy the political considerations there.

The CH-53E Heavy helicopter fleet needs a service life extension. As stated earlier in this paper, the first lots of CH-53E's will be grounded because of airframe fatigue in FY 2000. The MEF's ability to get ashore (ship-to-objective) and keep itself resupplied will depend upon the CH-53E fleet well into the next century. Maneuver, as envisioned in FMFM 1, will require vast amounts of fuel and other logistical support.

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[68] Exact dollar amount varies from $5 to 8 billion, depending upon the year of production increase and which source is consulted.

> An armored or mechanized division can gulp over 2,000 tons of fuel a day, another 1,000 tons of water, plus at least 1,000 tons of ammunition, food and other supplies... In the final analysis, most of the substantial quantities of supplies needed (to conduct maneuver warfare) will be liquids (fuel and water), to keep the machines and troops working.[69]

Undoubtedly, the Marine Corps will require a heavy lift rotorcraft to conduct its vital resupply mission on future battlefields. **V-22 can not make up for the loss of our CH-53E fleet. The Department of the Navy either must fund the service life extension for the CH-53E or face the reality that we will be parking our heavy lift fleet beginning in the year 2000.** The Super Stallion is a thirty year old design which is approaching 20 years of service. As stated, the first production lots will need a service life extension just to keep flying beyond 2000.

Today's CH-53E is not properly equipped to operate beyond the FLOT and should not be expected to do so. Survivability upgrades such as an integrated automatic counter-measures suite with upgraded chaff, flares and jammers, IR suppressers, IR jammers, aircraft and engine armor and upgraded night vision equipment would not be enough to protect the CH-53E. The IR signature, radar cross section, acoustic signature and visual signature of the Super Stallion are insurmountable. However, the IR signature can be reduced by over 50% and engine/airframe armor kits are now flying on U.S. Air Force H-53's. These improvements, coupled with an effective IR jamming pod, would increase the CH-53E's survivability. The estimated cost of these improvements is about $5 million dollars an aircraft ($800 million for the entire CH-53E fleet).

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[69] James F. Dunnnigan and Austin Bay, *From Shield to Storm*, 235 & 236.

The cost of these upgrades would be better spent on a new transport rotorcraft. The most viable heavy lift replacement program in the Department of Defense is the **Joint Transport Rotorcraft (JTR)**. The Army has headed up a long range, visionary effort to develop a heavy lift rotorcraft compatible with all of the services needs.

> Development ideas are already underway, including a lift requirement study, technical study and sustainment analysis. Initial Mission Needs Statements (MNS), draft concept papers and draft mission profiles have been submitted with FY-02 as the initial design target date. Initial operating capability is planned for 2015 and delivery completion scheduled for 2025.[70]

Unfortunately, the current Marine Corps Aviation Plan does not address a replacement for the CH-53E. This is understandable with the current state of our medium lift fleet and the need to increase production on V-22 from 24 to 36 aircraft per year. However, if the Marine Corps does not want to end up on the "short end" of the procurement process again, then it needs to get on board with the other services to develop JTR.

Finally, the Marine Corps can not execute maneuver warfare as envisioned in FM FM 1 with its current inventory of transport rotorcraft. Its transport helicopter fleet will not survive on a high-threat maneuver battlefield. V-22 is a major step in the right direction. Still, even after the introduction of V-22, operational maneuver will not be possible in light of the logistical support requirements of a MEF-sized maneuver element. We can not "wish away" these logistical requirements. If the Marine Corps hopes to fight successfully on a non-linear, maneuver style battlefield, then we need to increase our capability to maneuver and sustain the force. **The Joint Transport Rotorcraft must be**

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70 LCDR M. K. Tribbie, USN, Rotor Review, Fall 1996, 23.

a part of this long range vision and should be included in the Marine Corps Aviation Plan.

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