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PLANNING AND INVESTING FOR LOGISTICS SUPPORT OF MARINE EXPEDITIONARY FORCES IN THE 21ST CENTURY

by

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Naval Expeditionary Forces (NEFs), including the Marine Air Ground Task Force (MAGTF), will play an increasingly important role in the U.S. National Military Strategy(NMS). Future NEF roles will be shaped by the demise of the Soviet Union, advances in weapons technologies, mounting fiscal and resource constraints, and the rise in requirements for U.S. involvement in regional crises. Designing the right MAGTF to respond across the spectrum of conflict requires a keen understanding of readiness and sustainment issues and their associated costs. This thesis calculates the tooth-to-tail ratios of MAGTFs and uses them as a measurement of a force's readiness and sustainment capabilities. This thesis considers the readiness and sustainment requirements for particular MAGTFs performing various roles as outlined in the current NMS. The force structures of current notional and future MAGTFs are developed and analyzed and compared in terms of representative capital value and operating and support costs associated with raising and maintaining a specific MAGTF capability. The results provide one approach to designing an investment strategy for future MAGTFs in an era of constrained resources.

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ABSTRACT

Naval Expeditionary Forces (NEFs), including the Marine Air Ground Task Force (MAGTF), will play an increasingly important role in the U. S. National Military Strategy (NMS). Future NEF roles will be shaped by the demise of the Soviet Union, advances in weapons technologies, mounting fiscal and resource constraints, and the rise in requirements for U.S. involvement in regional crises. Designing the right MAGTF to respond across the spectrum of conflict requires a keen understanding of readiness and sustainment issues and their associated costs. This thesis calculates the tooth-to-tail ratios of MAGTFs and uses them as a measurement of a force's readiness and sustainment capabilities. This thesis considers the readiness and sustainment requirements for particular MAGTFs performing various roles as outlined in the current NMS.

The force structures of current notional and future MAGTFs are developed and analyzed and compared in terms of representative capital value and operating and support costs associated with raising and maintaining a specific MAGTF capability. The results provide one approach to designing an investment strategy for future MAGTFs in an era of constrained resources.

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I. INTRODUCTION

A. BACKGROUND TO THE RESEARCH

Since the late 1980s, significant geopolitical events have occurred which have impacted directly on the force structure and missions of the Naval Services. The end of the Cold War and the diminished threat of global war has confronted the United States with the need for fundamental decisions concerning its future security requirements. In this new environment, the unique capabilities of integrated naval expeditionary forces have taken on greater importance.

The decline of overt threats from a known enemy has led to increased domestic pressures to shift national resources away from defense and toward domestic economic concerns. Programs and weapon systems that were thought necessary during the Cold War are being reevaluated, and in many cases, scaled down or canceled. Personnel draw-downs are underway to reduce military forces to the level thought commensurate with the reduced danger. Military bases and facilities are undergoing significant realignment and, in many cases, are closed in order to comply with shrinking defense budgets.

Technology is also undergoing rapid change. Recent rapid advances in weapons technology provided what many view as a significant force-multiplier during Desert Shield/Desert Storm. Many observers are referring to an impending "Military Technological Revolution" (MTR). This term refers to many aspects of military forces besides technology. It is a timely combination of innovative technologies, doctrines, and military organizations that are reshaping the way in which wars are fought. (Mazarr, 1993, p. 1) The MTR is based on three comparative advantages. First, the MTR will increase the effectiveness of forces through improvements in maneuver and speed of these forces. Second, the MTR represents a capability that no emerging threat can as yet challenge. Thirdly, the MTR will act as a force-multiplier , allowing forces to do more with less at more efficient cost. (Mazarr, 1993, p. 15) This MTR will ostensibly have the capability to reshape the way wars are fought. However, the choices made possible by the MTR will also be subject to budgetary, fiscal, and political constraints. This is true for the Marine Corps as well.

B. OBJECTIVE OF THE RESEARCH

This thesis was undertaken to provide a complementary work to that which was done by LCDR Paul F. Healy in June of 1994. His work, entitled "Planning and Investing for a Maritime Reconnaissance Strike Complex: The U.S. Navy in the 21st Century," investigates the likely changes to Naval Forces (to include Marine components) between now and the year 2015. This thesis explores in greater depth the changes likely to emerge in Marine Air Ground Task Forces (MAGTFs) as components of Naval Expeditionary Forces (NEFs). This thesis follows the same general approach as Healy in estimating force structures. A baseline structure for Marine expeditionary forces during the 1991 Desert Shield/Desert Storm time frame is first calculated and costed out, and then the same methods are applied to estimating and costing out the force structure of Marine expeditionary forces in the 21st Century. The year 2015 is chosen as providing a good measure of change 25 years after the Desert Storm baseline.

Faced with a dynamic environment, affected by a myriad of economic, fiscal, political, social variables, how should the Marine Corps proceed to plan for, structure, and invest in its expeditionary forces of the future? What is the present notional baseline structure of expeditionary forces, and what is the cost to support these forces with logistical sustainment? Given an MTR, how might force structure and tooth-to-tail ratio of Marine Air Ground Task Forces (MAGTFs) be different? This thesis hopefully contributes some answers to these questions.

One way to gaining an understanding of force structure requirements is by looking at force-to-support ratios, also known as the "tooth-to-tail" ratio. MAGTFs constitute the Marine components of NEFs. They are a reservoir of integrated combined arms combat power that is task-organized to execute a wide range of global missions. Such a capability is fueled by a responsive and effective logistical support structure, i.e., the "tail" of the MAGTF. This chapter provides an overview of expeditionary warfare strategy development since World War II and its impact on MAGTF force structures and tooth-to-tail ratios.

C. RESEARCH QUESTIONS

This thesis addresses these specific questions:

1. What might be the force structure for a MAGTF configured for expeditionary warfare in the early 21st Century?
2. What will be the tooth-to-tail ratio of a MAGTF, how might this ratio differ from today's with regard to size, composition, and what will be the price tag of capital investment and operating support costs?

3. Assuming a continuing trend of diminished resources for procurement, operating, and support costs, how might the ratio of operating and support costs to capital value change?

4. What challenges are encountered in attempting to estimate the tooth-to-tail ratio for MAGTFs, and how might these challenges be resolved to promote a better understanding of the relationships between logistics support costs, capabilities, and requirements for expeditionary forces?

D. SCOPE, LIMITATIONS, AND ASSUMPTIONS

This thesis analyses the three different sizes of amphibious MAGTFs employed by the Marine Corps: the Marine Expeditionary Unit (MEU), the Marine Expeditionary Brigade (MEB), and the Marine Expeditionary Force (MEF). Notional structures are estimated for each of the three to form a current Baseline.[1] Using this baseline, tooth-to-tail ratios are estimated, and future expeditionary force structures with their corresponding tooth-to-tail ratios are developed. Notional MAGTFs are designed to cope with so-called Major Regional Conflicts (MRCs), but they are applicable also under current employment concepts to other contingencies, e.g., deterrence, peacekeeping, peacetime forward presence. The Bottom Up Review (BUR) provides the

[1]There are three different MEB configurations. The CE, GCE and selected units from the ACE and CSSE form the assault echelon (AE) of an amphibious MEB and deploy aboard Navy amphibious shipping as a balanced force. The remaining forces of the amphibious MEB deploy as an assault follow-on echelon (AFOE). The Maritime prepositioning Force (MPF) MEB is slightly larger than an amphibious MEB and heavily equipped with armor and mechanized assets. It is capable of combat against a sophisticated mechanized force. The smallest MEB organization, the Norway airlanded MEB (NALM) is deployed in Military Airlift Command (MAC) aircraft to reception areas in central Norway prior to hostilities to facilitate rapid reinforcement of NATO's northern flank. The Air Contingency Force MEB (ACF) is a short-notice, airlifted, light MEB ready for deployment by strategic airlift.

direction that has shifted the focus of U.S. military strategy away from that of a global Soviet threat to one oriented toward the new dangers emerging from the post Cold-War. "Chief among the new dangers is that of aggression by regional powers." (Aspin, Report on the BUR, 1993, p iii).[2]

A major interest of this thesis is to estimate the cost of achieving and maintaining a MAGTF capability now and in the future and to provide a view of MAGTF funding needs in the broad areas of personnel and equipment.

E. APPROACH AND METHODOLOGY

This research is limited to unclassified sources only. Data are gathered from Department of Defense (DOD) documents, trade journals, books, articles, various studies and reports, and personal interviews. In determining operating and support costs, the Quick Cost Model and Marine Corps Cost Factors Manual is used.

F. MARINE EXPEDITIONARY FORCE DEVELOPMENTS

1. Background

Department of Defense Publication 1-02 "Dictionary of Military Terms" defines the term "Expeditionary Force" as an armed force organized to accomplish a specific objective in a foreign country. An expeditionary force capability is a key element in maintaining a strong defense capability as

[2]Regional dangers include a host of threats: large scale aggression; smaller conflicts; internal strife caused by ethnic, tribal, or religious animosities; state-sponsored-terrorism; subversion of friendly governments; insurgencies; and drug trafficking.

described in the current National Security Strategy. NEFs provide a credible overseas presence in peacetime that will deter aggression and facilitate United States contributions to multilateral peace operations. (National Military Strategy, 1993, p. 7)

The role of MEFs in the national strategy assumes a special importance when one considers that oceans separate the United States from nine-tenths of the world's population. The United States has extensive overseas interests that are vulnerable; many are of vital importance and require that the United States be prepared to defend them. Under today's increasing budget constraints it is no longer feasible to maintain armed forces in every potential hotspot. Neither can the United States always count on a friendly reception at the locations it needs to deploy forces. By virtue of their versatility, forward positioning, and ability to assume a variety of alert postures, NEFs are an ideal instrument for crisis response.[3]

The MAGTF is one of the two key components of the NEF. It possess the capabilities, built on mobility, flexibility and striking power, that enable the United States to respond to a conflict expeditiously and to halt it at the lowest possible level of violence on terms favorable to the United States. (Reassessing U.S. Strategic Forces: An Interim Report p. 7) The Marine Corps is tasked with providing forces to serve with the Navy in the seizure and defense of advanced naval bases and in the conduct of land operations that may be essential to the prosecution of a naval campaign. (FMFRP 1-11, p. 1-1)

[3]While certainly not a new concept, NEFs assume an increased importance resulting from the end of the Cold War and Navy's recognition of regional threats and adoption of a littoral strategy. The NEF focus is a commitment to forces designed to operate overseas and respond swiftly to crisis. Integrating Navy and Marine forces into NEFs provides the ability to extend seapower beyond the shoreline and influence events ashore. (Force 2001, 1993, p. 20)

The Marine Corps is inherently an expeditionary military organization. It has the built-in capability to prepare and deploy logistically sustainable forces into areas with little or no existing U.S. logistical capability. Its forces provide a tremendous advantage and contribute to the balanced capabilities of U.S. fleets by virtue of the ability to conduct operations across the spectrum of naval warfare from the sea.

The keys to MAGTF structure and capabilities are implicit in the requirement for amphibious operations. MAGTFs are designed for amphibious assaults that require a maximum build-up of combat power on a hostile shore without a prepositioned logistics infrastructure. The unique seabased capabilities of amphibious forces allow them to serve as the bridge for deploying forces in circumstances where a lack of land based facilities would otherwise preclude operations. Amphibious operations plan for, and utilize a variety of assets to project forces ashore, such as helicopters, surface landing craft, Assault Amphibious Vehicles (AAVs), and Landing Craft Air Cushioned (LCACs).

> Amphibious forces are sea-bases from which we operate naval forces. They are flexible, utilitarian, and independent of constraints associated with establishing bases on foreign soil. From them, we can conduct the full spectrum of operations ranging from humanitarian assistance to violent projection of naval power. Like all sea-based forces, they are available for use unencumbered by the political constraints of other nations. This broadens their value to the President as a ready contingency response force. They provide a capability in a crisis situation which enable the United States to send a signal, employ forces for security and protection of U.S. interests, or if the situation dictates, forcibly intervene. (Integrated Amphibious Operations & U.S. Marine Corps Air Requirements Study 1993, p. 3)

The United States is highly dependent on the use of the seas for its political, economic and military well-being. This dependence stems, in part, from the need for rapid access to potential trouble spots which, if not checked, can trigger serious regional instabilities, which, in turn, could affect the stability of the global political and economic system on which U.S. and allied prosperity depends. As the U.S. post-World War II overseas basing infrastructure continues to shrink, the presence of mobile naval forces near areas of potential crisis becomes relatively more important. The focus of the NEF includes operations in the littoral sea and land areas, and the projection of military power ashore.

The importance and utility of NEFs since World War II have increased due to the rising number of problems encountered concerning basing access and restricted landing and overflight rights, the regional proliferation of sophisticated (and sometimes not-so-sophisticated) weapons has complicated the U.S. ability to exercise sea control when and where needed. (Polmar, 1981, p. 13)

2. Organization of the MAGTF

The Marine components of NEFs are highly specialized amphibious assault troops. Their, command, ground, aviation, and service support elements constitute a MAGTF. These task forces are capable of conducting sustained operations; they are logistically supported from their amphibious ships, and they are the principal means of projecting naval power ashore. MAGTFs possess sufficient combat service support capability to provide Combat Service Support functions, including: Supply, Maintenance, Services, Deliberate Engineering, Transportation, and Health Services. MAGTFs also contain organic aviation assets that are equipped to support ground units in amphibious operations by way of: Offensive Air Support, Anti Air Warfare, Assault Support, Air Reconnaissance, Electronic Warfare, and Control of Aircraft and Missiles.

The composition and size of MAGTFs may vary, but the organizational structures always include a single Command Element (CE) with subordinate Ground Combat Elements (GCE), Aviation Combat Elements (ACE), and Combat Service Support Elements (CSSE). Figure 1.1 shows the MAGTF structure.

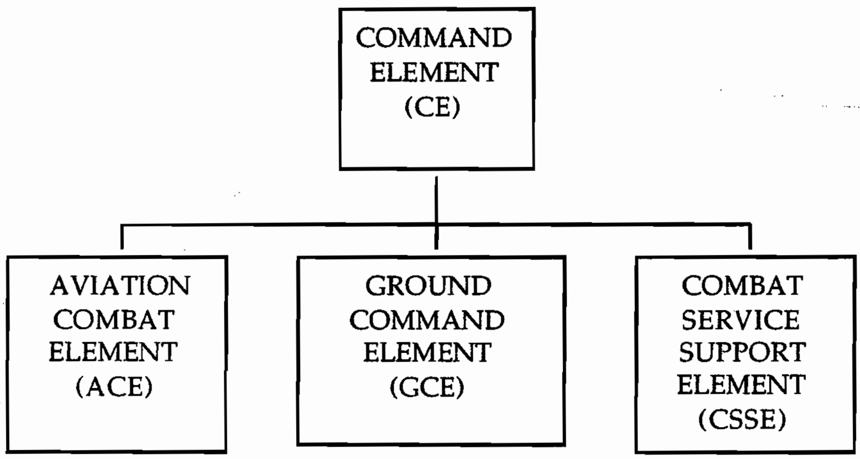

Figure 1.1 MAGTF Structure

Note: Information for MAGTF taken from Fleet Marine Force Organization (FMFRP 1-11), Washington, D.C., HQMC, 2 March 1992.

3. MAGTF Capabilities

The MAGTF is task-organized, meaning that senior commanders can alter the mix of personnel and equipment in a MAGTF to meet the objectives of a deployment, the size and capabilities of potential adversaries, and the weather and geography likely to be encountered. The CE provides a single headquarters for command and coordination of ground, air, and combat service support forces. The GCE may range in size from an infantry battalion to one or more divisions. The ACE may range in size from a reinforced helicopter squadron to one or more aircraft wings. Finally, the CSSE varies in size depending on the size and mission of the ground, and air components.

The effectiveness of MAGTF hinges upon its ability to provide the commander with the ability to project naval power ashore. This is accomplished through the organic logistic and sustainment capabilities inherent to the various sizes MAGTFs. Current doctrine plans for 15-60 days of sustainment in low-to-mid intensity conflict scenarios. The combined arms capability of the MAGTF establishes a broad and complex area of influence, and therefore requires a flexible, and responsive logistics support system. The MAGTF is the only fully integrated combined-arms component in the U.S. armed forces with a self-sustaining logistics capability. (FMFM 4, Combat Service Support, p. 1-1.)

The remainder of this chapter examines the development of MAGTF organization and missions from World War II to Desert Storm as it applies to expeditionary warfare strategy. This provides a basis for understanding the logistical sustainment and support requirements for MAGTFs.

G. DEVELOPMENTS SINCE WORLD WAR II

In the nearly 50 years since World War II the basic concepts for the organization and employment of amphibious MAGTFs have remained unchanged. During operations in the Solomon and Marshall Islands new methods were perfected which enabled Marine Aviation to function as part of an integrated air-ground task force. (Simmons, 1979, p. 2)

The advent of nuclear weapons prompted many observers to believe that atomic weapons made amphibious operations obsolete. Marine Corps officers themselves agreed that the threat of nuclear attack against an exposed amphibious force demanded important doctrinal adjustments. (Clifford, 1973, p. 71) In 1946, Lieutenant General Roy S. Geiger, Commanding General, Fleet Marine Force, Pacific wrote:

> It is my opinion that future amphibious operations will be undertaken by much smaller expeditionary forces, which will be highly trained and lightly equipped, and transported by air or submarine, and movement accomplished with a greater degree of surprise and speed than has ever been heretofore visualized.

In response to the dangers of atomic weapons, amphibious doctrine shifted away from the World War II reliance on heavy concentrations of ships and landing craft to dispersed assault techniques. It was felt that the speed and flexibility gained through the use of helicopter operations offered a practical means of overcoming the effects of dispersion while likewise reducing the exposure to atomic weapons. This led to the emergence of "vertical envelopment" concepts.

1. Post World War II

In 1945 the USMC maintained six divisions and a total end strength of 475,000 men. After World War II many questioned the need of a force that "duplicated " Army capabilities. Proponents of the USMC were instrumental in inserting in the National Security Act of 1947 a requirement for three active USMC divisions. This Act directed that,

> The Marine Corps shall be organized, trained and equipped to provide Fleet Marine Forces of combined arms, together with supporting air components, for service with the fleet in the seizure or defense of advanced naval bases and for the conduct of such land operations as may be essential to the prosecution of a naval campaign. ("The Maritime Strategy", p. 23)

2. The Korean War and "Massive Retaliation"

President Truman had sought to stabilize defense spending, but the outbreak of the Korean War, the Soviet acquisition of the atomic bomb, and the decision to commit the United States to NATO forced the abandonment of such expectations. (Lewis, 1990, p. 21) The outbreak of the Korean War in 1950 dealt a strong blow to air power enthusiast's claim that the next war would be fought with atomic weapons and that amphibious warfare had been rendered obsolete. (Enthoven, 1971, p. 165) General MacArthur's Inchon landing displayed the inherent flexibility of amphibious forces and also the value of the Marine Corps and its ability to conduct amphibious operations.

Title 10, U.S. Code amended the National Security Act and legislated the size of the Corps to be three combat divisions, three aircraft wings, and other supporting elements. It also directed that the Marine Corps would be a ground and air striking force ready to suppress or contain international disturbances short of large-scale war. This basic force structure established the "force-in-readiness" concept which led to the modern-day MAGTF concept. ("The Amphibious Warfare Strategy", p. 25)

During and after Korea, the concept of the air-ground team emerged in doctrinal and policy statements. (Simmons, 1979, p. 3) The integration of the helicopter greatly expanded the MAGTF's mobility and sustainability by providing it with the capability to conduct surface and airborne ship-to-shore operations simultaneously.

3. The Decade of the 1960s and "Flexible Response"

Under the Eisenhower administration, spending for conventional defense was held down in favor of reliance on a nuclear capability. During the early 1960s, however, it had become widely recognized that a nuclear balance of terror had been established, that nuclear weapons existed mainly for deterrence, and that "real" war would be fought with conventional means. The upshot was a revitalization of conventional forces. The new resulting strategy, called "Flexible Response," rejected the nuclear-dominated concept doctrine of "Massive Retaliation" in favor of a primary reliance on conventional warfighting forces. (Enthoven, 1971, p. 273) At the force programming level, Flexible Response called for sufficient forces to fight two-and-a-half major wars in Europe and Asia simultaneously, and a smaller war in the Mid-East. This concept was important for development, because it acknowledged the need for flexible response capabilities in "limited" contingencies. (Lewis, 1990, p. 87)

4. The Impact of Vietnam

The Marines role in Vietnam was very different from what their "organizational essence" had dictated. Instead of carrying out amphibious operations to lay-the-doormat for heavy Army follow on forces, the Corps was employed in sustained, Army-like land combat operations.[4] Toward the end of the conflict, the Nixon Doctrine modified the two-and-a-half war strategy to one of planning for a one-and-one-half war conflict. (Laird, 1970, p. 10)

The post-Vietnam focus for military, including Marine planners, became Europe. This "Europe-first" preoccupation effectively reduced the Navy's role to the provision of sea control and convoy escort for the reinforcement of forces, including Marines to Europe. Meanwhile, plans to rehabilitate and rebuild the Navy had been disrupted by the pressing requirements of the Vietnam War. By 1976, the size of the Navy's general purpose fleet had shrunk from 984 ships in 1967 to 467 ships. The size of the amphibious fleet had decreased commensurately. By the end of the 1970s the "NATO-first" preoccupation of U.S. defense planners came increasingly under criticism. The extension of Soviet military activities into Angola, Afghanistan and Ethiopia, to name a few countries, served to warn U.S. leaders that Europe was not the only region in which the Soviets could pose a threat.

[4]Prior to the Vietnam War MAGTFs were formally designated as expeditionary forces. This designation was changed in the early periods of the war to "amphibious" in deference to Vietnamese uneasiness to the term "expeditionary". (Progress and Purpose, 1973, p. 112) MAGTFs were again formally redesignated as "expeditionary" in 1989 to more closely reflect the Corps employment strategy.

5. "The Maritime Strategy"

In the late 1970s the United States realized that the greatest threat to its security and well being lay in the perceived quest for world domination by the Soviet Union. The Soviet Union had emerged after World War II as a superpower exhibiting ambitions beyond the context of Europe. The conventional might of the Soviet Union and its expansion of naval power to the world's oceans demanded serious consideration by defense planners. Related to the extensions of the Soviet Union's global reach was the growing number of Third World conflicts. It was recognized that the fundamental component to success in deterring war with the Soviet Union depended on the United States ability to stabilize and control escalation in Third World crisis. The Maritime Strategy was developed as a dynamic concept to enable intelligent planning for the global use of naval forces in countering and deterring the Soviet Threat. Preparation for global war was recognized as the critical element in deterring the Soviet Union, also the peacetime and crisis response operations were seen as crucial contributions to deterrence. The Maritime Strategy saw sea power as being relevant across the spectrum of conflict, and provided a framework for considering all uses of maritime power. (The Maritime Strategy, 1986, p. 4)

In January of 1980 the "Carter Doctrine" declared the oil supplies of the Persian Gulf a vital American interest. As a consequence, the Carter Administration began to explore ways by which existing forces could be deployed quickly to the Gulf region, and be logistically sustained. This set the stage for a revalidation of the need for a global focus in military contingency planning. Spurred by the potential of conflict in the Persian Gulf, defense planners developed the so-called Rapid Deployment Force (RDF). It was soon realized that naval expeditionary forces provided a viable means of establishing credible U.S. military capabilities in the Persian Gulf region. (Quinlan, 1983, p. 26)

6. "The Amphibious Warfare Strategy"

A key goal during this time was to further international stability through the support of regional balances. (The Maritime Strategy, 1986, p. 5) The heart of the evolving Maritime Strategy was crisis response. It was predicted that war with the Soviets would most likely result from a crisis that escalates out of control. Therefore the United States' ability to contain and control crisis was an important factor in preventing global conflict. In 1985 the "Amphibious Warfare Strategy" was published as a compliment to the Navy's "Maritime Strategy." Though oriented to address the phased employment of amphibious forces in a global conventional conflict the Amphibious Warfare Strategy recognized the utility of employing amphibious forces in low-intensity conflicts in Third World countries. (The Amphibious Warfare Strategy, 1986, p. 25), The complementary concept of "crisis response" and "forward presence" and the emergent new missions of humanitarian and peacekeeping operations, played a key role in developing the employment strategy for amphibious forces in the 1990s.

7. "...From The Sea"

The 1992 Navy-Marine Corps paper "...From the Sea" defined the concept which has taken the Navy away from its cold war preoccupation with an oceanic war against the Soviets, to planning for regional conflicts in littoral waters. The new direction for the Navy and Marine Corps was to provide the nation with NEFs, shaped for joint operations, capable of operating from forward deployed sea-bases which were tailored for national needs. (...From The Sea, 1992, p. 2) NEFs were described as being; swift to respond to short notice crisis, structured to build power from the sea when required, able to sustain support for long-term operations, and unrestricted by the need for transit or over-flight approval from foreign governments in order to enter the scene of action. The stage for this shift of focus from oceans to littorals had already been set in a speech by President Bush in August 1990 and the experience of the Gulf War immediately afterward.

In times of increasing global instability the presence of U.S. NEFs, acting as a deterrent, are a key element in this Nation's national security strategy. If deterrence fails, forward presence provides a rapid response capability. Since most of the world's population lives within 50 miles of the sea, and 75 percent of the urban areas containing U.S. embassies, outside allied or formerly Warsaw Pact territory, are within 150 miles of the sea, naval power projection capabilities are particularly useful in applying U.S. military might at appropriate places and times. (Mundy, 1993, p. 15)

8. "Forward...From The Sea"

The unpublished draft of "Forward...From The Sea," updates and expands "...From The Sea". The Department of Defense's focus on new dangers to include aggression by regional powers requires the ability to rapidly project military power to protect vital U.S. interests and defend friends and allies. (Forward...From The Sea, 1994, p. 1) Forward-deployed NEFs will be used to provide the critical operational linkages between peacetime operations and the initial requirements of a developing crisis or major regional contingency. (Forward...From The Sea, 1994, p. 2)

H. SUMMARY

In this introductory chapter, the development of Marine Expeditionary Forces since World War II and their evolving role in the national military strategy has been briefly discussed. In the next chapter the impact of the BUR and the new National Security Strategy (NSS) on MAGTF organization and force structure is addressed.

II. MARINE EXPEDITIONARY FORCE STRUCTURE

A. NATIONAL SECURITY STRATEGY AND THE EXPEDITIONARY ROLE

The experience of the United States in the Gulf War and the collapse of the Soviet Union were responsible for a fundamental change in the strategic environment. (National Security Strategy of the U.S., 1993, p. 12) To confront these new changes the National Security Strategy (NSS) of the United States was based on the four "cornerstones": Strategic Deterrence, Forward Presence, Crisis Response, and Reconstitution. This strategy was developed in response to the reorientation of U.S. strategic planning toward regional dangers and uncertainty. It entailed an increased emphasis on power projection tied to local sea control. This role was highlighted also in "...From the Sea", a joint product of the Secretary of the Navy, the Chief of Naval Operations, and the Commandant of the Marine Corps described the change in focus from an open ocean "blue water" strategy to one that emphasized power projection operations in the littoral areas of the world. ("...From The Sea," 1992, p. 1) Based on "...From the Sea," the Marine Corps has articulated "Operational Maneuver From the Sea" which set forth the Navy and Marine Corps' concept for the projection of naval power ashore. ("Operational Maneuver From The Sea," 1993, p. 2) A key point in both documents was the emphasis on the capabilities of expeditionary forces to tailor their composition and structure to meet the Nation's needs. The ability to task-organize forces to provide the required capabilities and flexibility in projection is the cornerstone ability of the MAGTF.

B. THE BOTTOM UP REVIEW

Initiated in March 1993, the Bottom Up Review (BUR) provides a blueprint for planning and implementing a national military strategy for the 21st Century. It announced that U.S. force planning is to be based on three fundamental principals. First, U.S. forces, alone or allied with friendly countries, must possess the capabilities to fight and win two nearly simultaneous Major Regional Conflicts (MRCs). Second, the United States must retain its status as a world power, and not turn to isolationism. Thirdly, the United States must maintain the fighting readiness of its armed forces.(Aspin, 1993, pp. 1-2)

To meet the challenges of fighting two near simultaneous MRCs, NEFs must be efficient and effective. They must fight smarter and be able to exploit opportunities and employ complex weapons systems. Smaller, leaner, more maneuverable forces that are capable of forcible entry and self-sustainment, will replace the larger, less flexible forces of the past. NEFs will be called on to achieve objectives in littoral areas using resources tailored for the mission. Operations must be seamlessly planned, executed and supported to break the cohesion and integration of enemy defenses while avoiding attrition style, head-on attacks. The mobility and sustainability of NEFs will serve as a force multiplier which allows for smaller sized forces possessing equal or greater capabilities of much larger forces of the past.

NEFs of the future will treat the sea as maneuver space and will rely on overwhelming tempo. This capability will demand the ability to apply sustainable forces operating at a high momentum to achieve total power projection with the already demonstrated technology of the Landing Craft Air Cushion (LCAC), Advanced Amphibious Assault Vehicle (AAAV), and tilt-rotor technology of the V-22 Osprey. Ships will be used as assembly areas and logistics bases which allow the MAGTF to maneuver from over the horizon. Speed and mobility will become dependent upon the ability to keep logistics responsive. The sustainment requirements under the new strategy will greatly stress the organic logistics capabilities of MAGTFs.

The BUR proposes that the military threats the United States will most likely face are regional. The BUR proposes a balanced force mix for addressing the danger of a major regional war at a cost that will not undermine the national economy. Using a "building block" concept the BUR defines four broad classes of military operations: MRCs; smaller scale conflicts or crises, overseas presence, and deterring attacks by weapons of mass destruction. Due to their relative freedom of maneuver, NEFs are considered the "weapon of choice" in many contingencies that, for political reasons, e.g., sovereignty, may be inappropriate for the insertion of land-based forces. Yet, NEFs face the difficult problem of how to achieve the required capabilities under the new strategy when U.S. defense spending as a percentage of gross national product will fall to the lowest level since the surprise attack on Pearl Harbor. (Stockton, 1992, p. 4)

For the Marine Corps the challenge is to redefine its force structure to accomplish its role as effectively as possible within the constraints imposed by shrinking defense budgets. (Krulak, 1992, p. 14)

C. THE RESTRUCTURING

Many respected defense analysts have argued that the way to improve the fighting effectiveness of the armed forces is not to reallocate huge defense budgets but instead to restructure the way the services are organized, equipped and employed. (Barlow, 1981, p. 13) The Marine Corps began the restructuring process in August of 1991, the key concern being how to keep Marine forces relevant, ready, and capable, while at the same time complying with the need to become even leaner and more efficient in the future. (Krulak, 1992, p. 14) It was felt that even with the changing world situation, a need still existed for an expeditionary force like the Marines. The Marine Corps Force Structure Planning Group (FSPG) decided to build a force that maintained the MAGTF capabilities vice develop new capabilities. One point was made clear when the Marine Corps briefed the national leadership on its restructuring plan: further reductions in endstrength would degrade current MAGTF capabilities and cause an increase in the current operating tempo. (Krulak, 1992, p. 15)

1. The Restructuring Plan

The restructuring plan did not leave one aspect of Marine Corps organization untouched. The Marine Corps is composed of two major groups, Fleet Marine Forces (FMF) and non-FMF. FMF units are the operating forces available for deployment. They are composed of combat and combat service support units that compose the MAGTF. Non-FMF Units are the supporting establishment which provides services from embassy duty to education, and recruiting. These forces are not available for composition in MAGTFs. Three active and one reserve Marine divisions help make up the FMF. 1st Marine Division is located at Camp Pendleton, CA; 2d Marine Division is located at Camp Lejeune, NC; 3d Marine Division is located on Okinawa, Japan; and the 4th Marine Division (reserve) is headquartered in New Orleans, LA with units located throughout the United States.

In response to direction stemming from the BUR, the Marine Corps looked extensively into ways of reducing overhead costs for both FMF and non-FMF units. The BUR determined, and the Secretary of Defense validated, the types and sizes of naval forces needed to execute the NSS. Specifically, it was agreed that a Marine Corps capable of fielding three MEFs along with the accompanying amphibious assault ships will comprise the core of Marine expeditionary force capabilities.

The force structure reorganization for the FMF must be closely coordinated with the Navy to meet the problem of not only declining personnel and budget pools but also the declining availability of amphibious lift. In order to be able to provide the flexible response capabilities outline in the BUR, the MAGTF personnel and equipment levels must be compatible with available amphibious shipping. Once a mission is assigned to the MAGTF it must be capable of responding quickly, arrive on station in an expeditious manner, and once there, be capable of sustaining itself logistically. Forces of the future will need to exhibit less raw military strength (mass, firepower, etc.), but be tailored instead to influence the direction of geopolitical events. (Rothrock, 1993, p. 2)

> The new Marine Corps will be different. It will be smaller; yet, in many ways it will be more efficient as a warfighting team-leaner, more mobile, more flexible, and more complementary in joint operations. Each element of the MAGTF has been given enhanced capabilities to meet the needs of the future. (Krulak, June 1992).

Though smaller, the FMF will remain a balanced combined arms team with full sustainment capability. This includes the ability to deploy substantial forces and sustain them in parts of the world where prepositioned equipment or adequate bases and support infrastructure are not available. This requires that the MAGTF force structure be reduced vertically vice horizontally.

The current program for amphibious lift calls for shipping to be capable of moving the assault echelons of two and a half MEBs instead of the current three. Future plans are to procure new but fewer amphibious ships. The goal is to maintain two to three Amphibious Ready Groups (ARGs), each with an embarked MEU, to be on station to provide forward presence.

D. THE CURRENT NATIONAL SECURITY STRATEGY

The NSS of Engagement and Enlargement published in July of 1994 recognized that while the threat of war among major powers and nuclear annihilation have receded dramatically troubling uncertainties and clear threats remain. These threats arise largely from the unstable political and economic transitions in the independent states of the former Soviet Union, the spread of weapons of mass destruction, and the worldwide resurgence of militant nationalism and religious and ethnic conflicts. (National Security Strategy, 1994, p. 1) Without active U.S. leadership and engagement abroad, the threats will grow and opportunities narrow. Current NSS is based on enlarging the democracy base and deterring and containing threats to the United States and its allies. The three central components to the strategy of engagement and enlargement are: efforts to enhance security by maintaining a strong defensive capability and promoting cooperative security measures; efforts to open foreign markets and spur global economic growth; efforts to promote democracy abroad. Enhancing U.S. security requires developing and maintaining a strong defense capability of forces ready to fight. A strong defense will arise from the deployment of robust and flexible military forces that can accomplish a variety of tasks such as; providing a credible overseas presence, and contributing to multinational peace operations. To meet these requirements successfully, U.S. forces must be capable of responding quickly and effectively. This ability requires qualified and motivated personnel, modern, well-maintained equipment, and sufficient sustainment capabilities. ("National Security Strategy", 1994, p. 7)

E. IMPACT OF THE MILITARY TECHNOLOGICAL REVOLUTION

Given the present nature of the world, NEFs must be efficient with far fewer resources. With reduced force levels and budgets at the lowest level since World War II, forces will pay huge penalties for inefficiencies. (Strategic Review, 1994, p. 13) The MTR provides one solution to the problem of matching increased demands to declining resources. Technological advancements in combat systems, space systems, and Command Control and Communications (C3I) systems are expected to provide the force-multipliers for lighter and more maneuverable force packages. Fiscal constraints will deny the luxury of redundant capabilities, and will require the joint integration of operations and logistics. The past decade marked a revolution in military technology that has enhanced not only the forces of the United States but also many Third World countries. Third World regional problems have raised dire questions concerning the future requirements for projecting and protecting U.S. forces in Third World regions.

The MTR has the potential to provide force multipliers that will allow the Navy and Marine Corps to restructure their amphibious forces around leaner more cohesive and flexible forces requiring reduced maintenance and logistics support. The character of high-technology U.S. Expeditionary Forces with high ratios of combat to support personnel makes it difficult to sustain any prolonged operation of mid to high intensity tempo. Such operations are handicapped by the lack of large, shore-based, logistical infrastructures. However, when one reviews the types of operations that NEFs have been involved in the past decade a spectrum of conflict can be constructed. Figure 2.1 shows such a spectrum.

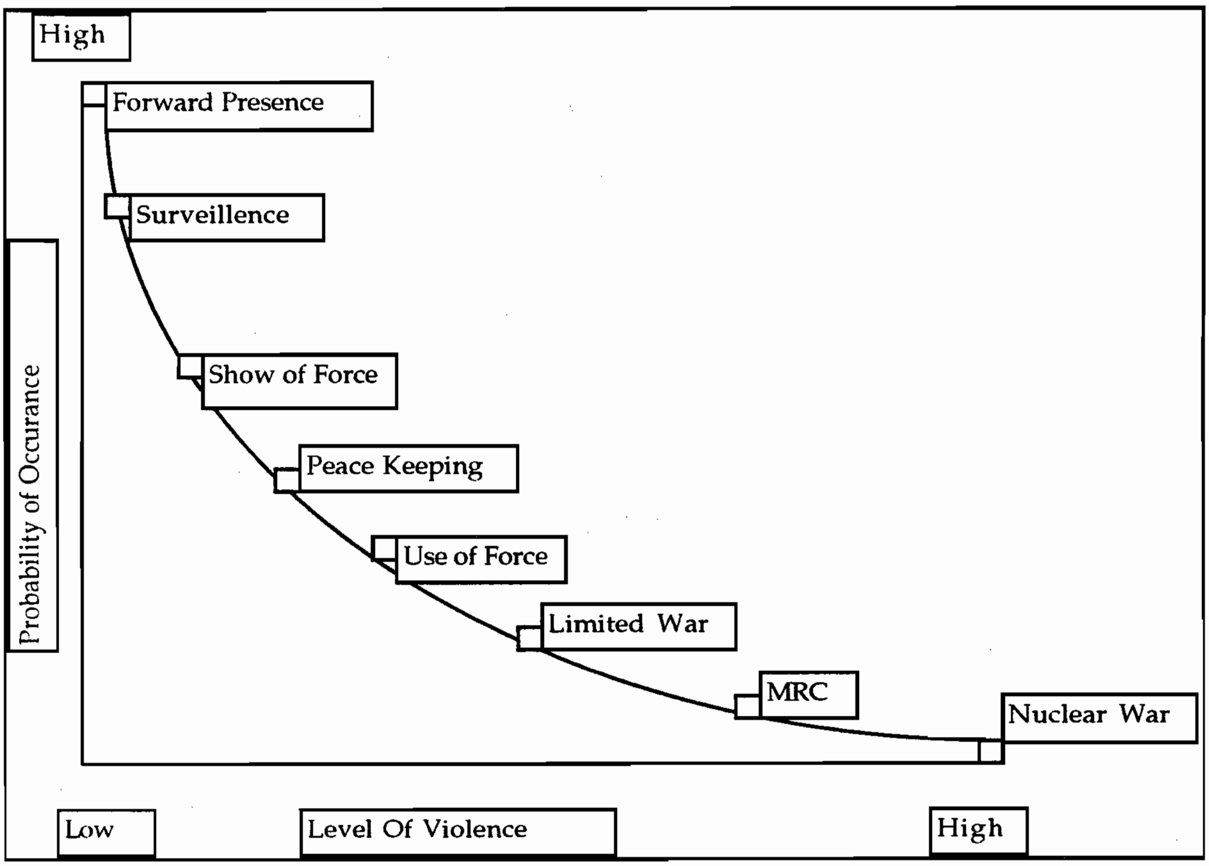

Figure 2.1 Spectrum of Conflict

Note: Chart derived from The Maritime Strategy, U.S. Naval Institute, January 1986, p. 8.

An important factor that impacts on logistical sustainment is that of forcible entry capability. The question of how much forcible entry capability to maintain and how to provide the necessary logistical structure to support it are extremely difficult to answer. The Navy and Marine Corps advocate that 15-60 days sustainment will be necessary for forcible entry capable units operating in a low to mid intensity environment depending on the type of MAGTF. (Concepts and Issues, 1994)

Expeditionary logistics require that amphibious ships and their escorts remain close enough to the land operation to provide continuous support. This concept contributes to a smaller footprint and logistics tail ashore. Helicopters, V-22 aircraft, and LCACs will be used to provide an "air-sea-bridge" between the maneuver forces ashore and their sea-based logistics base. NEFs may benefit from improved equipment possessing greater reliability and requiring less maintenance. Also, containerized, prepackaged resupplies, combat loaded for easy access and distribution after delivery, will facilitate the rapid resupply and sustainment of forces ashore.

While technologically complex weapons systems promise greater lethality and cost effectiveness they can be obtained only at the price of far fewer numbers of deployed weapons. One aspect of the MTR to remember is that advanced and complex systems require highly trained personnel to operate and maintain them. The combination of high Operating and Support (O&S) requirements directly impact on the tooth-to-tail ratio of a force. This issue is examined in chapters three and four. The MTR can expect to yield some lowering of manning levels due to higher engineered reliability.

E. SUMMARY

As the result of a diminished Soviet threat, the United States has the opportunity to trim its defense commitments to accommodate other national priorities. A program of restructuring is underway to modernize and reduce the defense force structure to one that is more affordable. It is obvious that the new national security strategy will have a major impact on the size and capabilities of the Navy and Marine Corps. NEFs in power projection roles will be central to this new strategy. Its success will depend, in part, on logistics and the inherent costs related to force sustainment. Logistical agility can be achieved by an increase in tactical mobility through the acquisition of lightweight armored fighting vehicles and an operational doctrine of maneuver warfare and the development of a sea-based logistical capabilities able to supply and maintain ground forces ashore. (Record, 1983, p. 3)

III. NOTIONAL MARINE EXPEDITIONARY FORCE ORGANIZATION

A. INTRODUCTION

In this chapter, the baseline force structures for notional MAGTFs are developed. From these baselines personnel strengths are determined according to the functional combat or support roles they perform, and the resulting tooth-to-tail ratios are calculated. Next, an analysis of personnel concentrations in logistics functional support areas is conducted to determine their contribution to the MAGTF "tail". Lastly, personnel and equipment costs for units within the MAGTF are calculated.

B. BACKGROUND

Marine forces are formed into MAGTFs for operations and exercises and, whenever possible, training. This practice promotes teamwork and coordination among the elements, and fosters the combined arms concept. While this concept provides tremendous organizational flexibility and integrated force projection capabilities, it also places a premium on the CSSE's ability to create and provide a flexible and responsive logistics apparatus.

The current restructuring program in the Marine Corps is an effort to reorganize existing forces for optimal efficiency. The current plans for force reductions and an austere budget environment are in effect placing a premium on forces capable of operating with a "large tooth and small tail." In order to achieve and maintain acceptable tooth-to-tail ratios the United States must structure expeditionary forces to yield enhanced flexibility and capabilities while consuming less resources to do so than in the past.

The increased emphasis and use of NEFs in U.S. national strategy will force planners to reexamine the direct relationship between force projection capability and the logistical requirements to conduct sustained operations, or more simply put, readiness versus sustainability. Readiness and sustainability can be defined in the following terms.

> Readiness is the ability of forces, units, weapons systems, or equipments to deliver the outputs for which they were designed (includes the ability to deploy and employ without unacceptable delays). Sustainability is defined as the ability to maintain the necessary level and duration of operational activity to achieve military objectives. Sustainability is a function of providing for and maintaining those levels of ready forces, material, and consumables, necessary to support military effort. (JOINT PUB 1-02)

This analysis views readiness as a function of sustainment, and sustainment as a function of readiness.[5] The tooth-to-tail ratio serves as a measurement of this relationship, and highlights the mutual dependence that exists between readiness and sustainability. The relationship between readiness and sustainability, as evidenced in tooth-to-tail ratios, will become increasing important indicator of expeditionary force capability in the future.

C. NOTIONAL BASELINE STRUCTURES

In order to effectively examine and analyze the tooth-to-tail ratio of MAGTFs it is necessary to develop a notional MAGTF force structure which can serve as a baseline. It will also facilitate the extrapolation of MAGTF-2015 force structure. This baseline model is formed, based on accepted MAGTF

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[5]While sustainability is defined as the ability to maintain a certain level and duration of activity this analysis uses the term sustainment to describe the specific level of support, in terms of days of organic support, a MAGTF possesses.

organizational concepts. From this notional force the tooth-to-tail ratio and the resulting capabilities of the notional force can be determined and used as a baseline for developing and measuring capabilities of future forces.

Before 1991, MAGTFs consisted of three basic types: the Marine Expeditionary Unit (MEU); the Marine Expeditionary Brigade (MEB); and the Marine Expeditionary Force (MEF). As the result of the BUR and the work of the Marine Corps Force Structure Planning Group, several changes to MAGTF organizations were made. One change was the decision to dissolve standing MEB headquarters staffs. The MEB structure evolved into what is currently termed a Special Purpose MAGTF (SPMAGTF). In recent years there has been continuing debate over when it is appropriate to use the term MEB. It may develop into a term that describes a degree of capability as in "a MEB sized" force rather than an actual standing organization. The MEF possesses the permanent headquarters staff and remains the premier expeditionary capability.[6] The term MEF (forward) may come to describe operations entailing a MEB size capability. The SPMAGTF will replace the MEB in planning terminology. (Interview with Maj. Stratman) Pending this evolution, this chapter discusses the composition of three notional MAGTFs: the MEU, MEB, and MEF. Including the MEB size force will help to quantify and analyze the tooth-to-tail ratios that result from "small", "medium", and "large" expeditionary capabilities. A brief explanation of organization and logistics sustainment capabilities of each is followed by a description and structure breakdown of their respective Combat Service Support Elements.

[6]The Marine Corps maintains three standing MEF headquarters. A MEF would be fully constituted from FMF units as the mission and task organization dictate. This analysis uses a notional MEF structure which reflects the current concepts for MEF force structure and capabilities.

D. COMPARATIVE ANALYSIS

Due to the sensitive nature of actual unit end strengths, the figures presented in this analysis are approximations based on open source data. Regardless of size or name, all MAGTFs are expeditionary. They are tailored for a specific mission and threat requirement, and must therefore have a flexible structure. As a result, estimates of MAGTF organizations above the MEU level become increasingly speculative and have therefore no exact Tables of Organization and Equipment (TOEs). As such, it is difficult to determine the composition of the CSSEs in terms of transportation, engineering, C3I, ammunition handling, health, services, and maintenance. With these factors to consider, the estimates developed in this thesis must be viewed as approximations to be employed in selected planning and budget exercises.

It is important to note that for planning purposes MEBs and MEFs may be divided into parts or echelons. The degree that this division occurs is dependent on the availability of assault amphibious shipping, which is affected by ship maintenance, and the exact task organization chosen for a given MAGTF. Generally speaking, at a minimum the Assault Echelon (AE) is comprised of that part of the MAGTF and its associated supplies that are needed to sustain it for an amphibious landing and the first 15 days of operations. Commercial ships and other modes of transportation are to carry personnel, equipment and supplies for the Assault Follow-On Echelon (AFOE). Aircraft would transport personnel, supplies, and equipment of the Fly-In Echelon (FIE). The AFOE and FIE would carry enough supplies to support the MEB and MEF for an additional 15 to 45 days, respectively, thus achieving a sustainment capability of 30 days for a MEB and 60 days for a MEF.

This analysis assumes a 100% availability of existing assault amphibious shipping and therefore does not break down MAGTFs into echelons. It also assumes that MAGTFs possess their full sustainment capabilities; 15 days for a MEU, 30 days for aa MEB, and 60 days for a MEF.

1. Notional MEF Organization

The MEF is the principal Marine Corps warfighting MAGTF. It is built around a Division/Wing team and can range in size from less than one, to multiple divisions and aircraft wings along with one or more Force Service Support Groups (FSSGs). Designed for 60 days of sustainment, a MEF will normally deploy in echelon with the lead elements designated as the MEF (Forward). It possesses 60 days of sustainment, and it is supported from its seabase. The MEF along with assigned naval forces and assault amphibious shipping make up the Amphibious Task Force (ATF). The ATF possesses approximately 56 ships. Figure 3.1 depicts notional MEF organization.

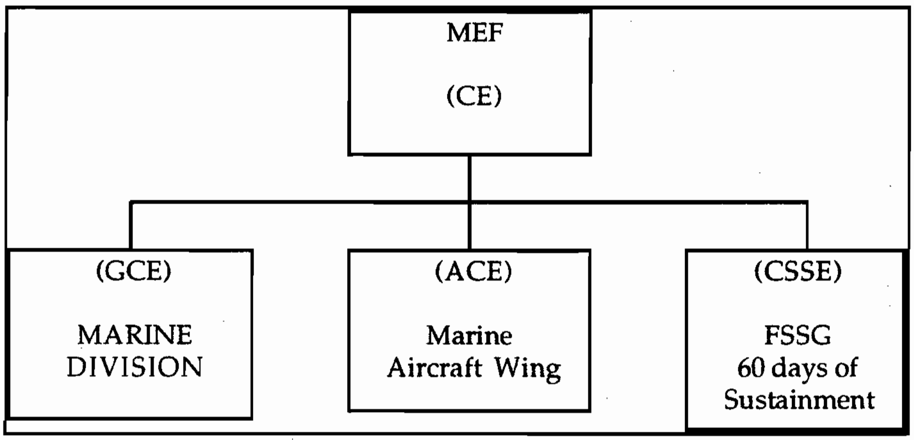

Figure 3.1 Notional MEF Organization

2. Notional MEB Organization

The MEB is task-organized to accomplish specific missions for which the MEF or MEU would be inappropriate. It is normally built around a Regimental Landing Team (RLT) and a provisional Marine Aircraft Group (MAG) of attack and support aircraft, and a Brigade Service Support Group (BSSG). The RLT is comprised of four maneuver battalions, three infantry battalions and one tank battalion. Tactical mobility is provided by Assault Amphibious Vehicles (AAVs), transport helicopters (CH-46E, CH-53A/D, CH53E) and trucks. Fire support is provided by a reinforced artillery battalion. The MEB possesses thirty days of sustainment and it is supported from its seabase. The MEB and assigned naval forces and assault amphibious shipping make up an Amphibious Task Force (ATF). The ATF possesses approximately 21 ships. Figure 3.2 depicts a notional MEB organization.

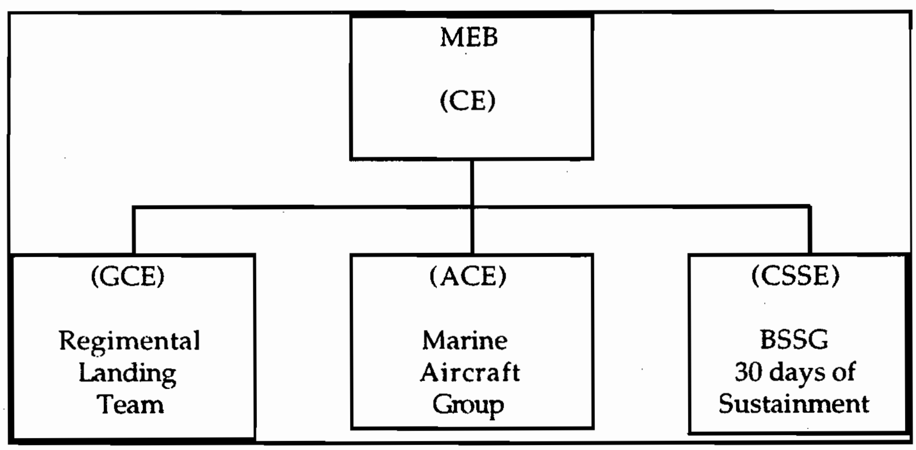

Figure 3.2 Notional MEB Organization

3. Notional MEU Organization

The MEU is normally built around a Battalion Landing Team (BLT), a composite helicopter squadron, a MEU Service Support Group (MSSG), and a command element. In some cases the squadron may contain VSTOL AV-8B aircraft. A MEU is deployed as an immediately responsive seabased MAGTF to meet forward presence and limited power projection requirements. The MEU provides an immediate crisis reaction capability and possess a limited capability for forcible entry. It possesses 15 days of sustainment and it is supported from its seabase of assault amphibious shipping. The MEU, along with the assigned naval forces and assault amphibious shipping constitute the Amphibious Ready Group (ARG). The ARG possesses approximately 3 to 4 ships. The MEU fills the role of a forward deployed element of a MEB, which would be constituted as required. Currently, MEUs are the basic lead elements that are deployed on a continuous basis. They form, train, deploy, and then disband according to current rotation plans. Three MEUs are required to keep one deployed. These plans ensure total rotations of personnel and equipment about every six months. Figure 3.3, on the following page, depicts notional MEU organization.

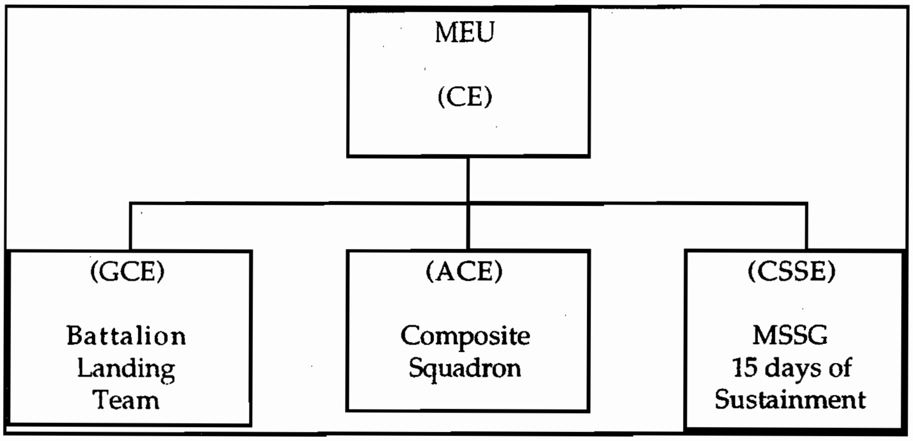

Figure 3.3 Notional MEU Organization

E. MAGTF SUSTAINABILITY

A fundamental characteristic of a MAGTF is its ability to operate for extended periods as an expeditionary force, relying on organic resources for sustainment. All MAGTFs have an inherent self-sufficiency for pre-planned periods. Table 3.1, on the following page, lists the different sustainment levels for MAGTFs. Larger MAGTFs have a deeper, broader, and more capable support capability thanks to increased organic assets.

MEU	15 days
MEB	30 days
MEF	60 days
SPMAGTF	As the situation requires

Table 3.1. MAGTF Sustainment Capabilities

MAGTFs can augment their organic sustainability by using external support from Navy organizations, wartime host nation support agreements, inter-service support agreements, and in theater cross service support. This analysis will only focus on the inherent organic sustainment capabilities of the MAGTFs. There are no textbook prescriptions for forming composite MAGTFs. Depending on size and organization, they possess different levels of offensive and sustainment capabilities. However, a key component built into the unit's structure is "mergibility." This basic capability exists to facilitate the combining and integration of units to constitute higher level MAGTFs.

This chapter examines how support structures contribute to the combat capability of MAGTFs. Within MAGTFs, functional purposes cannot be based solely on unit designation. Marines assigned to the GCE are not only combatants; they may serve as supplymen, drivers, mechanics, or they may have a combination of these duties. Multiplicity of functions may also be true of the unit as a whole. But the line must be drawn somewhere, even though it may result in oversimplifications. This analysis uses a straightforward method for computing tooth-to-tail ratios. Once MAGTFs are broken down into the basic units that form its structure, a macro level classification can be made which further breaks down the component units of the CE, GCE, ACE into either combat or support roles. Personnel strengths are developed for units and the resulting tooth-to-tail ratios are calculated. This method has the advantage of being generally applicable in across-the-board comparisons as it uses data reasonably estimated from available sources.

F. TOOTH-TO-TAIL RATIO

1. Tooth-to-Tail Defined

This analysis defines the tooth-to-tail ratio as the number of combat troops in the MAGTF supported by a certain number of support troops from the CSSE of the MAGTF. This ratio is computed by determining the number of personnel (Marine and Navy) assigned to combat roles in a MAGTF and dividing that figure by the total number of personnel assigned to support roles in that MAGTF. Therefore,

Tooth-to-Tail ratio= (C/S),

where; C=total combat forces strength, S=total support forces strength.

2. Structure of Support Units

The manpower strengths associated with support functions are computed by totalling the personnel strengths of units contributing to the functional support areas such as Supply, Maintenance, Transportation. The measurement is used to determine the relationships between the logistic support functions and different MAGTF configurations.

G. BASIC CONCEPTS

Combat power could be estimated by calculating the number of weapons operators per 1,000 men. The advantage of this method is that it presents a narrowly defined picture of the force's tooth-to-tail ratio. In practice, this method is extremely difficult to use because of the detailed analysis required down to the small unit level. A simpler method is to measure the quantity of weapons and equipment which give the force its firepower. Once the combat power and the support element for a unit are estimated, a comparison can be made which relates the level of combat power for a force with the level of its accompanying support element. A drawback to this method is that it fails to address how the overall support structure is employed to operate the weapons. Yet, support structure is obviously important. This method does provide information as to how the tooth-to-tail ratios relate to combat power and capability. At issue is the relationship between the capability of a force, the tooth-to-tail ratio which is a product of that capability, and the costs to maintain and operate that force.

In assessing the implications of these methods, it is necessary to have an analytical framework that allows for meaningful comparisons. One helpful approach in tooth-to-tail assessment is to view the MAGTF structure in a baseline form, evaluating major capabilities against support planned to sustain those capabilities. The issue then becomes one of determining how much capability the MAGTF derives from its combat forces as a result of an increment of support.

H. FUNCTIONS

In applying this baseline approach, it is useful to recognize that several support functions must exist for a MAGTF to perform its missions. Using this approach the support functions then can be translated into the MAGTF's actual capability to project combat power ashore. A measure of a unit's combat power thus can be gained by determining its capability to perform critical support functions. The latter include:

1. Ammunition Handling: the ability to store ammunition safely until breakout involves specific skills. Handling, packaging and transporting of ammunition resupplies is critical in the sustainment of combat operations.

2. Supply: the supply system provides the MAGTF with the requisite materials for conducting combined arms operations. The needs of the supported units are the basis of the supply effort.

3. C3I: a MAGTF must have effective C3I for developing a course of action. Real-time communications will be made possible through the use of satellite communications equipment. Portable navigational devices such as the Global Positioning System (GPS) will allow for pinpoint navigation and position locationing of forces, greatly enhancing the commanders ability to effectively employ and control his forces. Advances in data processing and communications utilizing satellite data-links provide the commander with direct communications to the National Command Authority. Space data-links will allow the commander to access information from source based reconnaissance assets. These enhanced C3I capabilities provided will be critical for implementing/coordinating maneuver and logistics ashore with the seabased infrastructure.

4. Engineering: engineering provides the capability of the force to conduct construction, demolition and obstacle removal, engineer reconnaissance and explosive ordnance disposal.

5. Transportation: a MAGTF must have adequate transportation to project naval power ashore. Once ashore, transportation assets provide the ability to maneuver and sustain forces. Adequate mobility is a critical capability for lightly armed expeditionary forces and serves as a

force-multiplier by virtue of its contribution to maneuver. The MAGTF must also have the capability to receive, absorb and transport adequate munitions, POL and other stocks while avoiding establishing a larger than necessary footprint ashore, and an excessive requirement for combat and support forces to operate and guard supply points.

6. Health: health services are a critical aspect of logistics planning and operations that is often neglected but can have a tremendous drain on assets. It comprises health maintenance, casualty collection, treatment and evacuation.

7. Services: adequate service support is necessary to provide for routine administration, disbursing, postal, legal, civil affairs, graves and registration. This function contributes to combat performance by providing a means to process casualties and replacements. For purposes of this analysis services include those units whose activities consist of a number of support activities that can not be categorized into one specific functional area of support.

8. Maintenance: maintenance support is necessary to repair broken or damaged weapons and equipment and return it to serviceable status as rapidly as possible. Due to amphibious lift limitations NEFs will not have the luxury of large stocks of replacement weapons and equipment.

A picture of a MAGTF's force projection capability can be gained by examining its capability to perform the requisite support functions. In this context, it is useful to recognize that the current employment plans for NEFs that emphasize mobility, flexibility, and quick response demand higher performance in these functions. For example, real-time C3I is particularly important in force projection operations characterized by speed and maneuver; transportation is needed to provide increased mobility and maneuver; and greater logistic support is needed to permit the sustainment of expeditionary forces. Efficient maintenance and a rapid individual replacement system are critical to maintaining the flexibility and momentum of operations.

I. MAGTF MANPOWER

1. Allocation

A good starting point is to analyze how manpower is allocated between combat and support. A basic Marine Corps tenet is that every Marine is a rifleman. This means that all Marines exist to support the infantryman in combat. (Mundy, Concepts and Issues, 1994, p. i) For the purposes of this analysis, however, "combat" personnel are defined as those personnel who perform combat roles, e.g., infantry, artillery, tactical aviation. Support personnel are defined as those personnel performing roles in one of the functional areas of support, e.g., Supply, Transport, C3I. On a macro level the "tail" of a MAGTF can be composed of personnel from the CE, GCE, ACE, and CSSE. Tables 3.2, 3.3, and 3.4 display the personnel slice for notional MAGTFs and the resultant tooth-to-tail ratios.

ELEMENT	STRENGTH	% OF MAGTF
CE	111	5
GCE	1,407	59
ACE	552	23
CSSE	325	14
TOTAL	2,395	100
COMBAT	1,495	62
SUPPORT	902	38
TOOTH-TO-TAIL	1.66:1	

Table 3.2. Notional MEU Strength.

Information for Table 3.2 taken from, Fleet Marine Force Organization 1992 (FMFRP 1-11), and Marine Corps Cost Factors Manual (MCO P7000.14), 19 June 1991, and author's estimate.

ELEMENT	STRENGTH	% OF MAGTF
CE	734	5
GCE	5,265	32
ACE	7,530	46
CSSE	2693	17
TOTAL	16,222	100
COMBAT	9,429	58
SUPPORT	6,793	42
TOOTH-TO-TAIL	1.39:1	

Table 3.3. Notional MEB Strength.

Information for Table 3.3 taken from, Fleet Marine Force Organization 1992 (FMFRP 1-11), and Marine Corps Cost Factors Manual (MCO P7000.14), 19 June 1991, and author's estimate.

ELEMENT	STRENGTH	% OF MAGTF
CE	2,192	5
GCE	19,232	42
ACE	14,292	31
CSSE	9,815	22
TOTAL	45,501	100
COMBAT	21,505	47
SUPPORT	23,996	53
TOOTH-TO-TAIL	0.90:1	

Table 3.4. Notional MEF Strength.

Information for Table 3.4 taken from, Fleet Marine Force Organization 1992 (FMFRP 1-11), and Marine Corps Cost Factors Manual (MCO P7000.14), 19 June 1991, and author's estimate.

2. Functional Analysis

A difficult question is whether larger manpower concentrations in the functional areas of service support buy significantly greater combat capability. Some insights can be gained by examining how these assets seem to contribute to the percentage of force strength. Table 3.5, on the following page, depicts units comprising the CSSE or "tail" of the MAGTF. Units have been divided into the functional areas of CSS.

	Ammo	Supply	C3I	Engineers	Trans.	Health	Services	Maint.	Total
MEU	14	52	219	144	347	27	65	34	902
MEB	42	720	1542	800	1215	139	2104	231	6,793
MEF	405	3007	5505	3409	2893	1211	5773	1793	23,993

Table 3.5 MAGTF Personnel Breakdown By CSS Functional Area

Information for Table 3.5 taken from, Fleet Marine Force Organization 1992 (FMFRP 1-11), and Marine Corps Cost Factors Manual (MCO P7000.14), 19 June 1991, and author's estimate.

Table 3.5 shows that as the size of the MAGTF goes up, the number of personnel assigned to CSSE functional areas increases. The MEU possesses the largest tooth-to-tail ratio, indicating a relatively high readiness vice sustainability. In all CSS functional areas the MEU, when compared to the MEB and MEF, is rather austerely supported. Assets appear to be sufficient to support limited operations of short duration and intensity. The functional areas can provide the force with necessary supplies and equipment to begin an operation and have sufficient forces for limited resupply. In terms of total personnel strength, the MEB is 6.77 times larger than the MEU. In the measured functional areas, the MEB size force shows an increase in CSS personnel strengths above that of the MEU by the factors displayed in Table 3.6. Moving from the MEU structure to the MEB structure shows an increase in size factors which add to the sustainability of the MAGTF in greater proportion than to its readiness. This is shown in the MEB's tooth-to-tail ratio of 1.39. Of particular note are the large increases in Supply, C3I, and Services, while Health, Transportation, and Maintenance show increases comparable to the increase in Personnel size. Ammunition and Transportation show much smaller increases. The MEF is 19 times larger than a MEU. In the measured functional areas the MEF size force shows an increase in CSS personnel strengths above that of the MEU by the factors displayed in Table 3.6. When moving from the MEU structure to the MEF structure, particularly large increases are found in the areas of Ammunition Handling, Supply, Health, Services, and Maintenance. C3I and Engineering show smaller increases compared to the increase in personnel of the MEF over the MEU. Especially notable is the small growth in Transportation. The data shows an increase in support areas contributing to sustainment and a smaller increase in readiness reflected in the MEF's tooth-to-tail ratio of .90.

	Ammo	Supply	C3I	Eng.	Trans.	Health	Service	Maint.
MEU/MEB	.33	.072	.142	.180	.286	.194	.031	.147
MEB/MEF	.104	.239	.280	.235	.419	.115	.364	.129
MEU/MEF	.035	.017	.040	.042	.120	.022	.011	.019

Table 3.6 Ratios of Personnel Strengths for CSS Functional Areas

Note: Table 3.6 shows the relative increases in personnel per CSS functional area when comparing a MEU to MEB and MEF size MAGTFs.

Table 3.7 depicts the MAGTF functional areas of CSS. Each functional support area is displayed as a percentage of total CSS strength for each MAGTF.

	Ammo	Supply	C3I	Eng.	Trans.	Health	Service	Maint.
MEU	1.6	5.8	24.3	16.0	38.5	3.0	7.2	3.8
MEB	.6	10.6	22.7	11.8	17.9	2.0	31.0	3.4
MEF	1.7	12.5	22.9	14.2	12.1	5.0	24.1	7.5

Table 3.7 MAGTF CSS Functional Areas as a Percentage of Support

Of particular note is the relatively large percentage of CSS structure allocated to C3I for all three MAGTFs. For the MEU, C3I accounts for 24% of CSS and Transportation accounts for 39% of CSS. For the MEB C3I and Services account for 51% of CSS and for the MEF C3I and Services account for 47% of CSS structure. These results indicate that the increase in CSS structure, as one moves from a small to a medium and to a large expeditionary capability, are concentrated in command and control and services. Supply accounts for roughly 10% of CSS structure for the MEB and 12% for the MEF. Transportation accounts for roughly 18% of CSS for the

MEB and 12% for the MEF. In moving from a small to a medium and then large expeditionary capability a shift in the percentage of personnel assigned to combat and support functions occurs. Figure 3.4 is provided to help visualize the change in balance between combat and support structure as one moves from the MEU to the MEB to the MEF.

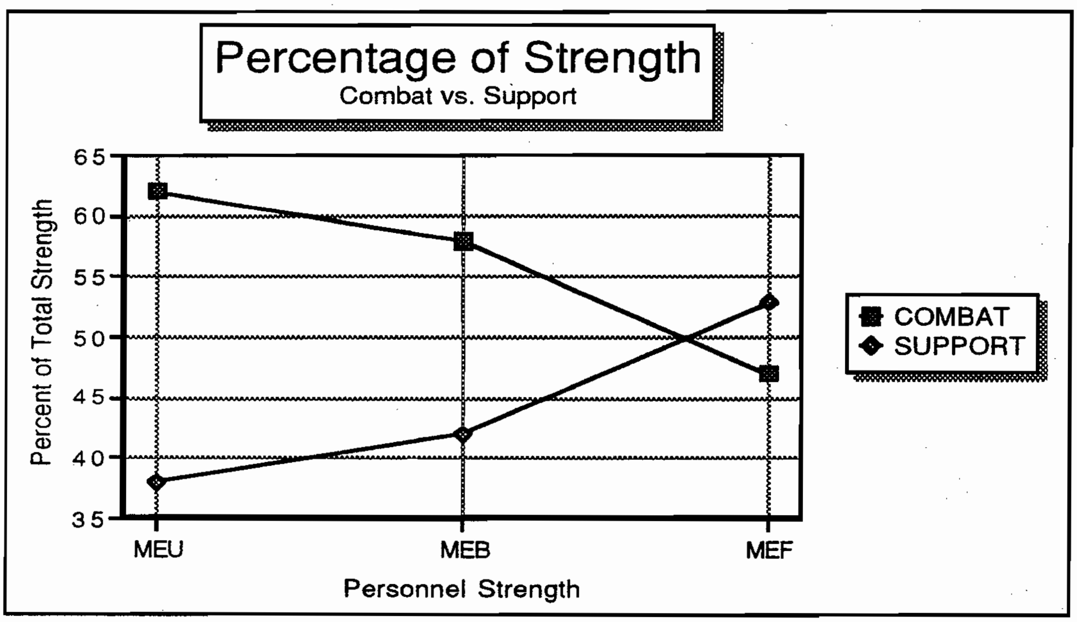

Figure 3.4 Shift in Combat vs. Support Troops for Notional MAGTFs
(Horizontal Axis not to scale)

3. Indications of Performance

This analysis has treated manpower as the primary indicator of resources investments and performance. However, additional observations can be made in comparing MAGTF weapons densities. Tactical aviation assets are counted as weapons systems as their primary purpose in supporting the MAGTF is to provide close air support of ground forces ashore. Weapons density in this case is defined as the number of major weapons per 1,000 men in a MAGTF. Table 3.8, on the following page, displays the quantities of major weapons systems possessed by the notional baseline MAGTF.

	MEU	MEB	MEF
Tanks M60A1	4	14	44
AAV	12	47	208
LAV	8	27	110
155 HOW	4	36	96
105 HOW	4	--	--
81mm Mortar	8	24	72
60mm Mortar	12	36	108
MK-19 MG	26	114	600
TOW Msl Lr	8	48	144
DRAGON Lr	24	72	216
.50Cal MG	20	138	435
M60 MG	50	206	601
HAWK Msl Lr	--	8	116
STINGER Lr	5	45	90
AV-8B	6	40	60
F/A-18	--	36	72
A-6E	--	10	10
EA-6B	--	6	6
CH-53	4	28	44
AH-1W	4	12	24
CH-46E	12	48	60
UH-1N	4	12	24

Table 3.8 Notional MAGTF Major Weapons

Note: Information for Table 3.8 taken from, Marine Air-Ground Task Force: A Global Capability (FMFRP 2-12), Washington, D.C., HQMC, April 1991, and author's estimate.

A quick measure of a unit's combat power can be derived from the quantity of weapons it possesses, the assumption being that higher weapons densities equate to increased combat power. Increases in weapons densities also imply a need for greater functional support. In order to compare the combat power of different MAGTFs the number of major ground weapons per MAGTF is calculated. These figures do not include aircraft because MEUs do not possess many of the tactical aircraft common to the MEB and MEF (F/A-18, A-6) and comparisons would not be equitable. Table 3.9 shows major ground weapons densities for MAGTFs.

MAGTF	MEU	MEB	MEF
Manpower Strength	2,395	16,222	45,501
Number of Major Weapons	185	815	2,740
Wpns Density (# Wpns/1000 Troops)	77.24	50.24	60.22
Wpns Density (#Wpns/1000 Combat Troops)	123.75	86.44	127.41

Table 3.9 Major Ground Weapons Density per MAGTF

Table 3.9 presents two different weapons densities for each of the three MAGTFs. The Weapons density per 1,000 men is based on the number of total personnel in a MAGTF. The weapons density per 1000 combat troops is based on the number of combat personnel assigned to MAGTFs. It is interesting to note that the densities calculated using total personnel are highest for MEUs at 77.24, decreases to 50.24 for MEBs, and increases again to 60.22 for the MEF. In the MEU's case, these results may indicate a high readiness in terms of potential combat power and a lesser capability for sustainment. The MEB results may indicate a higher level of sustainment for existing weapons relative to potential combat power. In the case of the MEF, the results may indicate greater balance in higher levels of readiness and sustainment. When using densities calculated from combat personnel strengths the densities show the same pattern of decreasing from the MEU to the MEB and then increasing from the MEB to the MEF. Using this method the weapons densities for the MEF actually exceed the densities for the MEU.

The use of a particular density method depends on what is being measured. Because NEFs are task-organized from a variety of units to perform a specific mission the more appropriate measure of their combat power can be arrived at by using the densities calculated using total personnel strengths. If the intent is to measure and compare combat power between units the densities calculated using combat troop strength may be more appropriate.

Another area to look at in order to compare combat power is the number of assets available per MAGTF for transportation and mobility . Table 3.10, on the following page, shows transportation densities for each notional MAGTF.

MAGTF	MEU	MEB	MEF
Manpower Strength	2,395	16,222	45,501
Total Trucks	20	50	127
Truck Density (# Trucks/1000 troops)	8.35	3.08	2.79
Truck Density (# Trucks/1000 combat troops)	13.38	5.30	5.90
Transport Helos	16	76	104
Helo Density (# Helos/1000 troops)	6.68	4.68	2.29
Helo Density (# Helos/1000 combat troops)	10.70	8.06	4.84
LCAC	6	24	78
LCAC Density (# LCAC/1000 troops)	2.50	1.48	1.71
LCAC Density (# LCAC/1000 combat troops)	4.01	2.54	3.63

Table 3.10 Transportation Density per MAGTF

Note: Figures on equipment taken from Fleet Marine Force Organization 1992, (FMFRP 1-11), Washington, D.C., HQMC, 2 March, 1992, and author's own estimate.

Again, it is interesting to note the effect that increases in MAGTF size have on the calculated densities. In examining these differences one would not expect to find the MAGTF density changes depicted in Figure 3.5.

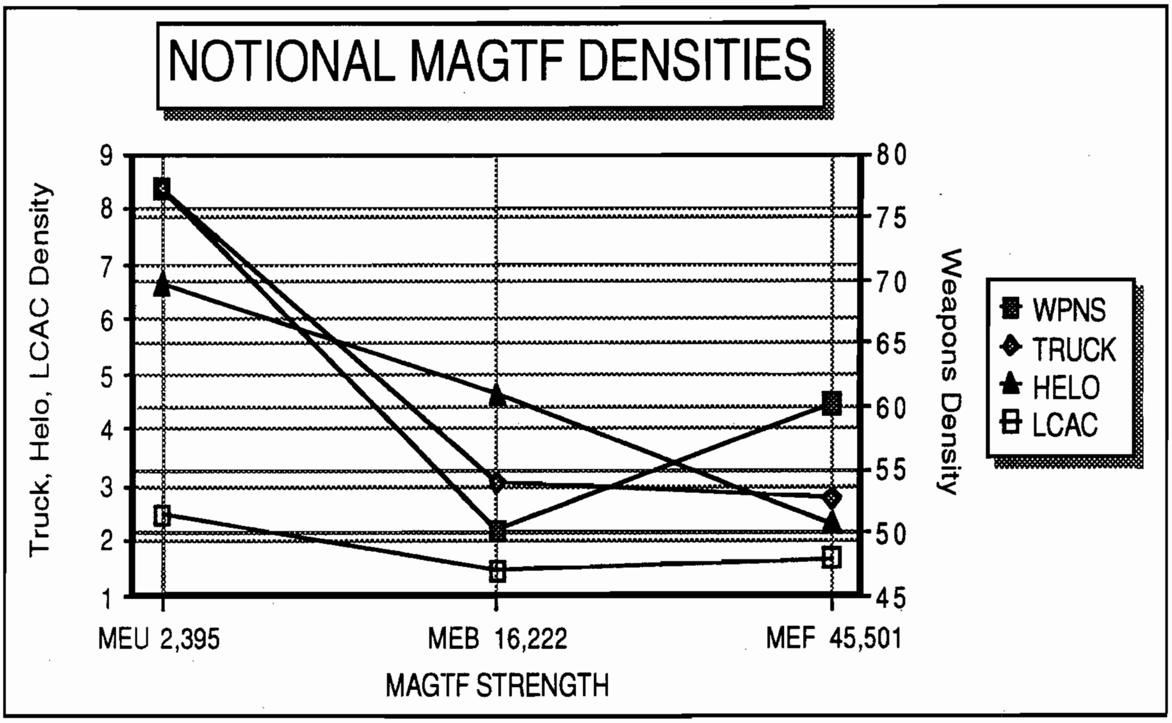

Figure 3.5 Notional MAGTF Densities/1000 Troops

Note: (Strengths not to scale) Figure 3.5 is based on information extracted from Fleet Marine Force Organization 1992, (FMFRP 1-11), Washington, D.C., HQMC, 2 March 1992, and author's estimate. Densities are calculated using total personnel strength per MAGTF.

These results tend to indicate that the task-organizations used to establish the MAGTFs "building block" concept is not linear. For example; three MEUs can not form a MEB because of a shortfall in command and support units. This example is also applicable when trying to form a MEF from three MEBs. The disparities in densities may be explained by examining the MAGTF force structure. In moving from the MEU to the MEB, and again from the MEB to the MEF, the MAGTF organization enjoys a significant increase in support troops and a comparatively smaller increase in combat troops and weapons. The resultant changes in densities are graphically displayed in Figure 3.5. Appendix F contains a detailed analysis and further elaboration on the changes in MAGTF densities.

It is important to note that the percentage changes of personnel in each CSS functional area which were previously discussed play an important role in density differences. The CSS structure change is in fact a summation of the functional area structure changes. Each MAGTF is structered slightly differently to achieve different sustainment and combat capabilities. Tables 3.6 and 3.7, display the increase in CSS structure by functional area. From these tables one can gain an understanding of the different factors contributing to the changes in MAGTF densities. For example; in comparing the personnel increases when moving from the MEB to the MEF there is a smaller overall increase in number of transportation assets compared to larger increases in non-transportation related CSS. In moving from the MEB to the MEF the percentage of transportation related CSS increases at a greater rate causing an increase in densities.

4. Assault Amphibious Shipping

Assault amphibious shipping is a key component of the NEF. Put simply, amphibious ships are the sea-bases from which naval forces operate. This thesis has estimated the assault amphibious shipping requirements for notional MAGTFs, using current assault amphibious shipping assets and respective capacities. The results are shown in Table 3.11, on the following page. A detailed discussion of amphibious lift is presented in Chapter IV.

	LH	LPD	LSD	LST	LCAC
MEU	1	1	1	1	6
MEB	5	4	5	7	24
MEF	14	11	13	18	78
2.5 MEBs	12	10	13	17	60

Table 3.11 Estimated Amphibious Ship Mix For Notional MAGTFs

Note: Information for Table 3.11 taken from "Integrated Operations & U.S. Marine Corps Air Requirements Study," Washington, D.C., Department of the Navy, 26 September 1993, and author's estimate.

J. DEVELOPMENT OF COST

Having established a baseline structure for notional MAGTFs and the corresponding tooth-to-tail ratios, the next step in this analysis is to estimate the cost of achieving and maintaining the tooth-to-tail ratios of MAGTFs.

1. Introduction To Costing

During times of shrinking defense budgets and resources, accurate cost estimation plays an increasingly important role in allocating resources. This is also true for the cost associated with an expeditionary MAGTF capability. In developing cost estimates for this analysis the internal cost factors developed by the Marine Corps are used in this thesis. The Marine Corps Cost Factors Manual (MCO P7000.14) is the standard handbook of all the accepted cost factors used by the Marine Corps. These cost factors apply specifically to organic Marine Corps units. The cost factors pertain to classes of personnel and types of equipment and are designed to facilitate the rapid estimation of selected costs for planning, programming, cost and economic analysis. The information contained in the Cost Factors Manual is generally only applicable to the peacetime Marine Corps. Wartime consumption rates could be considerably different than those listed in the manual and would have to be estimated using an operational tempo factor for adjustments. (Vessey, 1994) The costs, therefore, represent the peacetime costs of maintaining a wartime capability.

K. MILITARY CAPITAL

1. Measures of Capital

The next step in this analysis is to estimate the capital value (value of total assets in inventory) of MAGTFs, including planes, equipment and weapons authorized by a unit's Table of Authorized Equipment (T/E). This thesis is in agreement with Healy's observation that, "in presenting the topic of military capital, several key concepts need to be represented and understood. They are: investment, capital stock, capital services value, benefit, and the treatment of R&D costs." (Healy, 1994, p. 44)

a. Investment

"Investment" is the value of the durable military asset as acquired for a particular year. (Hildebrandt, 1990, p. 160) Marine Corps investment costs for development are detailed in the form of research and development accounts covered by Navy appropriations "Blue Dollars" (RDT&E,N). It is important to note that Marine Corps aircraft and associated ground support equipment are bought with Navy dollars; their acquisition costs for weapons and equipment are spelled out annually under Aircraft Procurement, Navy (APN).

b. Capital Stock

"Capital stock" measures the value of durable assets held in inventory. This inventory can represent capital goods that were acquired in past years but are still in service and rendering benefits. (Hildebrandt, 1990, p. 161) The value of the capital stock is measured in constant dollar, i.e., the amount that would be required to replace a durable asset.

c. Capital Service Value

"Capital service value" is a measurement of a durable asset's "value" during a particular year. (Hildebrandt, 1990, p. 161) It is necessary to consider capital services value in light of current force structure reorganizations and its relation to the recapitalization of force structure. (Healy, 1994, p. 45) For this analysis, capital services value will take into account both the capital stock value and the service life of durable assets.

d. Benefit

When acquiring additional durable assets it is necessary to consider not only the cost of the asset but also the benefits yielded throughout the asset's service life. (Hildebrandt, 1990, p. 161) In procuring an additional unit of military equipment, it is expected to yield benefits over its service life. By taking into account constant dollar value the unit's annual benefits per procurement dollar can be calculated .[7] The following formula is used to calculate the annual benefit per procurement dollar:

$$B = \frac{1}{\sum_{t=1}^{l} \frac{1}{(1+r)^t}}$$

Where r is the discount rate, l is the service life, and B the annual benefits per procurement dollar.[8] If the discount rate, accounting for the time value of money, is 0 (r=0) the formula for benefit specializes to B = 1/l. This indicates that the annual benefit received per dollar invested is inversely related to the service life of the asset. (Hildebrandt, 1990, p. 162)

e. R&D Cost

Research and development (R&D) costs are not considered part of the capital services value of MAGTFs, they are considered a "sunk cost" of a previous period.

2. MAGTF Capital Stock

Table 3.12 displays the aggregate capital stock value of T/E equipment of the three notional MAGTFs. Equipment includes, crew weapons, vehicles,

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[7] Constant dollars remove the effects of inflation and facilitate the comparison of capital values across time.

[8] It is assumed that the last procurement dollar spent is equal to the annual benefits received from that procurement dollar: $1 = B \sum_{t=1}^{l} \frac{1}{(i+r)^t}$

and individual and personal equipment possessed by baseline MAGTFs. The numbers and types reflect systems that are rated by T/E for the notional units and do not include aircraft and related ground support equipment.

a. Equipment

Unit equipment costs for Marine Corps units are composed of the procurement cost of the unit's T/E, including individual equipment and personal weapons, and organizational equipment (vehicles, crew weapons etc.), purchased under Marine Corps Appropriations. These figures show the average replacement cost of each item of equipment, and do not include assault amphibious ships or aircraft and ground support equipment costs.[9]

	MEU	MEB	MEF
CE	$5.96	$20.45	$85.43
GCE	$29.1	$132.45	$603.61
ACE	$2.25	$135.71	$278.74
CSSE	$7.48	$66.70	$222.88
TOTAL	$44.79	$355.31	$1,190.66

Table 3.12 Capital Stock Values For Organic Equipment Rated by USMC Units

Costs estimated from The Revised Fiscal Requirements Model. (CRM 93-158). (Alexandria, VA. Center for Naval Analysis, August 1993), Table 2. and Marine Corps Cost Factors Manual (MCO P7000.14), Washington, D.C., HQMC, 14 June 1991 Table 4B1. Costs do not include ship, aircraft and their ground support equipment, or the peacetime operating stock of spare parts. Costs in millions of FY 91 dollars.

[9] APN support costs associated with spares, support equipment, and peacetime operating stocks can be estimated by applying a factor of 26 percent of the aircraft weapons system procurement costs. (Eskew, 1993, p. 9)

b. Aircraft

Aviation unit T/E costs, which include the cost of equipment procured with Navy Appropriations ("Blue Dollars"), represent the average total procurement or replacement costs of the current aircraft . To gain a fuller understanding of costs it is useful to take into account the impact of training and maintenance requirements and their impact on a unit's ability to achieve a certain state of readiness.

A certain number of aircraft are needed for training purposes to achieve and maintain readiness of personnel. This requirement is compensated for by a percentage factor for each type of aircraft. (Naval Combat Aircraft: Issues and Options, 1987, p. 38) Extra aircraft are required to achieve a certain readiness objective for a unit. These aircraft serve to cover aircraft that are in a maintenance vice operational status. This is the "pipeline" demand, and is accounted for using a percentage factor for each type of aircraft. (Naval Combat Aircraft: Issues and Options, 1987, p. 38)

c. Aircraft Requirement Calculations

In addition to the aircraft rated by a MAGTF's T/E "extra" aircraft are needed to support the training of pilots and maintenance personnel as well as provide a reserve of aircraft to sustain operations. These "extra" aircraft play an important role in providing and maintaining a certain readiness. These "extra" aircraft therefore must be factored into total aircraft requirements. An example of this calculation for the AV-8B aircraft follows. Aircraft Requirements = number of Primary Aircraft Authorized (PAA) + training requirements + maintenance requirements. (Naval Combat Aircraft;

Issues and Options, 1987, p. 38)[10] Table 3.13 presents the combined cost of the aircraft needed to support the deployed MAGTFs.

A/C TYPE	MEU	MEB	MEF
AV-8B	$226.80	$1,411.20	$2,116.80
F/A-18	--	$1,771.20	$3,542.40
A-6E	--	$628.60	$628.60
EA-6B	--	$316.80	$316.8
CH-53	$135.60	$836.20	$1,310.80
AH-1W	$58.80	$156.80	$313.60
CH-46E	$255.00	$1,020.00	$1,275.00
UH-1N	$58.80	$156.80	$303.80
TOTAL	$735.00	$6,297.60	$9,807.80

Table 3.13 Capital Stock Value Of Aircraft

Costs estimated from The Revised Fiscal Requirements Model. (Crm 93-158). (Alexandria, VA., Center For Naval Analysis, August 1993), Factors obtained from Naval Combat Aircraft: Issues and Options. Congress of the United States, CBO, November 1987, p. 38. All costs in millions of FY 91 dollars.

d. Assault Amphibious Shipping

Estimated capital stock values for assault amphibious ships are shown in Table 3.14, on the following page, and reflect the cost of the estimated ship mix requirements for the notional MAGTFs depicted in Table 3.11.

[10]An example for the MEU AV-8B is:
1.00/(1.00-.20)=1.25, 1.25/(1.00-.10)=1.39, 1.39 x 6 = 8.34. Any fractional requirements for an aircraft must be rounded up to a whole number which results in the adjusted inventory amount, 9.00. (Refer to Appendix C for detailed calculations

Ship Type	Unit Cost	MEU	MEB	MEF
LPH/LHA/LHD	$850	$850	$4,250	$11,900
LPD	$330	$330	$1,320	$3,630
LSD	$250	$250	$1,250	$3,250
LST	$103	$103	$721	$1,854
LCAC	$20	$120	$480	$1,560
TOTAL		$1,653	$8,021	$22,194

Table 3.14 Capital Stock Values for Assault Amphibious Shipping

Costs estimated from The Revised Fiscal Requirements Model. (CRM 93-158). (Alexandria, VA. Center for Naval Analysis, August 1993), Table 2. Due to different possibilities for ship mix units costs are averages for ship types. All costs in millions of FY 91 dollars.

Table 3.15 depicts the aggregate capital stock values for notional MAGTFs.

(Costs in millions of FY 91 dollars)	MEU	MEB	MEF
T/E Equipment and Weapons	$44.79	$355.31	$1,190.66
Aircraft	$735	$6,297.6	$9,807.8
Assault Amphibious Shipping	$1,653	$8,021	$22,194
TOTAL	$2,433	$14,674	$33,193

Table 3.15 Estimated Aggregate Capital Stock Value For Notional MAGTFs

3. Capital Services Value for MAGTFs

If it is assumed that amphibious ships have a 40 year service life, aircraft a 20 year service life, and T/E equipment and weapons a 15 year service life, the aggregate capital services value for three notional MAGTFs can be estimated. (DOC, 1993, p. M-17) Recapitalization is emphasized by assuming the discount rate is zero and the annual benefit received per dollar invested is inversely related to the service life of the asset. Capital services value can be estimated by dividing the capital stock value of an asset by its service life (B=1/l). Table 3.16 shows the aggregate annual capital services values for MAGTFs.

	UNIT COST	MEU	MEB	MEF
Tanks M60A1	$1.5	$.387	$1.37	$4.37
AAV	$.969	$.773	$3.03	$13.4
LAV	$.762	$.41	$1.4	$5.6
155 HOW	$.553	$.15	$1.3	$3.5
105 HOW	$.021	$.0004	$0	$0
81mm Mortar	$.013	$.007	$.022	$.066
60mmMortar	$.011	$.009	$.028	$.09
Mk-19 MG	$.009	$.016	$.07	$.36
TOW Msl Lr	$.115	$.004	$.025	$.07
DRAGON Lr	$.014	$.023	$.07	$.21
HAWK Msl Lr	$.517	$0	$.276	$.552
STINGER Msl	$.027	$.001	$.005	$.011
.50Cal MG	$.015	$.02	$.14	$.44
M60 MG	$.003	$.011	$.05	$.14
AV-8B	$25.2	$11.34	$70.56	$105.84
F/A-18	$36.9	$0	$88.56	$177.0
A-6E	$44.9	$0	$31.43	$31.43
EA-6B	$39.6	$0	$15.84	$15.84
CH-53	$22.6	$6.78	$41.81	$65.54
AH-1W	$9.8	$2.94	$7.84	$15.68
CH-46E	$17	$12.75	$51.0	$63.75
UH-1N	$9.8	$2.94	$7.84	$15.20
TOTAL		$38.56	$323.00	$519.00

Table 3.16 Aggregate Annual Capital Services Values For MAGTF Weapons and Aircraft

Costs estimated from Marine Corps Cost Factors Manual (MCO P7000.14), Washington, D.C., HQMC, 14 June 1991 Table 4B1. Costs in millions of FY 91 dollars.

Table 3.17 shows the capital services value for amphibious shipping.

SHIP TYPE	UNIT	MEU	MEB	MEF
LPH/LHA/LHD	$21.25	$21.25	$106.2	$297.5
LPD	$8.25	$8.25	$33.0	$90.75
LSD	$6.25	$6.25	$31.25	$81.25
LST	$2.58	$2.58	$18.0	$46.35
LCAC	$1.3	$8.0	$32	$104
TOTAL		$46.08	$220.45	$619.85

Table 3.17 Estimated Capital Services Value for Amphibious Ships (Costs in millions of FY 91 dollars)

Table 3.18 depicts the aggregate capital services values for notional MAGTFs.

	MEU	MEB	MEF
T/E Equipment	$2.98	$23.68	$79.38
Major Weapons	$1.81	$7.78	$28.84
Aircraft	$65.75	$363.85	$542.24
Amphibious Ships	$46.08	$220.45	$619.85
TOTAL	$116.6	$616	$1,270

Table 3.18 Aggregate Capital Services Values for Notional MAGTFs (millions of $) (Costs in millions of FY 91 dollars)

When one compares the MAGTF's capital stock value in Table 3.16 with their aggregate capital service value in Table 3.18, it becomes apparent that simply maintaining a constant inventory level of durable military assets requires a significant annual investment to replace the consumed benefit for the previous period. As capital services value equals the capital stock value divided by the service life, it represents the annual investment needed in procurement to maintain the existing inventory. It does not contain the cost of operating and supporting the equipment. These costs are discussed later.

L. OPERATING AND SUPPORT (O&S) COSTS

O&S costs reflect the costs of operating, maintaining, and supporting a fielded system. O&S costs can be described as the value of efforts undertaken to achieve, and sustain a desired state of readiness. Table 3.19 shows O&S cost elements commonly considered in cost analyses.

MISSION PERSONNEL
Operations
Maintenance
Other Mission Personnel
UNIT-LEVEL CONSUMPTION
POL/Energy Consumption
Consumable Materials/Repair Parts
Depot Level Repairables
Training Munitions
INTERMEDIATE/DEPOT MAINTENANCE (External to Unit)
Maintenance
Consumable Materials/Repair Parts
CONTRACTOR SUPPORT
Interim Contractor Support
Contractor Logistics Support
SUSTAINING SUPPORT
Support Equipment Replacement
Modification Kit Procurement/Installation
Other Recurring Investments
Sustaining Investment Support
Software Maintenance Support
Simulator Operations
INDIRECT SUPPORT
Personnel Support
Installation Support

Table 3.19 O&S Cost Elements

Information taken from, Operating and Support Cost-Estimating Guide, Office of the Secretary of Defense, Cost Analysis Improvement Group, May 1992, p. 4-2

Many cost elements are not considered in the calculation of O&S costs because they can be considered one-time acquisition costs or contribute to sustainability rather than readiness. Several examples of these type costs are; RDT&E and military construction. (Hildebrandt, 1990, p. 6) In studying the O&S costs one can simplify the task of analysis by dividing O&S costs into two groups; direct O&S costs and indirect O&S costs. Direct O&S costs are seen as those variable costs elements which directly impact on O&S costs and vary with incremental changes in force structure and operating tempo. Indirect O&S costs are seen as those cost elements that do not vary with the incremental changes in force structure or operating tempo.

A main interest of this analysis lies in the identification of the cost associated with achieving and maintaining a MAGTF capability in peacetime. One method that can be used to simplify this task is to focus on the direct O&S costs and using them as representative estimates for measuring and comparing the cost of achieving and maintaining a certain MAGTF capability. In pursuing this interest the following list of representative elements were identified and selected from the Cost Factors Manual as being particularly useful in defining and estimating direct O&S costs for MAGTFs. (Vessey, 1994) These are displayed in Table 3.20 on the following page.

This analysis was unable to estimate depot level maintenance costs for ground equipment and weapons possessed by the MAGTF because maintenance records are not kept by unit, only by equipment item. This data is reflects depot level maintenance data for the total numbers of each item held in the Marine Corps inventory. Depot level maintenance was factored into the aviation and assault amphibious shipping O&S costs obtained from the Revised Fiscal Requirements Model.

GROUND COMBAT EQUIPMENT
MISSION PERSONNEL
Navy and Marine Corps
UNIT LEVEL CONSUMPTION
Maintenance
Training Ordnance
POL/Fuel
AIRCRAFT
ASSAULT AMPHIBIOUS SHIPS

Table 3.20 Elements Contributing to Direct O&S Costs

This analysis employs two different methods of estimating O&S costs for MAGTFs. First, the Marine Corps Cost Factors Manual is used to calculate representative O&S costs related to operating and maintaining a notional MAGTF. The Marine Corps Cost Factors Manual contains selected information concerning cost elements that account for significant portions of direct O&S costs for MAGTFs. (Vessey, 1994) When combined with the direct O&S costs for amphibious ships obtained from the Revised Fiscal Requirements Model, a representative estimate of direct O&S costs for notional MAGTFs can be made. A benefit of using this method in this analysis is that it provides a simple and quick method of calculating a representative portion of the direct costs associated with operating and maintaining a particular size MAGTF. These representative estimates can then be used as a basis for comparison between the MAGTFs.

One may gain a better appreciation for the complexity involved in estimating O&S costs by using an analogy that likens O&S cost estimations to the determination and application of overhead costs in business operations. The larger the operation being performed the greater the number of indirect support variables contributing support to the operation, and the greater the impact on total costs that these support variables have. This is to say that for analyzing relatively small operations direct costs will provide a good picture of the incremental costs associated with performing that operation as the indirect "overhead costs" may not significantly contribute to the incremental cost of operations. However, as the size of the operation increases so does the requirements for input from additional support resources. These support resources begin to comprise a larger portion of total operating costs and preclude the use of direct costs as an effective estimate of total costs of operating.

The task of estimating MAGTF O&S costs using the Cost Factors Method becomes increasingly difficult for the MEBs and MEFs due to the increases in force structure and impact of indirect O&S costs on the total O&S cost structure. The larger MAGTFs, especially the MEF, begin to comprise a significant portion of the total Marine Corps active duty endstrength and equipment. As such they account for a significant portion of total Budget Authority (O&M) and manpower appropriations for the Marine Corps. For this reason the Quick Cost Model is used as a second method to calculate O&S costs for this analysis. The Quick Cost Model, described in detail later in this chapter, is the model used by the Congressional Budget Office (CBO) to calculate O&S costs. This model is suitable for estimating O&S costs for larger MAGTFs due to its ability to link indirect O&S costs to major force program elements. For MEF size MAGTFs the Quick Cost Model provides a more comprehensive and accurate picture of the O&S costs because it takes into consideration those elements listed in Table 3.19 and their support costs as they relate to program elements. Again, it is important to include these costs when estimating MEF size force costs. However, when dealing with smaller size MAGTFs, which constitute a much smaller portion of total

Budget Authority (O&M) manpower for the Marine Corps, the cost factors method may provide a reliable estimate of variable direct costs for cost analysis and budget exercises.

1. Cost Factors Method

a. Mission Personnel and Training

Military Personnel costs are computed using annual workyear rates computed from the Navy's Revised Fiscal Requirements Model. The Marine Corps officer and enlisted workyear rates are $59,116 and $24,971, respectively. The Navy officer and enlisted workyear rates are $63,761 and $27,408, respectively. Personnel costs are calculated by multiplying the number of personnel in the MAGTF by the appropriate workyear rate. These numbers reflect the personnel cost of the unit at authorized strength. They are based on FY91 average man-year rates from the President's FY91 Budget Submission for USMC/USN officer and enlisted personnel. (Refer to Appendix A for data). Training costs for MAGTFs include funded operations and port visit services. Temporary Additional Duty (TAD) are funds used to send advance parties to locations to coordinate for training, conferences, port visits. (1stLt Pitts, 21 Sept, 1994)

b. Unit Level Consumption

(1.) Maintenance Costs. These costs take into account the maintenance costs for individual equipment which are calculated by multiplying the number of personnel in the unit by the average annual individual equipment maintenance cost of $448. Maintenance costs do not take into account the cost of upgrading, replenishment, replacement of ground equipment and weapons conducted at depot level maintenance facilities. (1stLt Pitts, 21 Sept, 1994)

(2.) Training Ordnance. These costs take into account the cost of high-usage training ammunition and ordnance for ground combat units expended annually to achieve readiness objectives established for deployed MAGTFs. (1stLt Pitts, 21 Sept, 1994)

(3.) POL/Fuel. These costs take into account fuel consumption factors for MAGTF ground vehicles and equipment. Fuel allowances are computed based on equipment operating and consumption rates for an allotted number of operating days ashore for each MAGTF. (1stLt Pitts, 21 Sept, 1994)

(4.) Aircraft. The average annual O&S costs for aircraft can be estimated using the following equation.

O&S Aircraft=(cost/flight hr)x(Ann. flight hrs)+(cost of rework)=Ann. cost of aircraft, (Ann. cost of aircraft)x(operating ratio)x(operating tempo)= O&S/aircraft.[11] Calculations take into account fuel, depot level repair and maintenance costs. (Eskew, 1993, p. 19)

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[11] The operating ratio is determined by dividing the time each aircraft is operationally capable by the sum of the time the aircraft is operationally capable and the time the aircraft is not operationally capable. The operating tempo is the average amount of time each aircraft was utilized in flying activities. An Op Tempo factor of 1.0 reflects 1991 flying hours. (Eskew, 1993, p. 19)

(5.) Assault Amphibious Shipping. The average annual O&M costs for amphibious shipping can be estimated using the following equation. (Eskew, 1993, p. 20) Detailed estimates are displayed in Appendix D.

Ship O&M Costs ={(OFF strength x work year rate)+(ENL strength x work year rate)}x(steaming hrs under way)x(op tempo factor)x(fuel cost per steam hr under way)+(steaming hrs not under way)x(fuel costs per steaming hr not under way)+(depot level maintenance costs)

Table 3.21 and 3.22 depict estimated costs for notional MAGTFs.

	MEU	MEB	MEF
PERSONNEL	$65.9	$834.7	$1,270.6
MAINTENANCE	$1.6	$3.2	$27.6
TRNG ORDNANCE	$2.1	$6.4	$25.2
POL/FUEL	$.013	$.051	$.302
AIRCRAFT O&S	$80.0	$440.5	$623.8
ASSLT. AMPHIB. SHIP O&S	$56.2	$280.6	$765.9
TOTAL O&S	$206	$1,566	$2,713

Table 3.21 Estimated O&S Costs for MAGTFs

Costs estimated from The Revised Fiscal Requirements Model, (CRM 93-158).(Alexandria, VA. Center For Naval Analysis, August 1993), Table 2. and Marine Corps Cost Factors Manual (MCO P7000.14), Washington, D.C.,HQMC, 14 June 1991. Cost in millions of FY 91 dollars.

(Costs in millions of FY 91 $)	MEU	MEB	MEF
CapStkVal	$2,433	$14,674	$33,193
CapSvcVal	$117	$616	$1,270
O&S Costs	$206	$1,566	$2,713
Tooth-to-Tail	1.66:1	1.39:1	.90:1

Table 3.22 Selected MAGTF Costs

Costs estimated from The Revised Fiscal Requirements Model, (CRM 93-158).(Alexandria, VA. Center For Naval Analysis, August 1993), Table 2. and Marine Corps Cost Factors Manual (MCO P7000.14), Washington, D.C.,HQMC, 14 June 1991, and historical data.

7. Quick Cost Model

a. Overview

The Quick Cost Model approach to O&S cost estimation becomes relevant for the MEF size MAGTF. MEFs account for a significant portion of total Budget Authority (O&M) and manpower appropriations for the Marine Corps. The model's ability to link indirect O&S costs to major force program elements provides a more comprehensive and accurate picture of total O&S costs than can be achieved by using the Cost Factors Approach.

The Quick Cost Model takes changes to Primary Defense Forces (e.g., numbers of divisions, airplanes, ships, etc.) and calculates costs for Primary units and all Supporting units. These costs are provided in terms of Budget Authority (BA) or Total Obligational Authority (TOA), and Manpower. (Vassar, 1989, p. 3) The Quick Cost Model is fully compatible to the Defense Resources Model (DRM) used by the Congressional Budget Office. Unclassified data is obtained from budget year data of the Future Years Defense Program (FYDP). This unclassified "Baseline" file is created by aggregating FYDP Program Elements (PEs) into DRM Aggregate Elements (AEs) and Resource Identification Categories (RICs) into Resource Identifiers (RIs). This process or "roll-up" creates a file which is further processed to "disaggregate" certain AEs into additional AEs. (Vassar, 1989, p. 3)

b. Aggregate Elements (AEs)

AEs are broken down into Primary AEs, changes in the resources in Primary AEs are directly related to changes in its force level. Related AEs are proportional to certain resource changes in certain resources of all primary and related AE, and other AEs. All are listed in Appendix D. For the purposes of this analysis, AEs are grouped in three categories; primary, related, and support (with support consisting of auxiliary and other AEs). The model cost calculations are hierarchical in nature, where changes to AEs in a support category depend on changes to certain resources at a higher level. The "certain resources" varies with support category and are called "Proxies". The proxies which directly influence changes in a particular AE are divided into seven categories. Changes to an AE are a function of what proxies affect it. How the proxies change is based on changes to force structure inputed into the model. Proxy sources appear at the top of the left hand side table in Appendix A, and the higher categories over which they are summed appear in the middle table. A related AE does not support all Primary AEs, only the certain ones it is "linked " to. (Vassar, 1989, p. 9)

c. Fixed-Variable Percent

When a resource change is computed for an AE it is multiplied by a "fixed/variable percent" quantity. This is the percent an AE would decrease by if all resources in higher categories were removed. Primary AEs are assumed to have a fixed/variable percent of 100.

For example; if there were no primary AEs in the model, there would be no need for Primary AE resources. Related AEs fall between 80 and 100 percent, and Support AEs from 0 percent to appropriate set percents. (Vassar, 1989, p. 10) The fixed/variable percent factors are derived from historical data pertaining to the impact of force structure changes on O&S costs in the post World War II era. For this analysis the primary AEs represent a Marine

Division, associated aircraft representing a Marine Aircraft Wing, and support elements. These forces comprise roughly one-third of the Active Marine Corps. Likewise, the primary AE comprised of 56 Assault Amphibious Ships represents a significant portion of Navy ship assets. When dealing with primary AEs that represent a large portion of total force structure, the 100% fixed/variable may not be appropriate. The author's personnel knowledge and experience with logistics indicates that the selection of appropriate fixed/variable percent warrants further research. When dealing with a primary AE that comprises a large percentage of force structure it is important to consider the support received from a broad base of support AEs. Removing a primary AE would not wholly affect the need for all related support AEs, which are also supporting other primary AEs.

d. Internal Factors

Each AE has 13 internal factors which are listed in Appendix A. Each internal factor is a linear combination of from one to seven RIs. The Internal Factors are part of the Force Cost Equation for Primary, Related, and Support AEs. Force Cost calculations are hierarchical beginning with Primary then proceeding to Related and then Support AEs. Changes to O&S costs resulting from changes to force structure are attained by compiling changes to the Primary, Related, and Support AEs and then summing them together. (Vassar, 1989, p. 12)

M. COST PRESENTATION

One of the major focuses of this analysis is to determine the tooth-to-tail ratios for MAGTFs and the related costs of achieving these ratios. As discussed, this analysis utilizes the Quick Cost Model, used by the Congressional Budget Office (CBO) as one method, to estimate O&S costs for a notional MEF. The Quick Cost Model breaks O&S costs down into three basic AEs discussed earlier: Primary, Related, and Support. These costs can be viewed as the costs of achieving and maintaining MAGTF readiness. The Primary AEs (e.g., Divisions, Aircraft, Assault Amphibious Ships) consist of that portion of manning (MPMC, RPMC, MPN, RPN) and operating (O&M, MC,N, APMC, APN) required for direct support. The APN contribution is not for individual aircraft procurement, but for direct support items which are funded in the APN account. The Related AEs include the accounts listed above (MPMC, RPMC, MPN, RPN, O&M, MC, N, APN) but pertain to indirect rather than supporting roles (e.g., command and control). The Support AEs include the accounts listed above, and also the remainder of the appropriations accounts (e.g., MCON, MCNR, FH, N&MC, etc.) that are needed to house dependents, build and operate maintenance facilities, etc. Several categories such as Investment, RDT&E, are not estimated by the model. For purposes of this analysis the Base Realignment and Closure (BR&C) account is excluded. Table 3.23 provides a summary of the Quick Cost Model results for a MEF.

Element	Primary AE	Related AE	Support AE	Total AE (millions $)
MarDiv w/AC	$1159.2	$444.0	$709.0	$2,312.2
AsltAmph.	$1413.1	$171.2	$765.9	$2,349.4
Total O&S				$4,661.6

Table 3.23 Quick Cost Model O&S Costs Estimates for a Notional MEF

Costs generated from the Quick Cost Defense Resources Model, Computer Software Model-Copyright, Thomas B. Vassar, 1989.

Now that the MAGTF Capital Stock Value, Capital Service Values and O&S costs have been estimated, the ratio of these costs for a given force structure can be developed. A macro view of the relationship can be seen using the formulas (O&S Costs/Cap SvcVal), and (CapSvcVal/CapStkVal). Table 3.24 shows the calculated ratios for the three MAGTFs using costs estimated by the Cost Factors Method.

	MEU	MEB	MEF
CapSvcVal/CapStkVal	.048	.042	.038
O&S/CapStkVal	.085	.107	.082
O&S/CapSvcVal	1.76	2.54	2.14
Tooth-to-Tail	1.66:1	1.39:1	.90:1

Table 3.24 Selected MAGTF Costs

Costs estimated from The Revised Fiscal Requirements Model, (CRM 93-158).(Alexandria, VA. Center For Naval Analysis, August 1993), Table 2. and Marine Corps Cost Factors Manual (MCO P7000.14), Washington, D.C.,HQMC, 14 June 1991, and historical data. All costs in millions of FY 91 dollars.

Table 3.25, on the following page, presents a summary of cost ratios for a MEF size MAGTF using the Quick Cost Model.

Element	CapSvcVal/CapStkVal	O&S/CapStkVal	O&S/CapSvcVal
MEF	.038	.140	3.671

Table 3.25 O&S To Capital Value Ratios For Notional MAGTFs

Costs generated from the Quick Cost Defense Resources Model, Computer Software Model-Copyright, Thomas B. Vassar, 1989.

These ratios serve a useful purpose in that they summarize the various costs associated with achieving and maintaining a MAGTF and its related tooth-to-tail. The first ratio relates Capital Services Value to Capital Stock Value of a particular size MAGTF and describes the average annual investment (in terms of a percentage of total capital value) required to maintain a constant inventory of capital equipment. The second ratio relates the O&S cost to the Capital Stock Value of a particular size MAGTF and describes the annual cost of operating and supporting a given force as a percentage of the MAGTF's total capital value of equipment. The third ratio relates the O&S costs to the Capital Services Value of a particular size MAGTF and compares the cost of operating and supporting a force to the cost of maintaining a constant inventory of capital equipment. Table 3.24 depicts the relative significance of direct O&S costs utilizing the Cost Factors Method and Table 3.25 depicts the significance of direct and indirect O&S costs utilizing the Quick Cost Model. The ratios produced by both methods point out the significant impact that O&S costs can play in achieving and maintaining a MAGTF capability. When comparing the total O&S costs of the MEF, estimated by the Quick Cost Model to the direct O&S costs of the MEF estimated by the Cost Factors Methods the results show that total O&S costs (direct and indirect) generated by the Quick Cost Model are 1.7 times greater than the direct O&S costs generated by the Cost Factors Method. Again, this difference in O&S costs estimates results from the inclusion of indirect O&S costs, assigned to the various program elements inputed into the Quick Cost Model.

N. SUMMARY

This chapter examines on a macro level, the notional organizational structure for MAGTFs and what is required in terms of personnel and equipment to field them. The tooth-to-tail ratios are helpful when used as a monitoring device to establish and demonstrate trends in MAGTF force structure, as well as a measure of a MAGTF's readiness and sustainment.

This analysis has shown that as one moves from a small to a medium and to a large expeditionary capability e.g., from a MEU to a MEB to a MEF a shift occurs in the levels of readiness and sustainment possessed by each MAGTF. The various investment and support costs involved with achieving a desired readiness and sustainment capability must be carefully analyzed and balanced to optimize the investment of shrinking resources and budgets.

IV. MAGTF-2015

A. INTRODUCTION

To facilitate the task of describing MAGTF-2015 and estimating its capabilities this analysis examines several major factors that will impact on future MAGTF structure and capabilities. First, likely missions are examined and discussed in terms of their impact on future expeditionary force requirements and capabilities. Secondly, the impact of operating in an environment of fiscal constraint balanced with the benefits gained from advances in technology and equipment modernization programs as they impact on expeditionary force capabilities are discussed. Thirdly, the estimated impact of reductions in assault amphibious shipping on amphibious MAGTF capabilities and force structure are examined and analyzed.

A picture of MAGTF-2015 is achieved by extrapolating from the notional baseline MAGTF. The extrapolation takes into account the major factors just discussed to arrive at a macro level picture of MAGTF-2015.

B. FORCE STRUCTURE

This chapter recognizes and addresses the pivotal role played by NEFs in the NSS and how this role will impact on force structure for MAGTF-2015. In order to perform this analysis the following implicit assumptions are made. First, the basic configuration for MAGTFs, (e.g., CE, GCE, ACE, CSSE), will remain unchanged. Second, The NSS will remain focused on the ability of our force to engage in two, near simultaneous, MRCs. Third, current levels of sustainment for MAGTFs remain unchanged. Lastly, future missions and employment of the NEFs will not require major departures from current authorized active forces endstrength for the Marine Corps.

1. The Nature of Future War

The simple act of downsizing MAGTFS will not solve the budget issue nor will it provide a forward deployed force capable of a timely and effective initial response. An important factor impacting on the downsizing of forces is the added risk to personnel that it causes. Risk comes from degradation of combat power. Even minor loss of American Servicemen's lives may become so unacceptable to the point of being a major factor to consider in the planning and implementation of foreign policy. (O'Keefe, SGL, 26 July 1994)

2. Organizational Structure

In the author's judgement MAGTF-2015 will possess the same basic combined arms structure that has proved effective for the past four decades. Looking at the personnel strengths and representative major weapons systems of MAGTFs over the past four decades one can see that the structure and composition has remained remarkably stable despite changes to Marine Corps endstrength. The consistent factor contributing to stability is the amphibious expeditionary role performed by MAGTFs. Taking this stability into account, and the continuation of the expeditionary role, a good argument can be made for consistency in structure. Some changes will occur in amphibious lift and mobility assets, as the result of shrinking budgets and as defense planners organize expeditionary forces to face the new missions at hand. What will these missions be and what is the composition of forces that are required to deal with them? How will the tooth-to-tail ratio change for future forces? This chapter attempts to answer these questions.

C. MISSIONS FOR MAGTF-2015

Revolutionary changes in technology, making weapons systems more lethal and more accessible to Third World countries, will continue to contribute to the need for crisis response capabilities. Due to geopolitical and socioeconomic factors there will likely be an increase in the occurrence and frequency of global "hotspots" that require force projections short of war. Limited actions, support to land operations, and show-the-flag missions will predominate while the probability of a large blue-water naval conflict will be slight. (Odom, 1992, p. 5)

1. Peacetime Engagements

In the three years immediately following Desert Storm, NEFs have deployed 17 times for crisis situations short of war. (Mundy,Concepts and Issues, 1994, p. 5) The instances of these "Peacetime Engagements" has shown dramatic growth. One can expect to see an increase in operations occurring on the lower end of the spectrum of conflict, reflecting the following types of operations:

1. Disaster Relief
2. Humanitarian Assistance
3. Counter Drug Operations
4. Arms Control/Treaty Compliance
5. United Nations Security Forces

The NEF's unique capabilities put them in a position to empower NMS in peacetime and war. Even when we are not close to going to war amphibious forces are used. (RAdm Durr, SGL, NPS, 16 August, 1994)

2. Requirements and Tradeoffs

How can forces bound to a fixed force strength effectively confront increasing numbers of commitments? Competing requirements for limited resources will make tradeoffs inevitable. Achieving the strategic objectives of forward presence, deterrence, and promotion of peace in a declining resource environment will force NEFs to take advantage of every opportunity to enhance efficiency and to exploit the leverage of technology. Specifically this will require that the following or similar actions be taken:

1. Review functions and capabilities and divest those which are not essential to mission accomplishment.

2. Adopt an aggressive neck-down strategy to reduce material and manpower functions.

3. Modernizing through the exploitation of new technologies.

3. Multipurpose/Multirole

Guided by the requirements of flexibility, and constrained by dwindling budgets and amphibious lift limitations, MAGTF-2015 will take advantage of multi-purpose, rather than specialized weapons systems to achieve multi-role capabilities.

D. CONCEPT

In performing the role of forward presence MAGTF-2015 will see employment as a crisis response, stop-gap force, which uses the sea to exploit opportunities. Emphasizing maneuver, speed, agility, and a small footprint its comparative advantage lies in not becoming engaged in sustained and costly land operations.

1. Implications For The Future

What then are the implications for future MAGTF force structure? Likely force structure parameters for MAGTFs should include:

1. Limit the density of forces that are exposed to enemy lethality by investing in sufficient maneuver capability.

2. Limit the footprint ashore and thus limit its exposure.

3. Mold the force to achieve the capabilities required by "peacetime engagements" rather than total war.

4. Assure continued U.S. naval supremacy in the Amphibious Objective Area (AOA).

2. Achieving Objectives

NEFs will achieve their objectives either completely from their sea base or through the establishment of a tailored forces ashore.

> A timely initial response is key. Forces must be structured for war not peace. Then if peace turns to crisis quickly, you will have the capability to make good a credible presence and response. (RAdm Durr, SGL,NPS,16 Aug 1994)

E. PRINCIPLES

1. Operational Maneuver From The Sea

"Operational Maneuver From The Sea" sets forth several basic principals under which MAGTFs will operate:

1. Focus on a strategic objective.
2. Use the sea as maneuver space.
3. Create overwhelming tempo.
4. Pit strengths against weaknesses.
5. Rely on intelligence, deception, and flexibility.

Such employment demands flexibility and momentum, both of which will be achieved through the use of ships as assembly areas to begin maneuver from over the horizon.

2. The Logistical Challenges

Crucial challenges will be faced by the MAGTF CSSE as it tries to support increased mobility, maneuver and sustainment in a much more fluid environment. Sustainment requirements will stress logistics capabilities. Speed and mobility equal to that of the combat forces is essential to keep logistics responsive to the dynamic needs. The flow of CSS must be controlled, efficient, secure, and timely.

The structure of the Marine Corps ground forces must be modified to produce enhanced tactical mobility, which is necessary to implement maneuver doctrine. (Lind, Reforming the Military, p. 26)

3. The Neck-down Strategy

The ongoing trend of significantly reduced budgets will severely limit investments in the capabilities and responsive programs needed to meet the challenges of the next century. MAGTFs will have to review all functions and capabilities and divest themselves of those which are no longer essential to accomplish the mission. This strategy of divesting itself of unnecessary capabilities can be described as a "neck-down" process to reduce material and manpower assets. This neck-down will be made possible because some capabilities, such as the Multiple Launch Rocket System (MLRS), are available as support from other services, such as the Army. Efforts will include extending the service life of existing systems vice developing and producing new ones. Implementation of these principles will help minimize resource requirements and the logistical infrastructure to sustain them. The effectiveness of any force structure will change as circumstances evolve and adversaries act to counter the most dangerous attributes of the force as they perceive it. Force structure must evolve to fit the changing conditions in which it will operate. (Peters,1993, p. 154)

F. POWER PROJECTION CAPABILITIES

1. Tactical Mobility

In developing MAGTF-2015, it is important to recognize the particular impact that tactical mobility will have on future MAGTF structure. Tactical mobility will likely be enhanced by three key platforms on the cutting edge of technology. First, to revolutionize the movement by air from ship to shore is the MV-22 OSPREY which is planned replace the CH-46 and CH-53 helicopter fleets. Second, the Advanced Amphibious Assault Vehicle (AAAV) is planned to replace the current Amphibious Assault Vehicle (AAV). Third, the Landing Craft Air Cushion (LCAC) will continue to provide high speed surface transportation of personnel and equipment from ship to shore.

2. Enhancements

These enhancements to maneuver and mobility open new windows to the projection of naval power ashore. MAGTFs of the future will be capable of a more rapid response to crisis, and will also be able to meter that response from quick and light to sustained and overwhelming combat power from bases at sea.

G. MAGTF FORCE SIZE

MAGTF-2015 will consist of the same basic force structure elements as today's MAGTF (CE,GCE,ACE,CSSE). Its capabilities will roughly be measured in terms of forward deployed MEUs which posses the ability to merge into a MEB size or larger force. MAGTF-2015 does not suggest any reduction in the overall size of the Marine Corps.[9]

[9]The ability of the Marine Corps to implement national foreign policy objectives is directly related to its size. The BUR validated Marine Corps active duty end strength at 174,000. Further end strength reduction will have a negative effect on capabilities and will stretch thin its ability to field MAGTFs with significant end strength and to maintain a satisfactory deployment tempo and will degrade the crisis response capability. (Mundy, Concepts & Issues, 1994)

H. EQUIPMENT MODERNIZATION PROGRAMS

In addition, the proliferation of sophisticated threat systems throughout the world will mandate a series of modernization requirements for MAGTF weapons and equipment. In recent years, the Navy and Marine Corps have invested in improvements that increase the speed and maneuverability of the equipment responsible for transporting troops and equipment from ship to shore. This analysis addresses several key programs that exploit technological advancements and enhance the capabilities of expeditionary forces.

1. Aircraft

The current policy is to integrate about 20% of Marine tactical air into Navy Carrier Wings. This results in the operational control of these aircraft being shifted from the MAGTF Commander for use in close air support of the MAGTF to the Navy Task Force Commander for use as he sees fit. (Concepts & Issues, 1994, p. 2-12) For example, directed missions might include strike interdiction missions or defense of the carrier battle group vice close air support of forces operating ashore.

a. Advanced Aircraft

The Marine Corps' long range aviation plan aims to reduce the number of aircraft types in its inventory. It is planned that an advanced short take-off and vertical landing (ASTOVL) aircraft, based on tilt rotor technology developed for the V-22, will replace the F/A-18 and AV-8B, and meld the best of both. Helicopter/tilt-rotor aircraft will provide the MAGTF with tactical and logistical air support. (Integrated Amphibious Operations & U.S. Marine Corps Air Requirements Study)

b. Medium Lift Alternative (MLA)

For the past three years, the MV-22 has been the Marine Corps number one acquisition priority. The MV-22 is looked on as a replacement for the 40 year old technology in the current medium lift fleet of CH-46E and CH-53D helicopters. The MV-22's combination of range, speed and payload almost triples the current capabilities offered by helicopters. The MV-22 is designed to have a top speed of over 240 knots, and to carry 24 combat loaded troops, compared to the CH-46E's top speed of 140 knots and 18 combat loaded troops. The MV-22 will allow naval ships adequate stand-off distance to respond to systems such as shore-to-ship missiles, enhanced observation, underwater mines, and other developing threats. A more probable near-term plan may be to utilize the Service Life Extension Plan (SLEP) to extend the life-span into subsequent models of existing aircraft. Figure 4.1 shows a possible neck-down strategy to achieve the Marine Corps long term aviation goal.

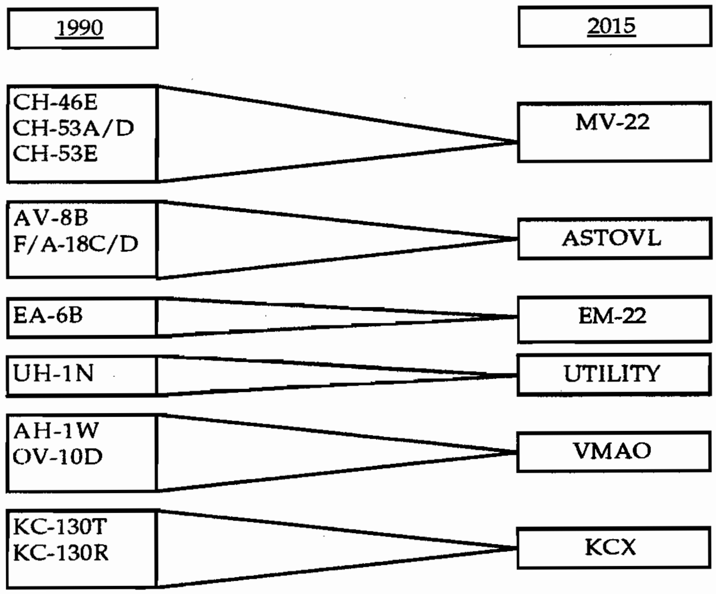


Figure 4.1 USMC Long-term Aviation Plan

Note: Information for Figure 4.1 taken from "Integrated Amphibious Operations & U.S. Marine Corps Air Requirements Study", Washington, D.C., Department of the Navy, 26 September 1993, and author's estimate.

2. Advanced Amphibious Assault Vehicle (AAAV)

Designed to replace the current Amphibian Assault Vehicle (AAV), the AAAV will serve as the principal means of tactical surface mobility for the MAGTF. Operationally, it will satisfy multiple mission area needs, such as surface power projection shoreward and armor-protected land mobility and supporting fires provided by its organic weapons systems. One proposed design proposes a craft capable of water speeds of 25 knots compared to the AAV's 8 knots.

3. Artillery

A light-weight 155mm howitzer (LW155) will provide organic fire support to the MAGTF and replace the heavier M198 155mm howitzer. The LW 155 will retain the current range and lethality while providing improved transportability by ground and air systems. The LW155 will also eliminate reliance on the 105mm howitzer currently in MEU inventories.

4. LCACs

LCACs will play a key role in over-the-horizon, ship-to-shore transport of troops, equipment, and supplies. Operating in littoral regions, LCACs will provide the "sea-land bridge" which overcomes many of the obstacles to amphibious ships that come from working in shallow water areas.

5. C3I

Integrated communications and tactical data systems will allow commanders real-time communications and data automation capability to process information to aid in decision making. Navigation Satellite Timing and Ranging (NAVSTAR) Global Positioning System (GPS) will provide the MAGTF with a significantly improved navigational capability and allow for encrypted satellite communications. Land based, Joint Surveillance Target

Attack Radar (JSTARS) under command of the Air Force, will provide the MAGTF with real-time ground intelligence information in an area of interest. A frequency-hopping digital VHF-FM radio will replace current radios and provide a secure voice and interoperability in joint operations.

6. Weapons

Reflecting reduced personnel strengths, MAGTFs will be task organized to meet the likely threat described previously. Weapons density for MAGTF-2015 will decrease slightly but still provide the ability to project highly accurate and lethal fires through increased resupply capabilities. Increased cargo capacity and high speed logistical air mobility provide the ability to rapidly resupply and sustain higher rates of usage than before. The air transportable LW 155 howitzer will provide supporting fires in excess of 30 kilometers with a much greater mobility. Table 4.1, on the following page, shows the estimate of major weapons possessed by MAGTF-2015. It is likely that advances in weapons systems engineering and development will have a great impact on future types and numbers of weapons systems held by the MAGTF. However, to facilitate measurements and comparisons between the current MAGTF and MAGTF-2015 this analysis assumes that MAGTF-2015 will possess follow-on models of the same type weapons, and their capabilities, as the current baseline MAGTF. This assumption allows the analysis to and focus on changes in combat power resulting from force structure changes.

	MEU	MEB	MEF
M1A1	4	14	44
AAAV	10	38	167
LAV	6	22	88
LW 155	3	18	56
81mm Mortar	6	18	56
60mm Mortar	9	27	86
MK19 MG	20	90	480
TOW LR	6	38	115
DRAGON	18	56	172
.50 cal MG	16	110	348
7.62 MG	40	164	480
HAWK Lr	--	5	10
STINGER Lr	3	24	48
AV-8C	7	43	66
F/A-18E	--	36	72
A-6F	--	10	10
EA-6C	--	6	6
CH-53F	4	30	46
AH-1X	4	13	26
CH-46F	12	50	64
UH-1M	4	13	26

Table 4.1 Estimate of MAGTF-2015 Major Weapons

I. AMPHIBIOUS LIFT

Amphibious ships are designed from the keel up to transport and support NEFs. Requirements for amphibious ships are based on amphibious lift goals of transporting and supporting specified NEFs.

> Transportation and logistics are fundamental elements of modern military power. They distinguish minor from major powers, and major powers can be reduced to minor status in some conflicts if they do not plan for sufficient transports and stocks of material. (Odom, 1992, p. 87)

In a 4 November 1984, memorandum from the Commandant of the Marine Corps (CMC) to the Chief of Naval Operations (CNO), the CMC agreed to accept operational risks and scale-down the then current amphibious lift requirements to fit the number and types of amphibious ships maintained by the Navy. It was recognized that these degradations in amphibious lift brought with them an increase to risk in the ability to conduct amphibious operations. This concept required the desired force levels of the MAGTF to be scaled down to conform to the amphibious shipping provided. The letter agreed that the Navy should count all active ships in matching lift to requirements, even if they are unavailable due to overhaul. (Barrow, 1982)

1. Current Capabilities

The current amphibious lift goal set by the NMS, is to provide sufficient lift for the assault echelons of 2.5 MEBs. The current amphibious lift is nominally capable of 2.5 MEBs. To be effective, tomorrow's smaller forces will have to be more mobile, and to respond more quickly. (Planning a Navy for Austerity, CNA Study, 1991, p. 9-20)

2. Future Capabilities

Satisfying a requirement for 2.5 MEBs of lift in 2015 will be achieved by a planned reduction in the types and number of ships, replacing them with newer ships of multipurpose design. As the result of budget trade-off decisions involving recapitalization of the Navy the amphibious fleet will shrink from 60 ships in 1991 to a projected 36 in 2015. The resulting amphibious fleet will be more homogeneous; as a result, some of the planning difficulties associated with a fleet comprised of ships of many types and ages may be reduced. Table 4.2 shows the estimated amphibious ship reductions for 2015.

Ship Types	1991	2015
LPH	7	0
LHA	5	5
LHD	2	7
LPD-4	11	0
LPD-17	0	12
LSD-36	2	0
LSD-36M	3	0
LSD-41	8	8
LSD-49	0	4
LST	18	0
LKA	4	0
TOTAL	60	36

Table 4.2 Results of Amphibious Lift Reduction Strategy

Information for Table 4.2 taken from "Integrated Amphibious Operations & U.S. Marine Corps Air Requirements Study", Washington, D.C., Department of the Navy, 26 September 1993.

J. AMPHIBIOUS READY GROUPS (ARGs)

Built around the MEU, ARGs are made up of the combined Naval and Marine forces, and are trained, organized and equipped to perform specified amphibious operations. As MAGTF-2015 is somewhat smaller in numbers than the notional baseline MAGTF, MEU ARGs will be composed of 3 ships, (LHA/LHD, LPD-17, LSD-41/49), and possess 30 days of sustainment. The MEB and MEF continue to be task organized for specific missions utilizing available amphibious shipping and assets.

> To meet the planned deployment schedule and provide for a means to respond to unplanned contingencies the Navy will require an increase from the current eleven ARGs to twelve. This will allow for adequate forward presence to reduce risk (gaps in presence) to an acceptable level. The National Defense Planning Guidance calls for an amphibious lift capability of 2.5 MEBs and a 12 ARG capability. (RAdm Durr, 16 Aug 1994)

The Navy's current goal is to have 12 ARGs consisting of at least three ships; a large helicopter deck ship (LHA/LHD), a ship with a secondary aviation support and well deck capability (LPD), and one or more ships required to support ARG lift requirements (LSD,LST,LKA).

K. ANALYSIS OF AMPHIBIOUS LIFT

1. Introduction

The NMS has set a requirement for 2.5 MEBs of lift in a 2 MRC environment. A basic assumption of this analysis is that the 2.5 MEB lift requirement will remain in effect in 2015. This author believes that there will be a close relationship between amphibious lift capabilities and MAGTF-2015 structure. To gain an understanding of this relationship and determine the effect of amphibious ship neck-down on the structure of MAGTF-2015, the lift capability of each type of ship was tabulated and then summed for each year. Tabulations included information on available ship capacities, including; troop space, vehicle stow, cargo stow, air spots, and LCAC spots.

1. Air spots can be defined as the resting space required by an aircraft in CH-46E equivalents. For example a CH-46E has a spotting factor of 1, an aircraft that is 1.5 times larger than a CH-46E has a spotting factor of 1.5.
2. Troop Space is based on total number of troops the ships can carry in normal berthing spaces plus surge capacity for short periods of time.
3. Vehicle Stow capacity is measured in square footage, it includes the deck area available for vehicle stowage.
4. Cargo stow capacity is measured in cubic feet and is determined by using the available deck area and all available stowage height of the compartment.
5. LCAC spots are based on the number of LCACs that can be transported by the ship, in well-decks. Well-decks are areas in the rear of ships that open to the sea and can be flooded with water. Landing craft can be loaded through ramps that lead from vehicle and cargo stowage areas directly to the well-deck. Once loaded, landing craft can then depart out of the stern of the ship.

2. Nominal Lift Capabilities

Table 4.3 shows the nominal lift capacities of amphibious ship types based on class averages.[10] It is important to note that nominal capacities do

[10]Nominal capacities are only used for planning purposes. Each ship's actual capacity depends on configuration, and is reflected in the ship's loading characteristics pamphlet (SLCP).

not reflect the application of broken stowage factors and tactical unit integrity factors, both of which can have significant impact on capacities. These factors are defined as follows:

1. The broken stowage factor is that loss of vehicle or cargo capacity due to the relationship of the vehicle or cargo configuration to the shape of the cargo space. Examples of broken stowage losses are empty spaces needed for tie-downs between vehicles or space between the top of a pallet and the ceiling of a cargo compartment.
2. The tactical unit integrity factor is that loss of troop or vehicle capacity which results when ships are loaded in accordance with an operation plan. A tactical integrity loss might result from the desire to load all of a unit's troops and equipment on the same ship, when there is available space for the troops on one ship and space for the equipment on a different ship.
3. The net capacity for each ship class can be determined by applying standard planning factors to nominal lift values as defined in FMFM 4-2, the Marine Corps embarkation manual.

Standard planning factors for reductions are:

1. Ship Vehicle Broken Stow	70%
2. Ship Cargo Broken Stow	75%
3. Tactical Unit Integrity	10%
4. Air Spots	Same for Gross and Net
5. LCAC Spots	Same for Gross and Net

Ship Class	Troops	Ksqft Veh	Kcuft Cargo	Air Spots	LCAC Spots
LHD	1892	17.9	125.0	46	3
LHA	1713	20.1	105.9	43	1
LPH	1489	3.4	40.5	27	--
LPD-4	788	9.8	38.3	4	1
LPD-17	700	25.0	25.0	4	1
LSD-36	302	6.2	1.4	--	3
LSD-36M	302	13.8	1.4	--	2
LSD-41	454	10.2	5.1	--	4
LSD-49	454	14.1	50.7	--	2
LST	347	12.3	3.4	--	--
LKA	208	32.9	66.1	--	--

Table 4.3 Amphibious Ship Lift Capacities

Note: Information for Table 4.3 taken from "Integrated Amphibious Operations & U.S. Marine Corps Air Requirements Study", Washington, D.C., Department of the Navy, 26 September 1993.

3. Baseline Factors

To determine the impact on lift areas resulting from the neck-down, the author selected 1991 as a baseline year from which to gauge lift (e.g., Desert Shield/Storm time-frame). An arbitrary value of 1.0 was assigned to each of the baseline capabilities in amphibious lift areas. Changes to capacity in subsequent years is reflected in values greater or less than one. This simple method provides a quick sketch of changing capabilities over a period of time. Subsequent changes to baseline resulting from the neck-down strategy can now be measured as a function of the baseline capabilities. Results of this analysis are shown in Table 4.4.

LIFT	1991	1993	2001	2009	2015
TROOPS	1	.95	.81	.80	.80
VEHICLES	1	.92	.67	.76	.76
CARGO	1	.98	1.05	1.01	1.01
AIR SPOTS	1	.99	.99	1.08	1.08
LCACS	1	1.05	1.30	1.18	1.18

Table 4.4 Changes to Amphibious Baseline Capabilities

Note: Information for Table 4.4 taken from "Integrated Amphibious Operations & U.S. Marine Corps Air Requirements Study," Washington, D.C., Department of the Navy, 26 September 1993, and author's estimate.

4. Impact of the Assault Amphibious Shipping Neck-down

The graphical display of the impact of neck-down on assault amphibious shipping on lift is shown in Figure 4.2.

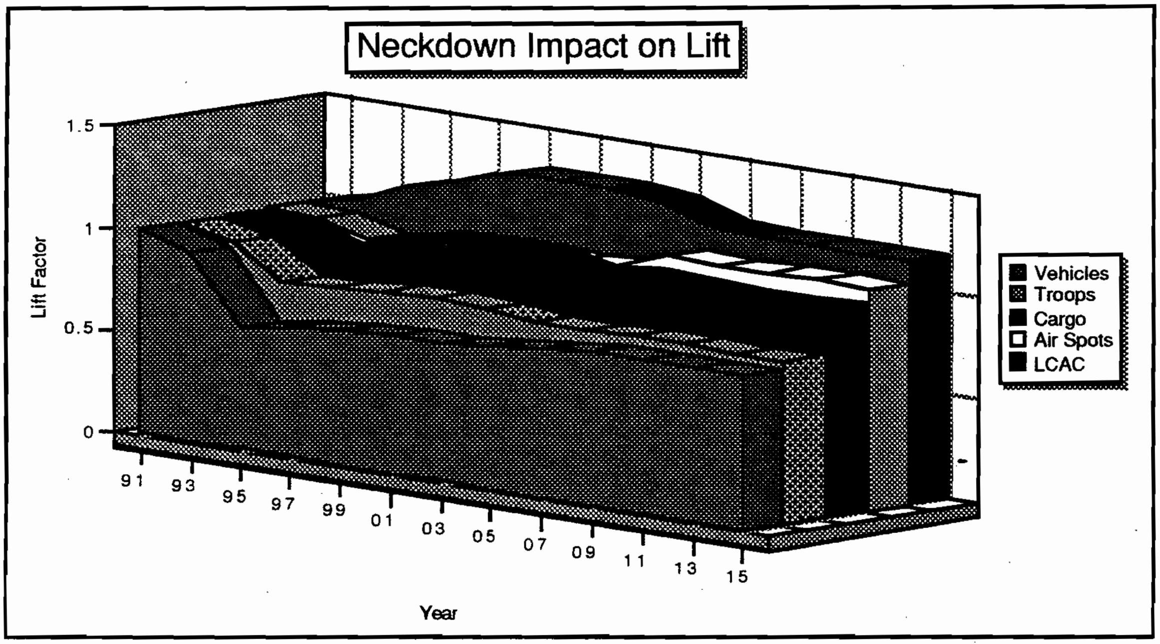


Figure 4.2 Effect of Amphibious Shipping Neck-down on Lift

5. Estimated ARG Configurations

Based upon the projected reduction in assault amphibious shipping, an estimate of amphibious ship assignments for MAGTF-2015 can be developed. These estimates reflect the types and numbers of ships that would be required to provide sufficient assault amphibious lift for MAGTF-2015. Table 4.5, on the following page, displays the estimated numbers and types of assault amphibious ships required to support MAGTF-2105.

	LHA/LHD	LSD-41/49	LPD-17	TOTAL	LCAC
MEU	1	1	1	3	7
MEB	4	3	7	14	28
MEF	10	10	21	41	92
2.5 MEBs	10	7.5	17.5	35	71

Table 4.5 Estimated Amphibious Ship Requirements For MAGTF-2015

Note: Information for Figure 4.5 taken from "Integrated Amphibious Operations & U.S. Marine Corps Air Requirements Study", Washington, D.C., Department of the Navy, 26 September 1993, and author's estimate.

6. Shipbuilding Implications

The estimated effects of the neck-down strategy show decreases in troop lift by a factor of .2 and in vehicle lift by a factor of .24. Increases in cargo cube by a factor of .01, air spots by a factor of .08, and LCAC spots by a factor of .18 are also shown. What implications can be drawn from these changes for MAGTF force structure? One implication is that revised ship capacities will reflect smaller MAGTFs in terms of personnel and vehicles to support them. A second implication can be drawn from increases in cargo capacity, especially in light of fewer personnel, which may indicate a greater capacity to provide a higher degree of organic sustainment for the MAGTF. Notable increases also occur in the number of air spots and LCAC spots, especially in light of the decrease number of personnel and vehicles. This may indicate a higher degree of tactical high-speed mobility and ship to shore projection capability.

7. Readiness Versus Sustainment

One approach to analyzing the implications of the amphibious neck-down and its impact on MAGTF-2015 is to look at the issues of readiness versus sustainment. By their very definition, readiness and sustainment are interdependent. Changes to one of the variables of troop, cargo, vehicle, air and LCAC spots will affect the others. This can be examined by looking at how changes in troop capacity may effect unit readiness. Changes to troop strengths also affect the densities of weapons and vehicle operators, and thus weapons densities themselves as operators are required before systems can be used. Changes to Air Spots and Vehicle lift may affect overall combat readiness and sustainment of ground forces ashore by their impact on transportation densities and capacities. This analysis may lead one to consider if increased levels of sustainment, evidenced by increased cargo capacity, can offset deficiencies in troop strength (e.g., fewer mechanics, maintenance personnel) by providing the ability to carry larger organic supply blocks, repair parts, and spare equipment. Larger supply blocks may reduce the requirement for mechanics and maintenance personnel. The decrease in vehicle spots may be overcome by the increase in air and LCAC spots, reflecting greater high speed tactical/logistical transportation at the expense of tracked and wheeled vehicle mobility.

The general utility of surface and air capable platforms with significant personnel, vehicle and cargo stowage seems to have been realized by defense planners. The trend in procurement has been to acquire multi-purpose ships such as the LHA/LHD, and LPD-17 which provide a range of lift capabilities. But, from both an operational and ships design point of view, the current procurement trend has resulted in tradeoffs in balance between troop, vehicle, cargo, air and LCAC capabilities, all important factors affecting the structure of MAGTFs.

L. FORCE STRUCTURE

To come up with an estimate of MAGTF-2015 this analysis considered the likely effects of reduction in amphibious lift, changes to force structure recommended by the Force Structure Planning Group, and technological advances in weapons systems. Personnel strengths of the MAGTF will be greatly influenced by the availability of amphibious lift. MAGTF-2015 will see an overall reduction in personnel numbers by 20 percent. Within the overall 20 percent reduction, it becomes apparent that there is a shift of personnel strengths among CSS functional areas due to the effects of vehicle lift reduction, increases in air spots and cargo capacity. It is likely that these shifts may equate to an increase in aviation personnel due to the increased in air spots and resultant capacity to handle aircraft. Likewise a decrease in vehicle personnel may result from the reduced vehicle lift capacity. It is the author's experience that moderate increases in cargo capacity does not necessarily equate to an increased need for supply personnel. At a macro level of analysis these shifting of strengths among CSS functional areas do not appear to affect the tooth-to-tail ratios calculated previously. Based on average ship configuration and troop lift capacity the personnel strengths for MAGTF-2015 have been estimated and are displayed in Table 4.6.

	MEU	MEB	MEF
STRENGTH	1900	12900	36400
SUSTAINMENT	15 days	30 days	60 days

Table 4.6 Estimated Personnel Strengths for MAGTF-2015

M. DEVELOPMENT OF COSTS

In developing costs for future weapons systems the simplifying assumption is made that systems will be represented by follow-on or upgrades to current weapons systems. This allows for the comparison of cost of MAGTFs in two different time periods. Cost Calculations for MAGTF-2015 follow the same approach used in Chapter III for the Notional Baseline MAGTF. First, an estimated force structure is presented and the capital stock values are estimated. Next, the capital service values and O&S costs are estimated. Finally, ratios are developed to facilitate analysis and comparison of the Notional Baseline MAGTF and MAGTF-2015 in Chapter V.

N. MILITARY CAPITAL

The majority of MAGTF-2015's force structure includes platforms already developed for the notional baseline. As a result, the difference in capital service values between the notional baseline and MAGTF-2015 is modestly affected by two factors: first, a change in the number of existing assets in the capital stock inventory between the notional baseline MAGTF and MAGTF-2015, and secondly, the addition of new assets developed and acquired to replenish capital stock inventory for MAGTF-2015.

1. Changes To Existing Capital Stock

Assuming that service lives remain constant, reduction of assets held in inventory result in future forces having a smaller capital services value (all else held constant). A smaller number of assets cause a reduction in the capital stock (inventory) value.

2. New Capital Stock

New capital stock developed and acquired for MAGTF-2015 includes, planes, vehicles, weapons, and amphibious shipping. Two major costs are associated with a new capital stock: RDT&E, and procurement. The difference in the value of capital stock from the notional baseline MAGTF to MAGTF-2015 is attributable to changes in force structure and modernization efforts. Inventory changes result from procurement and retirement of military assets. Modernization is the result of the replacement of existing forces with improved assets and through expenditures on RDT&E. With the continued application of new technologies to weapons systems development, R&D costs have continued to increase as compared to procurement costs. FY 93 defense programs displayed a 1.5:1 ratio between procurement and R&D. Present trends indicate that this ratio will fall to 1:1 by the year 2000. (Carlisle, 1992, p. 309) This analysis will treat RDT&E costs as sunk costs and does not factor in their impact when calculating capital stock value of assets. Presented in Appendix D are the capital stock values of MAGTF-2015 assets.

a. Equipment

Unit equipment for MAGTF-2015 is estimated by taking the current levels of T/E equipment authorized by the baseline MAGTF and decreasing it by 20%. This 20% reduction in equipment is a direct result of the 20% planned reductions in amphibious lift. Basically, the simplifying assumption is made that if the lift capacity for assault amphibious shipping is decreased by 20% then the size of the unit able to embark on that ship and the amount of equipment it can take along are also decreased by 20%.

b. Aircraft

Determining aircraft procurement cost to the year 2015 involves reviewing the USMC's long range aviation plan, which calls for reduction in the numbers and types of aircraft and the achievement of an all - STOVL force. This long range goal is likely to impact on MAGTF-2015 by increasing the number of AV-8 and medium lift helicopters possessed by the MAGTFs. Since it is not clear what realistic future aircraft types and quantities will be utilized in the MAGTF-2015 all costing for this analysis is based on costs of current model aircraft or follow on model aircraft. Table 4.7, on the following page, shows the estimated cost of aircraft and ground support equipment for MAGTF-2015.

A/C TYPE	MEU	MEB	MEF
AV-8C	$567	$2,495	$3,667
F/A-18E	$0	$1,956	$3,727
A-6F	$0	$763	$763
EA-6C	$0	$317	$317
CH-53F	$339	$1,107	$1,672
AH-1X	$98	$206	$382
CH-46F	$408	$1,242	$1,513
UH-1M	$176	$274	$441
TOTAL	$1,588	$8,359	$12,482

Table 4.7 Estimated Capital Stock Value for MAGTF-2015 Aircraft
(Costs in millions of FY 91 dollars)

c. Assault Amphibious Shipping

Estimated capital stock values for amphibious ships are shown in Table 4.8 and reflect the cost of the estimated ship mix requirements for MAGTF-2015 that are depicted in Table 4.5.

SHIP TYPE	UNIT COST	MEU	MEB	MEF
LHA/LHD	$1,075	$1,075	$4,300	$10,750
LSD-41/49	$245	$245	$735	$2,450
LPD-17	$360	$360	$2,520	$7,560
LCAC	$30	$210	$840	$2,760
TOTAL		$1,890	$8,395	$23,520

Table 4.8 Estimated Capital Stock Value of MAGTF-2015 Amphibious shipping

Costs estimated from The Revised Fiscal Requirements Model, (CRM 93-158). (Alexandria, VA. Center for Naval Analysis, August 1993), Costs are averages for ship types and are in millions of FY 91 dollars.

Table 4.9 depicts the estimated aggregate capital stock value of MAGTF-2015.

(Costs in millions of $)	MEU	MEB	MEF
T/E EQUIPMENT AND WEAPONS	$35.83	$284.25	$952.53
AIRCRAFT	$760.2	$6,546.6	$1,0230.8
AMPHIBIOUS SHIPS	$1,890	$8,395	$23,520
TOTAL	$2,686	$15,226	$34,703

Table 4.9 Estimated Capital Stock Values For MAGTF-2015
(Costs in millions of FY 91 dollars)

3. Capital Services Value

Table 4.10 shows the estimated capital services value for MAGTF-2015. The service life estimates are; 40 years for ships, 20 years for aircraft and 15 years for T/E equipment and weapons.

(Costs in millions of $)	MEU	MEB	MEF
T/E Equipment&Wpns	$2.39	$18.95	$63.50
Aircraft	$38.00	$327.33	$511.5
Amphibious Ships	$47.25	$210.00	$588.00
Total	$87.64	$556.28	$1,163.00

Table 4.10 Estimated MAGTF-2015 Capital Services Value
(Costs in millions of FY 91 dollars)

O. O&S COSTS .

Direct O&S costs for MAGTF-2015 are estimated using the cost factors method, explained in Chapter III, to obtain a comparative estimate of MAGTF O&S costs. Table 4.11 depicts representative O&S costs for MAGTF-2015.

(Cost in millions of FY 91 $)	MEU	MEB	MEF
MAINTENANCE	$1.28	$2.56	$22.10
TRNG ORDNANCE	$1.68	$5.12	$20.16
FUEL	$.011	$.041	$.242
AIRCRAFT O&S	$81.40	$444.53	$623.82
AMPHIB. SHIP O&S	$51.30	$230.00	$645.00
PERSONNEL	$52.72	$667.80	$1,016.5
TOTAL	$188.40	$1,350.00	$2,327.80

Table 4.11 Estimated Aggregate O&S Costs for MAGTF-2105

Table 4.12 shows the estimated cost ratios related to achieving and maintaining a MAGTF capability in the year 2015.

	MEU	MEB	MEF
CapSvcVal/CapStkVal	.04	.05	.05
O&M/CapStkVal	.94	1.26	.86
O&M/CapSvcVal	.04	.06	.04
Tooth-to-Tail	1.66	1.39	.90

Table 4.12 MAGTF-2015 Cost Ratio Presentation

These ratios again serve a useful purpose in that they summarize the various costs associated with achieving and maintaining a MAGTF capability and a related tooth-to-tail ratio for the year 2015. The first ratio relates Capital Services Value to Capital Stock Value of a particular size MAGTF and describes the average annual investment (in terms of a percentage of total capital value) required to maintain a constant inventory of capital equipment. The second ratio relates the direct O&S cost to the Capital Stock Value of a particular size MAGTF and describes the annual cost of operating and supporting a given force as a percentage of the MAGTF's total capital value of equipment. The third ratio relates the direct O&S costs to the Capital Services Value of a particular size MAGTF and compares the direct cost of operating and supporting a force to the cost of maintaining a constant inventory of capital equipment. Table 4.12 depicts the relative significance of direct O&S costs utilizing the Cost Factors Method. The Quick Cost Method is not used in this comparison because it is not flexible enough to permit entering and costing out Primary AEs smaller than a Marine Division. The ratios displayed show very similar results to those obtained in Chapter III for the notional baseline MAGTF and point out the significance role that O&S costs play in achieving and maintaining a MAGTF capability.

V. EVALUATING THE MAGTF

A. INTRODUCTION

This chapter will concentrate on comparing the force structures and tooth-to-tail ratios of the MEU, the MEB, and the MEF. The comparison is focused at answering the research questions presented in Chapter I and restated below:

1. What is the tooth-to-tail ratio for a MAGTF and what are its costs in terms of capital stock value, capital services value and O&S Costs?

2. How does a particular MAGTF's tooth-to-tail ratio play into the issue of readiness versus sustainment?

3. What might be the force structure for a MAGTF configured for expeditionary warfare in the early 21st Century?

The method used to conduct the analysis will focus on comparing several indicators of readiness and sustainment for a MAGTF. The indicators are:

1. Personnel Strength.
2. Major Equipment Density.
3. Logistic Sustainment.
4. Tooth-to-Tail Ratio.
5. Dollar Costs.

The last two chapters developed the force structure, tooth-to-tail ratios, and cost of a notional baseline MAGTF and MAGTF-2015. The notional baseline MAGTF was developed using a micro-level approach which estimated force structure for the major elements of a MAGTF (CE, GCE, ACE, CSSE). This level of detail permitted units to be classified as combat or support. The units designated as performing support roles were further classified into eight major CSS elements. This level of force structure detail permits a fairly accurate estimation of a MAGTF's tooth-to-tail ratio. It also permits one to determine and analyze the cost associated with achieving and maintaining a MAGTF capability. Based on cost estimates one can take the analysis one step further and determine the cost of achieving and maintaining a certain tooth-to-tail ratio for the various MAGTFs. For MAGTF-2015 a macro level approach was taken in estimating force structure, tooth-to-tail ratios, and costs. Based on several factors influencing MAGTF force structure, (e.g., endstrength, MTR, amphibious lift), a picture of MAGTF-2015 was developed. It should be noted that MAGTF-2015 estimates are broad, and as a result, do not contain the same accuracy as estimates of the notional baseline MAGTF. MAGTF-2015 does serve an important purpose in that it provides a "best estimate" picture of MAGTF capabilities and cost , factoring in the impact of current budgetary trends, NSS, and the geopolitical environment.

B. TOOTH-TO-TAIL CONCEPT

Key to this entire analysis is the issue of the MAGTF tooth-to-tail ratios. Each of the three MAGTFs looked at in this analysis possess different tooth-to-tail ratios. What are the benefits of a particular ratio for a particular size MAGTF? Perhaps the best way to address this question is to look at the capabilities possessed by the notional MAGTFs in terms of readiness and sustainment, and the cost associated with achieving and maintaining these capabilities. This type of analysis may serve as a useful evaluation of investment strategy in achieving and maintaining a MAGTF capability now and in the future.

A real difficulty exists in trying to measure a MAGTF's capability in terms of readiness and sustainment. Readiness is a measure of performance in peacetime that lacks a precise indicator. It is difficult to define and it is open to various interpretations. This analysis views readiness as an input variable which focuses attention on the operational potential offered from a specific force structure. Viewing the capacity to respond as readiness it can be seen that to be credible, a forward deployed force must encompass both a credible evidence of will and the capacity to respond. If the purpose of forward deployed forces is to threaten or apply violence to an opponent to alter his behavior, sustainment can be seen as providing the desired depth to readiness to make a forces capability credible.

C. EVALUATION OF NOTIONAL MAGTFs

1. Personnel Strength

In comparing MAGTFs one sees that the personnel strengths increase with the size of the MAGTF. As discussed in Chapter III, the ratio of combat troops to support troops changes as the size, capability, and sustainment levels of MAGTFs increase. This analysis has shown that within those general increases the number of support personnel increases at a greater rate than combat personnel. In turn these increases in support personnel appear to add depth to and increase the level of support the CSS functional areas are capable of providing to the MAGTF.

Within the CSS structure for each MAGTF the eight functional ares must be considered. The particular tooth-to-tail ratios for MAGTFs are in fact the result of complex grouping and interaction between force structure elements. Figures 5.1, 5.2, and 5.3 are charts which graphically depict the breakdown of personnel increases for a notional MEU, MEB, and MEF respectively. These charts further break down the CSS elements into the eight functional areas. From these charts one can gain an understanding and appreciation for the complexity involved in MAGTF organization and how the changes in personnel strength in each of the CSS functional areas contribute to the changes in densities and tooth-to-tail ratios for each particular size MAGTF.

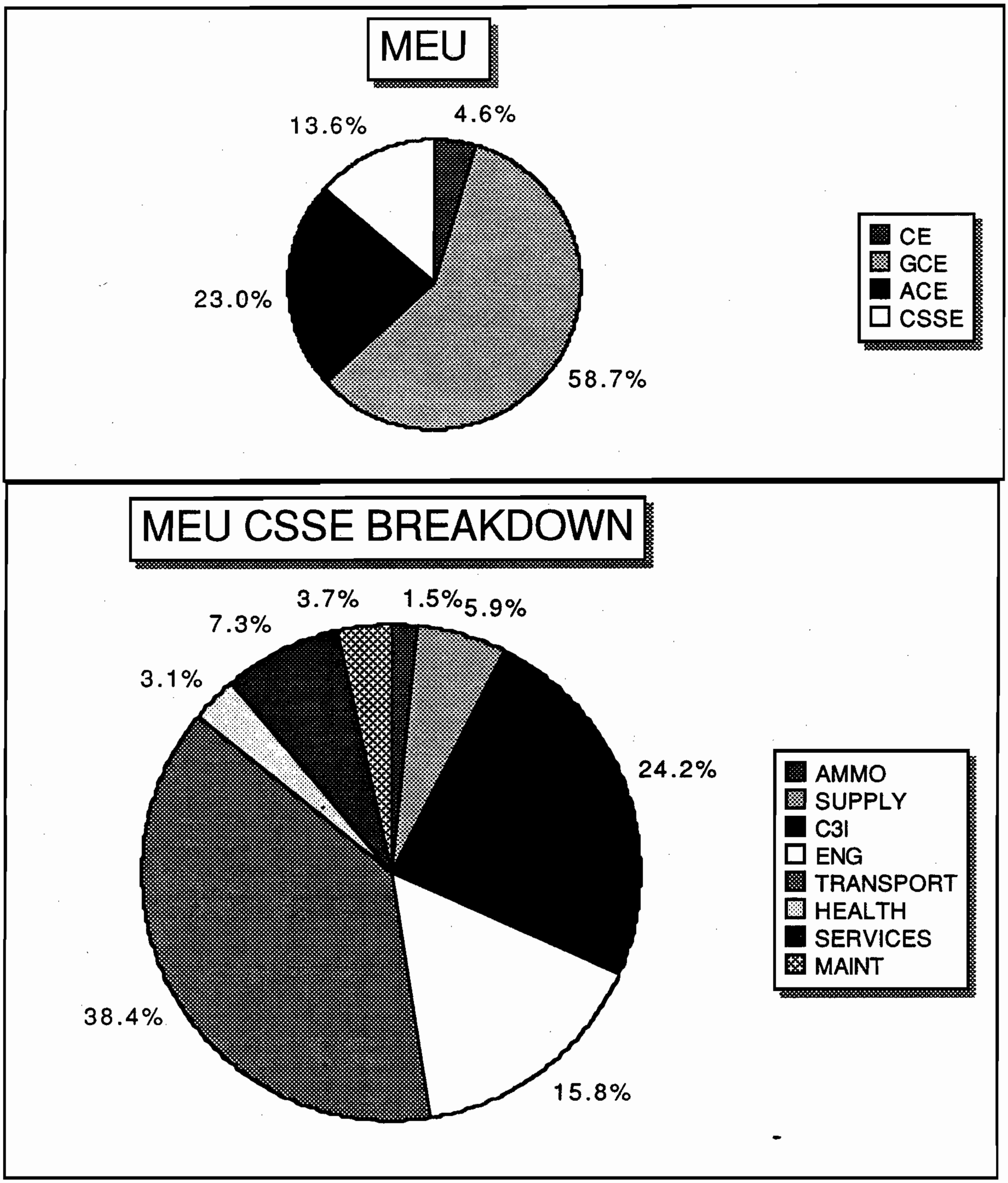


Figure 5.1 Personnel Breakdown for Notional MEU

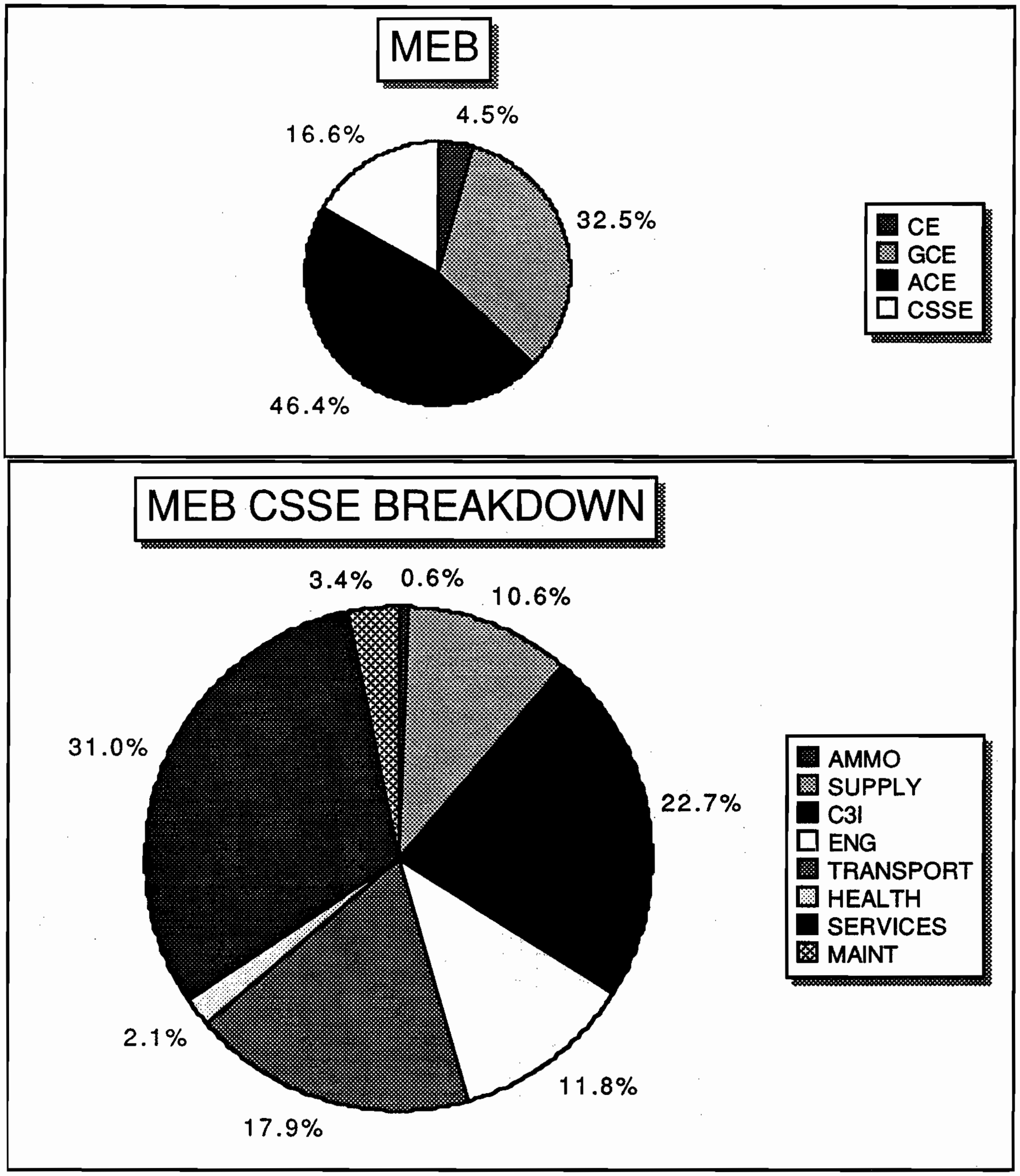
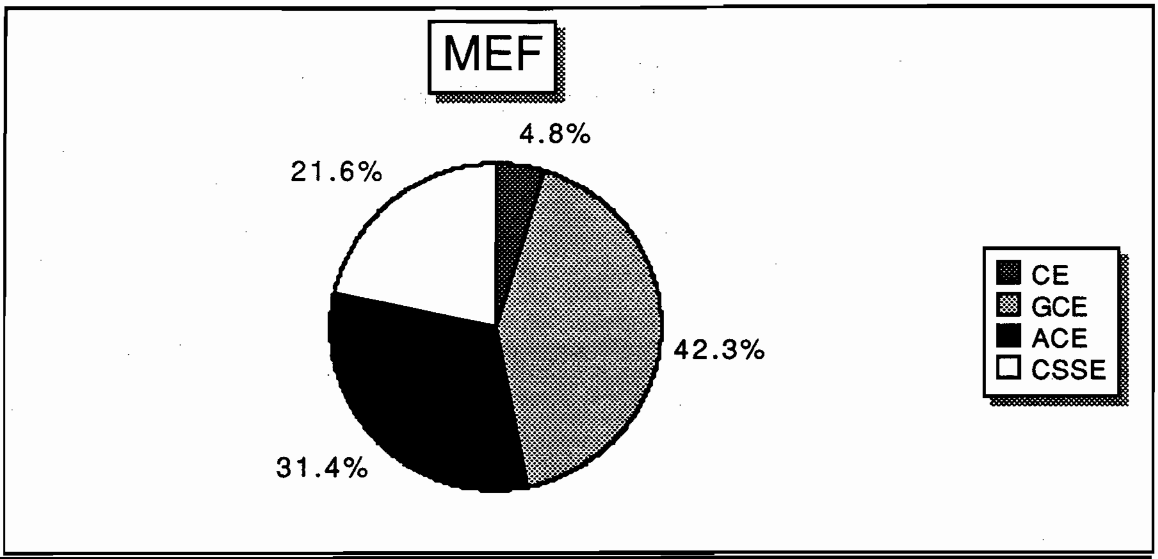


Figure 5.2 Personnel Breakdown for Notional MEB



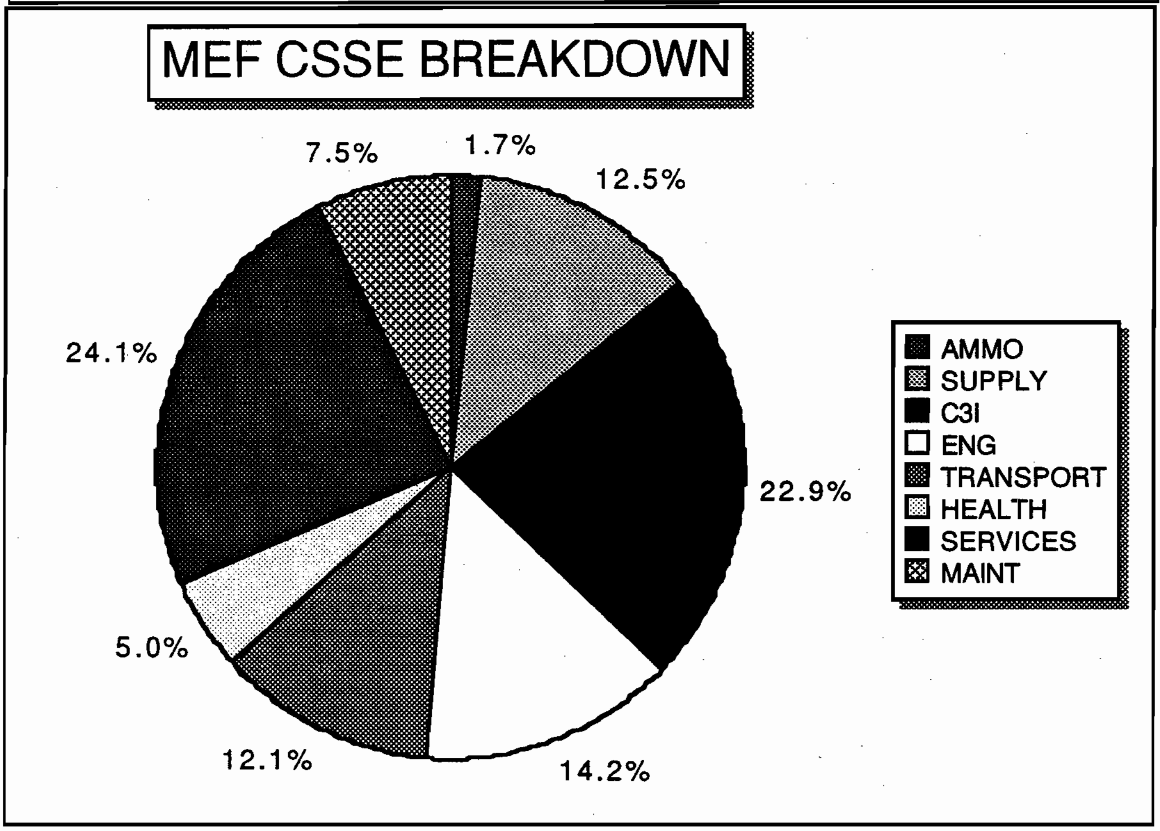


Figure 5.3 Personnel Breakdown for Notional MEF

2. Major Equipment Densities

This analysis shows that as the size of the MAGTF increases so does the quantity of major equipment it possesses. However, these increases in equipment quantities are not proportional to the overall personnel increases in the MAGTF. Rather, weapons and equipment increases are proportional to the combat units that comprise the MAGTF and a degree of linearity can be seen in combat unit structure. For example, three infantry battalions and supporting attachments make up a regiment and three regiments and supporting attachments form the basis for a division. However, as MAGTFs are task-organized to be self sustaining each successive size MAGTF possesses increasing command and control and combat support assets which cause the overall MAGTF structure to be non-linear. For example, three MEUs cannot make a MEB and three MEBs cannot make a MEF due to the increasing requirements at each higher MAGTF for command and control assets and support assets. In effect when moving from smaller to higher MAGTF capabilities the increases in non-combat assets begin to shift the balance between combat and support forces as sustainment capabilities increase. (See Figure 3.4) The resultant effect being that even though the amount of equipment increases the calculated densities generally decrease. One point to note is that weapons densities start to increase again as one moves from a MEB to a MEF. The increase is attributed to the inclusion of fixed wing tactical aircraft which are not integral to the MEU structure. This analysis shows that the transportation densities decrease for successive MAGTFs. It is important to note that these densities reflect the MAGTFs ability to provide tactical as well as logistical transportation to the MAGTF. Lower densities do not necessarily reflect a lesser capability to provide tactical and logistical transport. The support capability depends on the size of the MAGTF that will be supported at any given time. Current employment doctrine suggests that in situations likely to be encountered on the lower end of the conflict spectrum, MAGTFs will deploy the smallest size force necessary to accomplish the mission. Thus the existent transportation assets may be entirely sufficient to provide the required support.

3. Logistic Sustainment

Sustainability rates, measured in days of organic sustainment capability, effectively double for each successive notional MAGTF, providing the ability to conduct a higher tempo of operations for greater periods of time. One can infer from the analysis that higher sustainment levels may reflect the assignment of higher intensity, longer duration missions that would likely be assigned to these type forces. The enhanced sustainment levels are facilitated by increases in the CSS functional area capabilities and the greater organic supply capabilities inherent to the larger MAGTFs.

4. Tooth-to-Tail

This analysis uses the tooth-to-tail ratios as order-of-magnitude measures of the particular MAGTF's readiness and sustainment capabilities. The tooth-to-tail ratios for notional MAGTFs decreases from 1.66:1 to 1.39:1 to .90:1 for the MEU, MEB, and MEF respectively as the MAGTFs themselves increase in size and move from a "small," to "medium," and "large" expeditionary capability. The resulting force structure changes for larger MAGTFs reveal increases in capability for sustainment. It is important to note that these "decreasing" tooth-to-tail ratios do not reflect decreases in combat power but rather increases in combat power linked to greater increases in sustainment. In effect, the ratios are a measure of the operational tempo capabilities inherent to a particular MAGTF structure. When compared to the MEB and MEF a MEU possesses a relatively high tooth-to-tail ratio. Its force structure is designed to facilitate its mission of forward presence and rapid response. To perform such a mission successfully a high degree of readiness is required for rapid and credible initial response. A limited sustainment capability is adequate in situations where the most important factor is a quick response and a presence, albeit may possess relatively limited sustainment. Such a capability is best achieved by a MAGTF with a relatively high tooth-to-tail ratio. For situations requiring greater sustainment and resources, after the initial involvement, tooth-to-tail ratios reflecting increases in sustainment capability over readiness capability are appropriate. The MEB and MEF size MAGTFs possess forces which are designed to accomplish missions requiring greater combat power, resources and the ability to sustain those efforts for longer periods of time.

5. Dollar Cost

The spread of technology, and with it lethality, has tended to increase the cost of intervention. To maintain the capability for intervention at an acceptable cost the forward deployed force must possess a high level of readiness. This leads to a need for a determination of the fitness of a force in particular circumstances and the probability of these circumstances occurring. (See Figure 2.1, Spectrum of Conflict) A key point to consider is that the military power of a MAGTF influences cost. A stronger projection capability, gained from increased forces and more capable weapons, should be able to project naval power ashore at a lower cost to human life, and destroyed equipment, than a weaker force. Thus, increases in readiness and sustainment expenditures may ultimately reduce the total cost, and lower the risk, of actual force projection yet at the same time increase the level of O&S costs. The comparative cost estimates presented in this analysis make it clear that each successive size MAGTF is more expensive than the first and a good portion of the cost is attributable to achieving sustainment. While the maintenance and employment of MAGTFs possessing high tooth-to-tail ratio may be desired for forward presence missions there are likely to be tradeoffs involved. These tradeoffs will be in the form of the inherent risk of tailoring and deploying a more cost effective force capable of performing the likely forward presence missions against the probability of that force being unprepared to engage in unforseen, higher tempo actions.

Current employment plans call for a MEU to be capable of performing a variety of roles, from forward presence and deterrence where readiness and potential combat power are key capabilities, to gaining a foothold for follow-on forces in a situation where cost of intervention is high. Conversely, a larger MAGTF, committed after a MEU, requires a larger sustainment capability in its reinforcing role. This analysis indicates that further research is required to determine if the current practice of maintaining standing MEUs and of maintaining only the Headquarters element for larger MAGTFs on a permanent basis can be viewed as a cost effect method of dealing with MAGTF deployment requirements.

a. Capital Stock Value

The capital stock value of major weapons possessed by MAGTFs, as displayed in Table 5.1, represents potential combat power that can be brought to bear on an enemy. This analysis shows that while capital stock values for MAGTFs increase for successively larger MAGTFs, they do so at a decreasing rate. When coupled with the corresponding increase in support personnel it can be seen that the investment in MAGTFs begins to shift from that of buying higher readiness through increased combat power to that of buying smaller increases in combat power and greater increases in sustainment, provided in large part by increases in personnel assigned to CSS functions. Table 5.1 presents a comparison of readiness and sustainment indicators, as well as cost comparisons, between the three notional baseline MAGTFs.

	MEU	MEB	MEF	MEB/MEU	MEF/MEB	MEF/MEU
Personnel	2395	16222	45501	6.77	2.80	19.00
Combat Troops	1495	9429	21505	6.31	2.28	14.38
Support Troops	902	6793	23996	7.53	3.53	26.60
Major Wpns Density	77.24	50.24	60.22	.65	1.20	.78
Transportation Density	17.53	9.25	6.79	.53	.73	.39
Sustainment	15	30	60	2.00	2.00	4.00
Tooth-to-Tail	1.66	1.39	.9	.84	.65	.34
CapStkVal	2433	14674	33193	6.03	2.26	13.64
CapSvcVal	117	616	1270	5.26	2.06	10.85
O&S Costs	206	1566	2713	7.60	1.73	13.17
CapSvcVal/CapStkVal	.048	.042	.038	.88	.91	.79.2
O&S/CapSvcVal	1.76	2.54	2.14	1.44	.84	1.22
O&S/CapStkVal	.085	.107	.081	1.26	.76	.95

Table 5.1 Notional Baseline MAGTF Cost Comparisons

b. Capital Services Value

The capital services value represents the amount of annual investment in procurement that is required to maintain a certain level of resources, and for purposes of this analysis, capability evidenced through combat power. By looking at the ratio of capital services value to capital stock value displayed in Table 5.4 one can see a fairly consistent investment is required to maintain a constant level of MAGTF readiness.

c. O&S Cost Estimates

(1.) The Cost Factors Method. O&S costs are viewed as the cost of achieving and maintaining a certain level of readiness and sustainment capability. This analysis shows that the ratios of O&S costs to capital services value and capital stock value of a MEU size MAGTF are relatively small when compared to those estimated O&S costs for a MEB and a MEF. Table 5.1 shows an 760% increase in O&S costs as one moves from a MEU to a MEB size MAGTF. O&S costs then increase at a much smaller rate (173%) going from a MEB to a MEF size MAGTF. This increase in ratios as one moves from a MEU to a MEB can be explained in part by the addition of a fixed wing tactical aircraft to MEB weapons inventories and the relatively large increase in personnel strengths. It is interesting to conduct a simple comparison between MAGTFs using direct O&S costs. Roughly eight MEUs can be deployed for the cost of one MEB, where in terms of size a MEB is six and a half times larger than a MEU. Roughly fourteen MEUs can be deployed for the cost of one MEF where a MEF is nineteen times larger than a MEU. This thumbnail comparison of O&S costs suggests that MAGTFs with greater tooth-to-tail ratios may be more costly in terms of O&S costs than the MEF size MAGTF with its lower tooth-to-tail ratio. Further research into this area would be required to determine if the larger size MAGTFs benefit from certain economies of scale relating to O&S costs.

(2). The Quick Cost Model. The Quick Cost Model was used to estimate O&S costs for a MEF size MAGTF in Chapter IV. Because of the level of detail involved in this method compared to the cost factors method a strict comparison of results is impossible. However, several interesting observations can be drawn from the cost estimates obtained from the Quick Cost Model. O&S costs comprise a significant portion of the total expense of possessing and maintaining a MAGTF capability. The O&S /CapStkVal ratio shows that O&S costs equate to 14% of the capital stock value of major weapons and equipment possessed by the notional MEF. The ratio of O&S/CapSvcVal shows that O&S costs exceed the annual investment in resources required to maintain a level of capital stock by a factor of 3.67:1, or by roughly three-and-a-half times. Within the total estimated O&S costs from a notional MEF manpower costs are the single largest contributor for both Marine and Navy force elements.

O&S costs calculated using the cost factors method also show manpower as the single largest contributor to total O&S costs. The results obtained from the Quick Cost Model provide the opportunity to estimate the MEF tooth-to-tail ratio from a standpoint of O&S costs. Recall that O&S costs are separated into Primary, Related, and Support AEs. O&S costs for Primary AEs result from the direct operation of the major force elements such as flying aircraft or operating ships at sea. O&S costs for Related AEs result from support activities not directly associated with the major elements such as operating support facilities ashore. O&S costs for Support AEs result from activities such as housing, medical support and maintenance. If one considers the Primary AE O&S costs as those that most contribute to the MAGTF "tooth" and the Related and Support AE O&S costs as those that most contribute to the MAGTF "tail" the following relationship can be used to express the tooth-to-tail ratio: O&S Cost (Primary AE)/O&S Costs(Related AE) + O&S Costs(Support AE) (Healy, 1994, p. 96) This relationship reveals a tooth-to-tail ratio of 1.23:1 for a notional MEF.

D. MAGTF-2015

MAGTF-2015 organization remains the same as the notional MAGTF. Some differences occur in force structure. The differences between MAGTFs are driven by the 64% decrease in the number of assault amphibious ships, which in turn produces a 20% personnel decrease due to troop lift constraints and an 8% increase in helicopter and VSTOL aircraft due to increased airspots. As discussed, personnel costs seem to have the greatest impact on total O&S costs in a MAGTF. The amphibious ship reduction and affects of the MTR on weapons systems will likely impact on MAGTF-2105 O&S costs in several ways. First, while the numbers of assault amphibious ships decrease they will be replaced by more modern and efficient platforms capable of providing multiple support to the MAGTF, such as troop and cargo lift, air spots, and well deck operations. Taking into account the changes in cost for MAGTF-2015 caused by the amphibious ship neck-down some interesting results can be obtained by comparing representative costs of maintaining and operating MAGTF-2015. Table 5.2 presents the percent changes in estimated costs as one moves from the notional baseline MAGTF to MAGTF-2015.

	%Change MEU	%Change MEB	%Change MEF
CapStkVal	149	152	175
CapSvcVal	155	172	209
O&S Cost	-5	-7	-9
CapSvcVal/CapStkVal	105	113	121
O&S/CapStkVal	-33	-33	-47
O&S/CapSvcVal	-37	-46	-56

Table 5.2 Comparison of Notional Baseline MAGTF and MAGTF-2015

The results of these comparisons between MAGTFs reveals that MAGTF-2015 displays noticeable increases in capital stock values and capital service values despite the fact that it possesses roughly 20% fewer major ground weapons and 64% fewer assault amphibious ships. These increases in values can be attributed to the increase in VSTOL and helicopter assets as well as impact of increased costs related to the upgrades of existing systems and procurement of next generation systems. The comparison also reveals a decrease in O&S costs for MAGTF-2015 which are likely attributed to troop lift reductions and reductions in the number of assault amphibious ships resulting from the amphibious ship neck-down.

VI. CONCLUSIONS

A. DISCUSSION

Presently, numerous dynamic events are impacting on the structure, roles, and missions of NEFs. Among these are; the recent demise of the Soviet Union and with it the perceived threat that has driven National Security Strategy for the past four decades, advances in technologies applied to weapons systems, fiscal and resources constraints, and the rise in requirements for U.S. involvement in Third World crisis. These events have played a significant role in redefining the NSS and within it the basic concepts for employment and structure of MAGTFs. This thesis has attempted to analyze the impact of these dynamic events on the MAGTF organization and structure. The MAGTF exists to fill the unique role of forward presence and deterrence and provides the United States with a global capability for projecting naval power ashore. Specifically, this analysis has looked at the tooth-to-tail ratios as a means of measuring the MAGTF's capabilities in terms of readiness and sustainment and to determine the various costs associated with possessing and maintaining these capabilities. This thesis has also attempted to incorporate the impact of the dynamic events currently shaping NEFs and come up with an estimation of what the MAGTF will look like as it enters the 21st Century.

The Navy and Marine components of MAGTF-2015 are very similar in organization and structure to the current notional MAGTF. The roles and missions remain the same as they continue to engage in "operational maneuver from the sea." MAGTF-2015 possesses the forward deployment, deterrence and power projection capabilities equivalent to the current notional MAGTF while utilizing smaller and equipment resources. Differences in size and costs exist between the two MAGTFs due to reductions in MAGTF-2015 force size and benefits resulting from technological advancements in weapons and equipment.

B. CONCLUSIONS

While the total Marine Corps endstrength remains the same as the baseline MAGTF-2015 is smaller in troop strength by approximately 20% when compared to the current notional MAGTF. Composition of MAGTF-2015 closely resembles the notional MAGTF. Some small force changes take place among ground combat units and include an estimated 8% increase in helicopter and VSTOL capabilities resulting from the assault amphibious ship neck-down. Force elements such as aircraft, ships and divisions continue to account for a large portion of each dollar invested in NEFs. As cost comparisons in Chapter V revealed, capital stock values for MAGTF-2015 shows significant increases over the notional MAGTF and takes up a larger "share of the total cost pie." This occurs because MAGTF-2015 is affected by the increased costs applied to the upgrading of existing weapons and equipment and the development and procurement of new ones. Although MAGTF-2015 possesses smaller numbers of weapons and equipment, these cost increases will cause the capital stock and capital services values to be higher than those of the notional MAGTF. At this point it is important to recognize and appreciate the far reaching impacts that the assault amphibious ship neck-down will have not just on MAGTF organization and structure but also on costs.

MAGTF-2015 enjoys a small decrease in O&S costs and larger decreases in the ratio of O&S to capital stock value. The results of this analysis indicate that the savings in O&S costs are not all derived by the reduction in numbers of ships. The new, multi-function ships tend to have higher O&S costs than the older ships they replace. A large part of the reductions in O&S costs result from the reduction in personnel strengths for MAGTF-2015. These reductions in turn are driven by the 20% reduction in troop lift for assault amphibious ships. From these results one can see that additional reductions in numbers of assault amphibious ships will have significant impact on MAGTF force structure as well as O&S costs. At this point it may help to recall that this thesis deals with amphibious MAGTFs and does not consider MPF or other types of MAGTFs described in Chapter I. The "excess" forces resulting from the 20% decrease in amphibious lift may be utilized in manning and staffing a 12th ARG or fleshing out non-amphibious MAGTFs.

MAGTF-2015 shows a large increase in the estimated capital services cost. This may necessitate a shift in long-term funding strategy from O&S costs to capital stock investment. Such a situation would place increased importance on the need to recapitalize the MAGTF when planning the overall budget. The O&S costs to capital services value ratio decreases from the notional MAGTF to MAGTF-2105. This change in ratios may indicate an increased importance of recapitalization, and the reduced cost of operating and maintaining a smaller and more efficient force.

Several challenges were encountered when attempting to estimate the costs of MAGTFs. Several simplifying assumptions had to be made with respect to the types and quantities of weapons and equipment possessed by notional MAGTFs and those that would likely be possessed by MAGTF-2015. While organizational structures and guidelines exist for all three size

MAGTFs, in practice the MEU is the only permanent standing MAGTF. As such, historical data from which to base comparisons and perform analysis is lacking for the MEB and MEF size MAGTF. In estimating O&S costs the cost factors method was used to arrive at a more micro level picture of O&S costs for each size MAGTF. The results of the Quick Cost Model provided accurate information for MEF size MAGTFs but does not possess the ability to input the major force elements of MEU and MEB size MAGTFs to perform analysis for comparisons.[11]

This analysis calculated and examined the tooth-to-tail ratios of MAGTFs and used them as a measure of a MAGTFs readiness and sustainment capabilities. One of the keys to conducting this type of analysis is to first arrive at an acceptable and uniform definition of the terms "combat" and "support" and then to consistently apply them throughout the analysis. Determining the tooth-to-tail ratios for MAGTFs becomes increasingly difficult as the size of the MAGTF increases. This difficulty results from the increasing numbers of units which perform multiple functions. In order to make force comparisons this analysis developed a simple and straightforward method of categorizing units into combat or support roles. The benefit of this method is that it creates ratios that can be legitimately used as gross summary indicators of relative force capability within similar environments. One of the main learning point of this analysis is that meaningful tooth-to-tail ratio comparisons can be derived only by developing and applying a standard method of classifying combat and support personnel within a unit.

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[11] The Quick Cost Model did present several difficulties in that it did not differentiate between classes of amphibious ships. In actuality each ship class varies in size, and often times mission, and do not incur the same O&S costs. For Marine forces the model did not list the O&S costs attributed to Marine A-6 aircraft so the data for EA-6 aircraft was substituted.

For purposes of this analysis the firepower and tactical maneuver units were the only ones generally classified as combat. All remaining functions were classified as support.

NEFs assigned the roles of forward presence, deterrence and rapid response missions must be configured differently than NEFs assigned roles requiring the conduct of in-depth, high-intensity offensive operations. NEFs equipped with technologically advanced weapons and equipment require carefully designed and trained support forces capable of providing a full range of combat service support functions. The depth of these assets or the "sustainment" capability depends on the duration and intensity of operations and the probable roles to be assigned to the force. A high state of readiness or "stored potential combat power" can be achieved while utilizing a relatively shallow depth in supporting forces. The MEU is a good example of this type arrangement. It possesses a relatively high degree of stored potential combat power and a capable, but limited, support structure which lacks a great deal of depth. In other words, the MEU possess a high degree of readiness and a lesser degree of sustainment. This is evidenced by the MEU's comparatively high tooth-to-tail ratio among MAGTFs.

MAGTF task organization can depend on, to a great extent, the expected types of missions it will be required to undertake. The "tail" of the MAGTF is therefore greatly affected by the tactical employment envisioned for the MAGTF. This analysis has shown that O&S costs are major contributors to the overall cost of a MAGTF. Within the total O&S costs, manpower is the single greatest factor affecting costs. Based on the results of this analysis it can be assumed that for any given combat force the greatest return on investment would result from forces possessing a high tooth and a small tail. In reality this reasoning may prove valid only for certain roles such as forward presence and deterrence, where the actual risk of violence is slight. In fulfilling the roles of forward presence and deterrence the appearance of capability and credibility may prove to be more important than the actual capabilities possessed by a force. For roles where the level of violence and intensity of operations is expected to be low, NEFs possessing high tooth-to-tail ratios are appropriate. Unfortunately history has shown that the United States can not afford to discount the possibility of involvement in higher intensity conflicts. To maintain standing forces tailored to deal with higher intensity and longer duration roles requires a significant investment in both combat power and support structure and may not prove cost effective when compared to the probability of its actual use. The opportunity cost of maintaining such a force, for use just in case a contingency arises, is prohibitive under any form of analysis. A better method of preparing for and dealing with higher intensity conflicts may be found in the MEB and MEF size MAGTFs. Each of these possess sufficient increases in combat power along with significant increases in support infrastructure and capability which allow them to effectively deal with roles calling for higher levels of violence and duration than normally encountered in forward presence and deterrence roles. These MAGTFs are organized and structured for contingency purposes and are not necessarily comprised of standing organizations. The MEU size MAGTF serves as the building block which provides the ability to merge smaller forces into significantly larger ones. MAGTF task organization proves to be an efficient approach to minimizing the opportunity costs associated with maintaining large standing forces. The MEU possesses a high tooth-to-tail ratio and can be viewed as being efficient in terms of maximizing the investment return in combat power. Since the Vietnam War MEU size

MAGTFs have been used to respond to the majority of contingencies requiring U.S. involvement.

From this analysis no imbalances appear to exist between the MAGTF force structures and the resultant tooth-to-tail ratios. Ratio changes can be directly tied to readiness and sustainment capabilities needed to perform specific expeditionary roles. From this analysis one can understand that tooth-to-tail ratios are best used as order-of-magnitude measures of capabilities, and must be understood within the context of specific force structures. The tooth-to-tail ratio of a specific force should not be used as a hard and fast specification for developing a force. These ratios are probably best employed as a monitoring device to assist defense planners in determining the right amount of readiness and sustainment required to perform certain roles. There is not necessarily an optimum tooth-to-tail ratio that will meet all the requirements of diverse contingencies. Savings in dollars and personnel can be made by reducing combat or support structures in units but the efficiency and effectiveness and ultimately success of an operation may be placed in jeopardy if NEFs are not provided with the appropriate support structure to adequately accomplish their assigned roles.

No matter what roles MAGTFs are assigned to perform, the principle of sustainability cannot be overlooked. Sustainment plays a deciding role in deciding what forces can be used where, how they can be employed, and for how long. NEFs continue to command a distinct advantage over land based contingency forces due to their ability to deploy world wide, unincumbered by international boundaries and project naval power ashore at the decisive place and time. Sustainment is the critical enabling factor for NEFs.

C. AREAS FOR FURTHER RESEARCH

This analysis indicates that the impact of decreases in the assault amphibious ship fleet will have significant impact on force structure, capabilities and costs of future NEFs. One potential area of study may be to analyze this subject in greater detail to determine the impact on Navy and Marine Corps investment strategies for forces of the future. Another area of interest would be to examine potential economies of scale for O&S costs between the various size MAGTFs as touched upon in Chapter V.

APPENDIX A. AES IN EACH AEC

Proxy Used To Distribute Resources

	Units	Military Pay	Total O&M	Civialian Pay O&M only	BTL Procurement	Officer End Strength in Aviation AEs	Military End Strength
Primary	*						
Related		*					
Auxiliary		*					
MSF Force Training		*					
Mgt. HQ-Combat		*		*			
BOS-Combat		*	*				
CSF Flight Trng						*	
Central Logistics			*		*		
Individual Training		*					
BOS-Support		*	*				
Central Spt. Act.							
and Mgt. HQ- Spt		*		*			
Medical and Persn. Spt.		*					
Miscellaneous							*

(a) Relationship of AECs and Allocation Variables

Source Of A Data Used To Apply Proxy

	Primary	Related	Auxiliary	MSF Force Training	Mgt. HQ-Combat	BOS-Combat	CSF Flight Training	Logistics	Training	BOS-Support	Mgt. HQ-Support	Medical/Personnel Support
Primary												
Related	*											
Auxiliary	*											
MSF Force Training	*	*										
Mgt. HQ-Combat	*	*										
BOS-Combat	*	*	*	*								
CSF Flight Trng	*	*	*	*	*							
Central Logistics	*	*	*	*	*	*						
Individual Training	*	*	*	*	*	*	*					
BOS-Support	*	*	*	*	*	*	*	*				
Central Spt. Act.	*	*	*	*	*	*	*	*	*			
and Mgt. HQ- Spt	*	*	*	*	*	*	*	*	*	*		
Medical and Persn. Spt.	*	*	*	*	*	*	*	*	*	*	*	
Miscellaneous	*	*	*	*	*	*	*	*	*	*	*	*

(b) Inter-AEC Relationships

Appropriations Adjusted

	Military Personnel - Service	O&M - Service	Procurement - BTL	Military Family Housing	Military Construction, Other	Military Construction, Family Housing
Primary	*	*	*			
Related	*	*	*			
Auxiliary	*	*	*			
MSF Force Training	*	*	*		*	
Mgt. HQ-Combat	*	*	*		*	
BOS-Combat	*	*	*		*	
CSF Flight Trng	*	*	*		*	
Central Logistics	*	*	*		*	
Individual Training	*	*	*		*	
BOS-Support	*	*	*		*	
Central Spt. Act.	*	*	*	*	*	*
and Mgt. HQ- Spt	*	*	*			
Medical and Persn. Spt.	*	*	*			
Miscellaneous	*					

(c) Resources Adjusted

Each internal factor is a linear combination of from one to seven RIs. The complete internal factor for one combination of resources (e.g., on of the 13 internal factors) for a specific AE is as follows:

for Primary AE;

(Linear Combination of RIs)/(Number of Forces)

for Related AE;

(Linear Combination of RIs)/(Proxy resources summed over all Primary AEs to which it is linked)

for Support AE;

(Linear Combination of RIs)/(Proxy resources summed over AEs in higher categories)

For example: Internal Factor 10 (Primary AE) for Military Construction is;

Internal Factor 10 (Primary AE) = 4410(MCN)+4450(MCNR)/Number of Forces of the Structure.

Internal Factors are part of the Force Cost Equation for Primary, Related, and Support AEs. The formula for a change in the cost of a particular AE is listed on the following page:

for Primary AE;

(Change in Force Level) X (Internal Factor) X (Fixed/ Var. %)

for Related AE;

(Change in Proxy Res. summed over all Primary AEs to which linked) X (Internal Factor) X (Fixed/Var. %)

for Support AE;

(Changes in Proxy Res. summed over AEs in higher categories) X (Internal Factors) X (Fixed/Var. %)

APPENDIX B. NOTIONAL MAGTF ORGANIZATION AND COSTS

NOTIONAL MEU RESOURCE COSTS ($000 FY91)		USMC			USN			TOTAL PERS	INDIV MAINT	TOTAL	
		OFF	ENL	AN. RATES	OFF	ENL	AN. RATES	COSTS	COSTS	PERS	T/E EQUIP
TYPE ORGANIZATION											COSTS
COMMAND ELEMENT		15	94	$3,234,014.00	1	1	$91,169.00	$3,325,183.00	$49,728.00	111	$5,966,272.00
HQ. MEU	S/C3I	13	25	$1,392,783.00	1	0	$63,761.00	$1,456,544.00	$17,472.00	39	$754,528.00
DET. SCAMP. HQBN	S/C3I	0	4	$99,884.00	0	0	$0.00	$99,884.00	$1,792.00	4	$376,208.00
DET. RADIO BN	S/C3I	1	26	$708,362.00	0	0	$0.00	$708,362.00	$12,096.00	27	$234,904.00
DET. FORRECON CO	S/C3I	1	6	$208,942.00	0	1	$27,408.00	$236,350.00	$3,584.00	8	$164,416.00
DET. COMM BN	S/C3I	0	33	$824,043.00	0	0	$0.00	$824,043.00	$14,784.00	33	$4,436,216.00
		0	0	$0.00	0	0	$0.00	$0.00	$0.00	0	$0.00
GROUND COMBAT ELEMENT		61	1276	$35,469,072.00	3	67	$2,027,619.00	$37,496,691.00	$630,336.00	1407	$29,101,664.00
INF BN (REIN)		44	861	$24,101,135.00	3	66	$2,000,211.00	$26,101,346.00	$436,352.00	974	$8,256,648.00
ARTY BN (REIN)		12	223	$6,277,925.00	3	67	$2,027,619.00	$8,305,544.00	$136,640.00	305	$7,124,360.00
RECON PLT (REIN)	S/C3I	1	25	$683,391.00	0	1	$27,408.00	$710,799.00	$12,096.00	27	$323,904.00
TANK PLT (REIN)		1	26	$708,362.00	0	1	$27,408.00	$735,770.00	$12,544.00	28	$4,329,456.00
AAV PLT (REIN)		1	41	$1,082,927.00	0	1	$27,408.00	$1,110,335.00	$19,264.00	43	$4,234,736.00
DET. CEB		1	45	$1,182,811.00	0	1	$27,408.00	$1,210,219.00	$21,056.00	47	$1,016,944.00
DET. TRK CO	S/TRANS	1	33	$883,159.00	0	1	$27,408.00	$910,567.00	$15,680.00	35	$2,158,320.00
ANTI-TANK SECT		0	22	$549,362.00	0	0	$0.00	$549,362.00	$9,856.00	22	$1,624,144.00
		0	0	$0.00	0	0	$0.00	$0.00	$0.00	0	$0.00
AVIATION COMBAT ELEMENT		69	487	$15,648,721.00	1	5	$200,801.00	$15,849,522.00	$247,296.00	552	$2,249,704.00
HMM SQDN (12 CH-46)	S/TRANS	32	173	$6,211,695.00	1	3	$145,985.00	$6,357,680.00	$93,632.00	209	$339,368.00
HMH DET (4CH-53E)	S/TRANS	9	71	$2,304,985.00	0	1	$27,408.00	$2,332,393.00	$36,288.00	81	$153,712.00
HML/A DET (4UH-1/4 AH-1)		18	115	$3,935,753.00	0	1	$27,408.00	$3,963,161.00	$60,032.00	134	$37,968.00
MALS SPT ELEMENT	S/SUPPLY	0	28	$699,188.00	0	0	$0.00	$699,188.00	$12,544.00	28	$351,456.00
MWSS SPT ELEMENT	S/SERVICES	0	67	$1,673,057.00	0	0	$0.00	$1,673,057.00	$30,016.00	67	$622,984.00
MASS SPT ELEMENT	S/C3I	0	17	$424,507.00	0	0	$0.00	$424,507.00	$7,616.00	17	$437,384.00
LADD SECTION		0	16	$399,536.00	0	0	$0.00	$399,536.00	$7,168.00	16	$306,832.00
		0	0	$0.00	0	0	$0.00	$0.00	$0.00	0	$0.00
COMBAT SERV SUPT ELEMENT		11	293	$7,966,779.00	2	21	$703,090.00	$8,669,869.00	$146,496.00	327	$7,476,504.00
DET. H&S BN. FSSG	S/C3I	7	58	$1,862,130.00	0	2	$54,816.00	$1,916,946.00	$30,016.00	67	$1,079,984.00
DET ENGR SPT BN. FSSG	S/ENG	1	61	$1,582,347.00	0	0	$0.00	$1,582,347.00	$27,776.00	62	$2,861,224.00
DET. MAINT BN. FSSG	S/MAINT	1	33	$883,159.00	0	0	$0.00	$883,159.00	$16,232.00	34	$1,148,768.00
DET. SUPPLY BN. FSSG	S/SUPPLY	1	24	$658,420.00	0	1	$27,408.00	$685,828.00	$11,648.00	26	$94,352.00
DET. LANDING SPT BN. FSSG	S/ENG	1	82	$2,106,738.00	0	0	$0.00	$2,106,738.00	$37,184.00	83	$436,816.00
DET. MED BN. FSSG	S/HEALTH	0	8	$199,768.00	1	16	$502,289.00	$702,057.00	$11,200.00	25	$78,800.00
DET. DENTAL BN. FSSG	S/HEALTH	0	0	$0.00	1	2	$118,577.00	$118,577.00	$1,344.00	3	$38,656.00
DET. MOTOR TRANS BN. FSSG	S/TRANS	0	27	$674,217.00	0	0	$0.00	$674,217.00	$12,096.00	27	$1,737,904.00
											$0.00
TOTAL MEU		146	2150	$62,318,586.00	7	94	$3,022,679.00	$65,341,265.00	$1,073,856.00		$728,094,144.00

NOTIONAL MEB RESOURCE COST ($000 FY91)		USMC			USN			TOTAL PERS	INDIV MAINT	TOTAL	
		OFF	ENL	AN. RATES	OFF	ENL	AN. RATES	COSTS	COSTS	PERS	T/E EQUIP
TYPE ORGANIZATION											COSTS
AMPHIBIOUS MEB		1201	14442	$431,629,498.00	95	484	$401,883,631.00	$833,513,129.00	$7,186,346.00	16222	$28,172,524,654.00
				$0.00			$0.00	$0.00	$0.00	0	$0.00
COMMAND ELEMENT		87	626	$20,774,938.00	7	14	$17,603,735.00	$38,378,673.00	$325,162.00	734	$20,449,838.00
COMMAND SECT	S/C3I	52	118	$6,020,610.00	5	8	$3,552,949.00	$9,573,559.00	$81,069.00	183	$2,125,931.00
COMM CO COMM BN	S/C3I	10	192	$5,385,592.00	0	0	$5,262,336.00	$10,647,928.00	$89,486.00	202	$3,999,514.00
DET. SUP CO COMM BN	S/C3I	2	138	$3,564,230.00	0	0	$3,782,304.00	$7,346,534.00	$62,020.00	140	$8,951,980.00
DET. HQ CO COMM BN	S/C3I	1	25	$683,391.00	1	4	$748,961.00	$1,432,352.00	$13,733.00	31	$161,267.00
DET. CO A RADIO BN	S/C3I	2	25	$742,507.00	0	0	$685,200.00	$1,427,707.00	$11,961.00	27	$1,216,039.00
DET. CO B RADIO BN	S/C3I	0	32	$799,072.00	0	0	$877,056.00	$1,676,128.00	$14,176.00	32	$1,092,824.00
DET. H&S CO RADIO BN	S/SERVICES	7	48	$1,612,420.00	0	2	$1,315,584.00	$2,928,004.00	$25,251.00	57	$1,511,749.00
DET. FORCE RECON CO	S/C3I	3	32	$976,420.00	0	0	$877,056.00	$1,853,476.00	$15,505.00	35	$1,115,495.00
DET. CIVIL AFF GRP, FMF	S/C3I	10	14	$940,754.00	1	0	$447,473.00	$1,388,227.00	$11,075.00	25	$194,925.00
DET. TOPOGRAPHIC PLT	S/C3I	0	2	$49,942.00	0	0	$54,816.00	$104,758.00	$886.00	2	$80,114.00
				$0.00			$0.00	$0.00	$0.00	0	$0.00
GRND COMBAT ELEMENT		251	4760	$133,700,076.00	16	238	$131,482,256.00	$265,182,332.00	$2,332,395.00	5265	$132,449,605.00
H&S ELEMENT	S/C3I	7	204	$5,507,896.00	0	0	$5,591,232.00	$11,099,128.00	$93,473.00	211	$6,470,527.00
DET. TRK CO, HQ BN	S/TRANS	3	79	$2,150,057.00	0	0	$2,165,232.00	$4,315,289.00	$36,326.00	82	$3,124,674.00
RADAR BCN TM COMM CO	S/C3I	0	4	$99,884.00	0	0	$109,632.00	$209,516.00	$1,772.00	4	$186,228.00
DET. MP CO HQBN	S/SERVICES	1	30	$808,246.00	0	0	$822,240.00	$1,630,486.00	$13,733.00	31	$159,267.00
DET. SVC CO HQBN	S/SERVICES	0	26	$649,246.00	0	0	$712,608.00	$1,361,854.00	$11,518.00	26	$964,482.00
DET. HQ CO (NBC)	S/SERVICES	1	13	$383,739.00	0	0	$356,304.00	$740,043.00	$6,202.00	14	$357,798.00
DET. ITT, HQ CO HQBN (2)	S/C3I	2	20	$617,652.00	0	0	$548,160.00	$1,165,812.00	$9,746.00	22	$562,254.00
DET. HQ CO (SCAMP)	S/C3I	0	12	$299,652.00	0	0	$328,896.00	$628,548.00	$5,316.00	12	$1,124,684.00
				$0.00			$0.00	$0.00	$0.00	0	$0.00
INFANTRY REGT		156	2879	$81,113,605.00	11	205	$79,609,003.00	$160,722,608.00	$1,440,193.00	3251	$33,886,807.00
REGT HQS	S/C3I	24	296	$8,810,200.00	2	7	$8,240,290.00	$17,050,490.00	$145,747.00	329	$9,102,253.00
INFANTRY BN (3)		132	2583	$72,303,405.00	9	198	$71,368,713.00	$143,672,118.00	$1,294,446.00	2922	$24,784,554.00
				$0.00			$0.00	$0.00	$0.00	0	$0.00
D/S ARTY BN (REIN)		62	963	$27,712,265.00	5	19	$26,712,709.00	$54,424,974.00	$464,707.00	1049	$35,854,293.00
DET. HQ BTRY, ARTY REGT	S/SERVICES	1	27	$733,333.00	0	0	$740,016.00	$1,473,349.00	$12,404.00	28	$2,063,596.00
D/S ARTY BN		51	700	$20,494,616.00	5	13	$19,504,405.00	$39,999,021.00	$340,667.00	769	$25,835,333.00
HQ BTRY, D/S ARTY BN	S/C3I	18	172	$5,359,100.00	5	4	$5,032,981.00	$10,392,081.00	$88,157.00	199	$4,364,843.00
155 D/S HOW BTRY (T) (3)		33	528	$15,135,516.00	0	9	$14,471,424.00	$29,606,940.00	$252,510.00	570	$21,470,490.00
G/S ARTY BN SP (-)		10	227	$6,259,577.00	0	6	$6,221,616.00	$12,481,193.00	$107,649.00	243	$7,959,351.00
DET. HQ BTRY G/S BN	S/C3I	0	24	$599,304.00	0	0	$657,792.00	$1,257,096.00	$10,632.00	24	$422,368.00
155 SP BTRY, G/S BN		5	98	$2,742,738.00	0	3	$2,685,984.00	$5,428,722.00	$46,958.00	106	$2,591,042.00
8" SP BTRY, G/S BN		5	105	$2,917,535.00	0	3	$2,877,840.00	$5,795,375.00	$50,059.00	113	$4,945,941.00
DET. TAB		0	9	$224,739.00	0	0	$246,672.00	$471,411.00	$3,987.00	9	$0.00
				$0.00			$0.00	$0.00	$0.00	0	$0.00
COMBAT ENGR CO (REIN)	S/ENG	5	157	$4,216,027.00	0	3	$4,303,056.00	$8,519,083.00	$73,095.00	165	$2,832,905.00
COMBAT ENGR CO	S/ENG	5	109	$3,017,419.00	0	0	$2,987,472.00	$6,004,891.00	$50,502.00	114	$785,498.00
DET. ENGR SPT CO	S/ENG	0	32	$799,072.00	0	0	$877,056.00	$1,676,128.00	$14,176.00	32	$1,810,824.00
DET. H&S CO CEB	S/SERVICES	0	16	$399,536.00	0	3	$438,528.00	$838,064.00	$8,417.00	19	$236,583.00
				$0.00			$0.00	$0.00	$0.00	0	$0.00
AAV CO (REIN)		7	230	$6,157,142.00	0	5	$6,303,840.00	$12,460,982.00	$107,206.00	242	$23,770,794.00
DET. H&S CO AAV BN	S/SERVICES	0	11	$274,681.00	0	5	$301,488.00	$576,169.00	$7,088.00	16	$837,912.00
AAV CO		7	219	$5,882,461.00	0	0	$6,002,352.00	$11,884,813.00	$100,118.00	226	$22,932,882.00

TANK CO (REIN)		6	189	$5,074,215.00	0	3	$5,180,112.00	$10,254,327.00	$87,714.00	198	$23,370,286.00
DET. H&S CO TKBN	S/SERVICES	0	11	$274,681.00	0	3	$301,488.00	$576,169.00	$6,202.00	14	$586,798.00
MED TANK CO		5	105	$2,917,535.00	0	0	$2,877,840.00	$5,795,375.00	$48,730.00	110	$17,321,270.00
TOW CO (-)		1	73	$1,881,999.00	0	0	$2,000,784.00	$3,882,783.00	$32,782.00	74	$5,462,218.00
				$0.00			$0.00	$0.00	$0.00	0	$0.00
RECON CO (REIN)	S/C3I	5	79	$2,268,289.00	0	1	$2,165,232.00	$4,433,521.00	$37,655.00	85	$974,345.00
DET. H&S CO RECONBN	S/SERVICES	0	4	$99,884.00	0	1	$109,632.00	$209,516.00	$2,215.00	5	$230,785.00
RECON CO	S/C3I	5	75	$2,168,405.00	0	0	$2,055,600.00	$4,224,005.00	$35,440.00	80	$743,560.00
				$0.00			$0.00	$0.00	$0.00	0	$0.00
LAI CO (REIN)		3	59	$1,650,637.00	0	2	$1,617,072.00	$3,267,709.00	$28,352.00	64	$5,289,648.00
DET. H&S CO. LAV BN	S/SERVICES	0	9	$224,739.00	0	2	$246,672.00	$471,411.00	$4,873.00	11	$643,127.00
LAV CO (-)		3	50	$1,425,898.00	0	0	$1,370,400.00	$2,796,298.00	$23,479.00	53	$4,646,521.00
				$0.00			$0.00	$0.00	$0.00	0	$0.00
COMBAT SERV SPT ELEMENT				$0.00			$0.00	$0.00	$0.00	0	$135,111,000.00
BSSG	S	125	2409	$67,544,639.00	34	125	$68,193,746.00	$135,738,385.00	$1,192,999.00	2693	$66,690,001.00
				$0.00			$0.00	$0.00	$0.00	0	$0.00
HQ BN (-)	S/C3I	81	549	$18,497,475.00	9	45	$15,620,841.00	$34,118,316.00	$303,012.00	684	$6,883,988.00
DET. H&S CO. HQ BN	S/SERVICES	45	242	$8,703,202.00	8	45	$7,142,824.00	$15,846,026.00	$150,620.00	340	$4,926,380.00
MP CO (-) H&S BN	S/SERVICES	1	40	$1,057,956.00	0	0	$1,096,320.00	$2,154,276.00	$18,163.00	41	$230,837.00
DET. SVC CO. H&S BN	S/SERVICES	18	102	$3,611,130.00	1	0	$2,859,377.00	$6,470,507.00	$53,603.00	121	$689,397.00
DET. SVC CO H&S BN (DISP)	S/SERVICES	17	165	$5,125,187.00	0	0	$4,522,320.00	$9,647,507.00	$80,626.00	182	$1,037,374.00
				$0.00			$0.00	$0.00	$0.00	0	$0.00
LANDING SPT BN (-)	S/ENG	7	226	$6,057,258.00	0	0	$6,194,208.00	$12,251,466.00	$103,219.00	233	$3,504,781.00
DET. LANDING SPT EQUIP CO	S/ENG	1	47	$1,232,753.00	0	0	$1,288,176.00	$2,520,929.00	$21,264.00	48	$2,119,736.00
BEACH&TERM OPS CO (-)	S/ENG	2	115	$2,989,897.00	0	0	$3,151,920.00	$6,141,817.00	$51,831.00	117	$918,169.00
LANDING SPT CO. LSB	S/ENG	4	64	$1,834,608.00	0	0	$1,754,112.00	$3,588,720.00	$30,124.00	68	$466,876.00
				$0.00			$0.00	$0.00	$0.00	0	$0.00
MAINTENANCE BN (-)	S/MAINT	7	414	$10,751,806.00	0	0	$11,346,912.00	$22,098,718.00	$186,503.00	421	$6,760,497.00
DET. H&S CO MAINT BN	S/SERVICES	2	79	$2,090,941.00	0	0	$2,165,232.00	$4,256,173.00	$35,883.00	81	$2,069,117.00
DET. MT MAINT CO	S/MAINT	2	177	$4,538,099.00	0	0	$4,851,216.00	$9,389,315.00	$79,297.00	179	$1,747,703.00
DET. ENGR MAINT CO	S/MAINT	2	41	$1,142,043.00	0	0	$1,123,728.00	$2,265,771.00	$19,049.00	43	$545,951.00
CONTACT TM (3)	S/MAINT	0	20	$1,498,260.00	0	0	$1,644,480.00	$3,142,740.00	$8,860.00	20	$780,140.00
DET. ELEC MAINT CO	S/MAINT	1	45	$1,182,811.00	0	0	$1,233,360.00	$2,416,171.00	$20,378.00	46	$1,252,622.00
DET. GS MAINT CO	S/MAINT	0	12	$299,652.00	0	0	$328,896.00	$628,548.00	$5,316.00	12	$382,684.00
				$0.00			$0.00	$0.00	$0.00	0	$0.00
SUPPLY BN (-)	S/SUPPLY	6	257	$6,772,243.00	0	24	$7,043,856.00	$13,816,099.00	$127,141.00	287	$3,677,859.00
DET. H&S CO SUPPLY BN	S/SERVICES	0	12	$299,652.00	0	0	$328,896.00	$628,548.00	$5,316.00	12	$126,684.00
DET. SUP CO. SUP BN	S/SUPPLY	4	127	$3,407,781.00	0	0	$3,480,816.00	$6,888,597.00	$58,033.00	131	$195,967.00
DET. H&S CO. SUP BN	S/SERVICES	0	29	$724,159.00	0	0	$794,832.00	$1,518,991.00	$12,847.00	29	$307,153.00
DET. AMMO CO. SUP BN	S/AMMO	2	85	$2,240,767.00	0	0	$2,329,680.00	$4,570,447.00	$38,541.00	87	$314,459.00
DET. MED LOG CO. SUP BN	S/SUPPLY	0	4	$99,884.00	0	24	$109,632.00	$209,516.00	$12,404.00	28	$2,733,596.00
				$0.00			$0.00	$0.00	$0.00	0	$0.00
ENGINEER SUPT BN (-)	S/ENG	17	663	$17,560,745.00	1	7	$18,235,265.00	$35,796,010.00	$304,784.00	688	$25,420,216.00
DET. H&S CO. ENGR SUPBN	S/SERVICES	3	19	$651,797.00	1	7	$584,513.00	$1,236,310.00	$13,290.00	30	$255,710.00
DET. BRIDGE CO. ESB	S/ENG	0	42	$1,048,782.00	0	0	$1,151,136.00	$2,199,918.00	$18,606.00	42	$7,455,394.00
BULK FUEL CO. ESB	S/ENG	6	290	$7,596,286.00	0	0	$7,948,320.00	$15,544,606.00	$131,128.00	296	$5,370,872.00
ENG CO. ESB	S/ENG	5	136	$3,691,636.00	0	0	$3,727,488.00	$7,419,124.00	$62,463.00	141	$2,693,537.00
DET. ENGR SUP CO. ESB	S/ENG	3	176	$4,572,244.00	0	0	$4,823,808.00	$9,396,052.00	$79,297.00	179	$9,644,703.00
				$0.00			$0.00	$0.00	$0.00	0	$0.00
DENTAL CO (REIN)	S/HEALTH	0	2	$49,942.00	24	49	$1,585,080.00	$1,635,022.00	$33,225.00	75	$621,775.00
DET. H&S CO. DENTAL BN	S/SERVICES	0	2	$49,942.00	0	1	$54,816.00	$104,758.00	$1,329.00	3	$44,671.00
DENTAL CO, H&S BN	S/HEALTH	0	0	$0.00	24	48	$1,530,264.00	$1,530,264.00	$31,896.00	72	$577,104.00

MEDICAL CO (REIN)	S/HEALTH	1	49	$1,282,695.00	17	83	$2,426,929.00	$3,709,624.00	$66,450.00	150	$3,205,550.00
DET, H&S CO MED BN	S/SERVICES	1	31	$833,217.00	3	6	$1,040,931.00	$1,874,148.00	$18,163.00	41	$592,837.00
COLLECT & CLEAR CO	S/HEALTH	0	18	$449,478.00	14	77	$1,385,998.00	$1,835,476.00	$48,287.00	109	$2,612,713.00
				$0.00			$0.00	$0.00	$0.00	0	$0.00
MOTOR TRANSPORT BN	S/TRANS	7	298	$7,855,170.00	0	0	$8,167,584.00	$16,022,754.00	$135,115.00	305	$16,548,885.00
DET. H&S CO, MT BN	S/SERVICES	1	33	$883,159.00	0	0	$904,464.00	$1,787,623.00	$15,062.00	34	$801,938.00
D/S MT CO, MT BN	S/TRANS	5	154	$4,141,114.00	0	0	$4,220,832.00	$8,361,946.00	$70,437.00	159	$4,684,563.00
DET. G/S MT CO, MT BN	S/TRANS	1	111	$2,830,897.00	0	0	$3,042,288.00	$5,873,185.00	$49,616.00	112	$11,062,384.00
				$0.00			$0.00	$0.00	$0.00	0	$0.00
AIR COMBAT ELEMENT		738	6647	$209,609,845.00	38	107	$184,603,894.00	$394,213,739.00	$3,335,790.00	7530	$135,707,210.00
				$0.00			$0.00	$0.00	$0.00	0	$0.00
MAR AIR CNTRL GRP (-)		117	1377	$41,301,639.00	4	8	$37,995,860.00	$79,297,499.00	$667,158.00	1506	$88,077,842.00
HQ, MACG	S/C3I	13	27	$1,442,725.00	4	3	$995,060.00	$2,437,785.00	$20,821.00	47	$7,444,179.00
DET.MWCS (2)	S/C3I	22	382	$10,839,474.00	0	0	$10,469,856.00	$21,309,330.00	$178,972.00	404	$13,913,028.00
UNIT, MWCS	S/C3I	2	44	$1,216,956.00	0	0	$1,205,952.00	$2,422,908.00	$20,378.00	46	$1,110,622.00
DET, MASS	S/C3I	17	96	$3,402,188.00	0	1	$2,631,168.00	$6,033,356.00	$50,502.00	114	$7,508,498.00
MACS/TOAM	S/C3I	30	186	$6,418,086.00	0	2	$5,097,888.00	$11,515,974.00	$96,574.00	218	$22,334,426.00
DET. MATC (2)	S/C3I	8	144	$4,068,752.00	0	0	$3,946,752.00	$8,015,504.00	$67,336.00	152	$690,664.00
LAAM BTRY (REIN)		15	325	$9,002,315.00	0	0	$8,907,600.00	$17,909,915.00	$150,620.00	340	$26,931,380.00
DET. HQSVC BTRY	S/SERVICES	9	182	$5,076,766.00	0	0	$4,988,256.00	$10,065,022.00	$84,613.00	191	$19,179,387.00
MISSILE BTRY		6	143	$3,925,549.00	0	0	$3,919,344.00	$7,844,893.00	$66,007.00	149	$7,751,993.00
LAAD BTRY (REIN)		10	173	$4,911,143.00	0	2	$4,741,584.00	$9,652,727.00	$81,955.00	185	$8,145,045.00
DET. HQSVC BTRY	S/SERVICES	5	32	$1,094,652.00	0	1	$877,056.00	$1,971,708.00	$16,834.00	38	$1,011,166.00
FIRING BTRY		5	141	$3,816,491.00	0	1	$3,864,528.00	$7,681,019.00	$65,121.00	147	$7,133,879.00
				$0.00			$0.00	$0.00	$0.00	0	$0.00
MAG (FIXED WING)		304	2970	$92,135,134.00	17	48	$82,485,697.00	$174,620,831.00	$1,479,177.00	3339	$26,796,823.00
HQ MAG (V)	S/C3I	23	77	$3,282,435.00	5	5	$2,429,221.00	$5,711,656.00	$48,730.00	110	$342,270.00
MALS (FW)	S/SUPPLY	26	282	$8,578,838.00	1	3	$7,792,817.00	$16,371,655.00	$138,216.00	312	$623,784.00
MWSS (V)	S/SERVICES	28	674	$18,485,702.00	5	20	$18,791,797.00	$37,277,499.00	$322,061.00	727	$16,444,939.00
DET, 6 KC-130	S/SUPPLY	21	159	$5,211,825.00	0	1	$4,357,872.00	$9,569,697.00	$80,183.00	181	$380,817.00
SQDN 12 F/A-18 (2)		46	480	$14,705,416.00	2	6	$13,283,362.00	$27,988,778.00	$236,562.00	534	$1,121,438.00
SQDN (-) 14 AV-8B (2)		72	630	$19,988,082.00	2	6	$17,394,562.00	$37,382,644.00	$314,530.00	710	$1,437,470.00
VMA (AW) 10 A6E		32	273	$8,708,795.00	1	3	$7,546,145.00	$16,254,940.00	$136,887.00	309	$720,113.00
DET, EA6-B		39	235	$8,173,709.00	1	2	$6,504,641.00	$14,678,350.00	$122,711.00	277	$4,806,289.00
DET, VMFP-3	S/C3I	17	160	$5,000,332.00	0	2	$4,385,280.00	$9,385,612.00	$79,297.00	179	$919,703.00
				$0.00			$0.00	$0.00	$0.00	0	$0.00
MAG (ROTARY WING)		317	2300	$76,173,072.00	17	51	$64,122,337.00	$140,295,409.00	$1,189,455.00	2685	$20,832,545.00
MAG HQ	S/C3I	23	77	$3,282,435.00	5	5	$2,429,221.00	$5,711,656.00	$48,730.00	110	$328,270.00
MALS	S/SUPPLY	25	253	$7,795,563.00	1	3	$6,997,985.00	$14,793,548.00	$124,926.00	282	$1,637,074.00
MWSS (R)	S/SERVICES	27	589	$16,304,051.00	5	20	$16,462,117.00	$32,766,168.00	$283,963.00	641	$15,339,037.00
HMM SQDN 12 CH-46(4)	S/TRANS	128	692	$24,846,780.00	4	12	$19,221,380.00	$44,068,160.00	$370,348.00	836	$2,209,652.00
HMH SQDN 12 CH53A/D	S/TRANS	41	253	$8,741,419.00	1	3	$6,997,985.00	$15,739,404.00	$132,014.00	298	$650,986.00
HMH (-) DET, CH-53E 4A/C	S/TRANS	10	77	$2,513,927.00	0	4	$2,110,416.00	$4,624,343.00	$40,313.00	91	$175,687.00
HML SQDN 12 AH-1/12 UH-1		63	359	$12,688,897.00	1	4	$9,903,233.00	$22,592,130.00	$189,161.00	427	$491,839.00

NOTIONAL MEF RESOURCE C	(FY90 -$000)	USMC			USN			TOTAL PERS	INDIV MAINT	TOTAL PERS	
		OFF	ENL	AN. RATES	OFF	ENL	AN. RATES	COSTS	COSTS	0	T/E EQUIP
TYPE ORGANIZATION				$0.00			$0.00	$0.00	$0.00	0	COSTS
NOTIONAL MEF		3200	39788	$1,182,717,348.00	410	2103	$83,781,034.00	$1,266,498,382.00	$20,156,943.00	45501	$1,210,826,000.00
				$0.00			$0.00	$0.00	$0.00	0	$0.00
COMMAND ELEMENT	S/C3I	224	1880	$60,187,464.00	18	40	$2,244,018.00	$62,431,482.00	$957,766.00	2162	$85,433,234.00
HQ, MEF	S/C3I	60	86	$5,694,466.00	7	6	$610,775.00	$6,305,241.00	$70,437.00	159	$602,563.00
H&S CO (NUC) MEF	S/C3I	9	107	$3,203,941.00	2	7	$319,378.00	$3,523,319.00	$55,375.00	125	$2,595,625.00
SRI GROUP	S/C3I	118	1417	$42,359,595.00	6	26	$1,095,174.00	$43,454,769.00	$694,181.00	1567	$76,890,819.00
LONG LINES CO. COMM BN	S/C3I	9	199	$5,501,273.00	0	0	$0.00	$5,501,273.00	$92,144.00	208	$4,538,856.00
CIVIL AFFAIRS GRP	S/C3I	28	71	$3,428,189.00	3	1	$218,691.00	$3,646,880.00	$45,629.00	103	$805,371.00
				$0.00			$0.00	$0.00	$0.00	0	$0.00
GROUND COMBAT ELEMENT		1065	17221	$492,984,131.00	73	873	$28,581,737.00	$521,565,868.00	$8,519,776.00	19232	$603,607,224.00
HQBN, DIV	S/SERVICES	136	1098	$35,457,934.00	7	32	$1,323,383.00	$36,781,317.00	$563,939.00	1273	$38,182,061.00
INF REGT (3)		468	8637	$243,340,815.00	33	615	$18,960,033.00	$262,300,848.00	$4,320,579.00	9753	$101,663,421.00
ARTY REGT		257	3577	$104,514,079.00	22	76	$3,485,750.00	$107,999,829.00	$1,741,876.00	3932	$145,599,124.00
AAV BN		47	1097	$30,171,639.00	2	20	$675,682.00	$30,847,321.00	$516,538.00	1166	$105,450,462.00
LAI BN		38	786	$21,873,614.00	3	66	$2,000,211.00	$23,873,825.00	$395,599.00	893	$83,318,401.00
CBT ENGR BN	S/ENG	43	814	$22,868,382.00	2	15	$538,642.00	$23,407,024.00	$387,182.00	874	$19,739,818.00
RECON BN	S/C3I	32	391	$11,655,373.00	2	32	$1,004,578.00	$12,659,951.00	$202,451.00	457	$9,289,549.00
TANK BN		44	821	$23,102,295.00	2	17	$593,458.00	$23,695,753.00	$391,612.00	884	$100,364,388.00
				$0.00			$0.00	$0.00	$0.00	0	$0.00
AVIATION COMBAT ELEMENT		1471	12523	$399,671,469.00	83	215	$11,184,883.00	$410,856,352.00	$6,331,356.00	14292	$278,743,644.00
MAW CMD ELEMENT	S/C3I	108	357	$15,299,175.00	9	8	$793,113.00	$16,092,288.00	$213,526.00	482	$2,742,474.00
HQ MAW	S/C3I	94	249	$11,774,683.00	8	7	$701,944.00	$12,476,627.00	$158,594.00	358	$182,406.00
MAR WING HQSQDN	S/C3I	10	63	$2,164,333.00	1	1	$91,169.00	$2,255,502.00	$33,225.00	75	$2,393,775.00
MAR WING WPNS UNIT	S/SUPPLY	4	45	$1,360,159.00	0	0	$0.00	$1,360,159.00	$21,707.00	49	$166,293.00
				$0.00			$0.00	$0.00	$0.00	0	$0.00
MAR AIR CNTRL GRP	S/C3I	244	2580	$78,849,484.00	6	24	$1,040,358.00	$79,889,842.00	$1,264,322.00	2854	$190,053,678.00
MACG HQ	S/C3I	13	27	$1,442,725.00	4	3	$337,268.00	$1,779,993.00	$20,821.00	47	$7,754,179.00
MAR TAC AIR CMD SQDN	S/C3I	30	121	$4,794,971.00	0	2	$54,816.00	$4,849,787.00	$67,779.00	153	$70,221.00
MAR ATC SQDN	S/C3I	23	305	$8,975,823.00	0	2	$54,816.00	$9,030,639.00	$146,190.00	330	$1,613,810.00
MAR WING COMM SQDN	S/C3I	33	506	$14,586,154.00	0	0	$0.00	$14,586,154.00	$238,777.00	539	$18,305,223.00
MAR AIR CONT SQDN (2)	S/C3I	46	474	$14,555,590.00	0	6	$164,448.00	$14,720,038.00	$233,018.00	526	$77,418,982.00
MAR AIR SPT SQDN	S/C3I	44	223	$8,169,637.00	0	3	$82,224.00	$8,251,861.00	$119,610.00	270	$19,156,390.00
LAAD BN		24	353	$10,233,547.00	0	4	$109,632.00	$10,343,179.00	$168,783.00	381	$15,280,217.00
LAAM BN		31	571	$16,091,037.00	2	4	$237,154.00	$16,328,191.00	$269,344.00	608	$50,454,656.00
				$0.00			$0.00	$0.00	$0.00	0	$0.00
MAR WING SPT GRP	S/SERVICES	125	2585	$71,939,535.00	22	84	$3,705,014.00	$75,644,549.00	$1,247,488.00	2816	$63,944,512.00
H&H SQDN	S/SERVICES	15	59	$2,360,029.00	2	4	$237,154.00	$2,597,183.00	$35,440.00	80	$376,560.00
MAR WING SPT SQDN F/W (2)	S /	56	1348	$36,971,404.00	10	40	$1,733,930.00	$38,705,334.00	$644,122.00	1454	$32,889,876.00
MAR WING SPT SQDN R/W (2)	S /	54	1178	$32,608,102.00	10	40	$1,733,930.00	$34,342,032.00	$567,926.00	1282	$30,678,074.00
				$0.00			$0.00	$0.00	$0.00	0	$0.00
MAR AIR GRP (HELO)		543	3259	$113,480,477.00	23	51	$2,864,311.00	$116,344,788.00	$1,717,068.00	3876	$8,472,932.00
MAG HQ (2)	S/C3I	46	154	$6,564,870.00	10	10	$911,690.00	$7,476,560.00	$97,460.00	220	$656,540.00
MAR AVN LOG SQDN (2)	S/SUPPLY	50	506	$15,591,126.00	2	6	$291,970.00	$15,883,096.00	$249,852.00	564	$3,274,148.00
MAR OBS SQDN (VMO)	S/C3I	38	198	$7,190,666.00	1	3	$145,985.00	$7,336,651.00	$106,320.00	240	$632,680.00
HMLA SQDN (2)		126	718	$25,377,794.00	2	8	$346,786.00	$25,724,580.00	$378,322.00	854	$981,678.00
HMM SQDN (5)	S/TRANS	160	865	$31,058,475.00	5	15	$729,925.00	$31,788,400.00	$462,935.00	1045	$907,065.00
HMH SQDN (2)	S/TRANS	82	506	$17,482,838.00	2	6	$291,970.00	$17,774,808.00	$264,028.00	596	$1,303,972.00
HMH SQDN (1)	S/TRANS	41	312	$10,214,708.00	1	3	$145,985.00	$10,360,693.00	$158,151.00	357	$716,849.00

MAR AIR GRP (FIXED)		451	3742	$120,102,798.00	23	48	$2,782,087.00	$122,884,885.00	$1,888,952.00	4264	$13,530,048.00
MAG HQ (2)	S/C3I	46	154	$6,564,870.00	10	10	$911,690.00	$7,476,560.00	$97,460.00	220	$682,540.00
MAR AVN LOG SQDN (2)	S/SUPPLY	52	564	$17,157,676.00	2	6	$291,970.00	$17,449,646.00	$276,432.00	624	$1,249,568.00
SQDN VMFA 12 F/A 18 (4)		92	960	$29,410,832.00	4	12	$583,940.00	$29,994,772.00	$473,124.00	1068	$2,242,876.00
SQDN VMA 20 AV-8B (3)		108	945	$29,982,123.00	3	9	$437,955.00	$30,420,078.00	$471,795.00	1065	$2,156,205.00
SQDN VMA(AW) (2)		64	546	$17,417,590.00	2	6	$291,970.00	$17,709,560.00	$273,774.00	618	$1,438,226.00
SQDN VMGR	S/SUPPLY	49	333	$11,212,027.00	1	3	$145,985.00	$11,358,012.00	$170,998.00	386	$813,002.00
DET, VMAQ 6 EA6		40	240	$8,357,680.00	1	2	$118,577.00	$8,476,257.00	$125,369.00	283	$4,947,631.00
				$0.00			$0.00	$0.00	$0.00	0	$0.00
CBT SERV SPT ELEMENT		440	8164	$229,874,284.00	236	975	$41,770,396.00	$271,644,680.00	$4,348,045.00	9815	$222,884,955.00
H&S BN, FSSG	S/SERVICES	191	1485	$48,373,091.00	17	91	$3,578,065.00	$51,951,156.00	$790,312.00	1784	$21,282,688.00
ENGR SPT BN, FSSG	S/ENG	55	1538	$41,656,778.00	3	20	$739,443.00	$42,396,221.00	$715,888.00	1616	$59,397,112.00
MAINT BN, FSSG	S/MAINT	58	1762	$47,427,630.00	2	2	$182,338.00	$47,609,968.00	$808,032.00	1824	$38,903,968.00
SUPPLY BN, FSSG	S/SUPPLY	58	1292	$35,691,260.00	6	80	$2,575,206.00	$38,266,466.00	$636,148.00	1436	$14,537,852.00
MED BN, FSSG	S/HEALTH	6	233	$6,172,939.00	132	628	$25,628,676.00	$31,801,615.00	$442,557.00	999	$15,861,443.00
DENTAL BN, FSSG	S/HESLTH	0	5	$124,855.00	75	153	$8,975,499.00	$9,100,354.00	$103,219.00	233	$1,984,781.00
MT BN, FSSG	S/TRANS	30	915	$24,621,945.00	0	0	$0.00	$24,621,945.00	$418,635.00	945	$52,123,365.00
LSB, FSSG	S/ENG	42	934	$25,805,786.00	1	1	$91,169.00	$25,896,955.00	$433,254.00	978	$18,793,746.00

APPENDIX C. CAPITAL STOCK VALUES

	UNIT COST	MEU	MEB	MEF
Tanks M60A1	$1.5	$6.0	$21	$65
AAV	$.969	$12	$46	$202
LAV	$.762	$6.0	$21	$84
155 HOW	$.553	$2.2	$20	$53
105 HOW	$.021	$.084	--	--
81mm Mortar	$.013	$.110	$.33	$1.0
60mmMortar	$.011	$.139	$.42	$1.3
Mk-19 MG	$.009	$.234	$1.0	$5.4
TOW Msl Lr	$.115	$.920	$5.5	$16.6
DRAGON Lr	$.014	$.340	$1.0	$3.1
HAWK Msl Lr	$.517	$0	$4.14	$8.28
STINGER Msl Lr	$.027	$.135	$1.22	$2.4
.50Cal MG	$.015	$.304	$2.1	$6.6
M60 MG	$.003	$.167	$.688	$2.00
AV-8B	$25.2	$353	$1,562	$2,293
F/A-18	$36.9	$0	$1,956	$3,727
A-6E	$44.9	$0	$763	$763
EA-6B	$39.6	$0	$317	$317
CH-53	$22.6	$316	$1,062	$1,559
AH-1W	$9.8	$88	$196.0	$363
CH-46E	$17.0	$391	$1,156	$1,411
UH-1N	$9.8	$167	$265	$412
TOTAL		$1,343.633	$7,401.398	$11,295.68

MAGTF Weapons Systems Capital Stock Value

Costs estimated from The Revised Fiscal Requirements Model. (CRM 93-158). (Alexandria, VA. Center for Naval Analysis, August 1993), Table 2. and Marine Corps Cost Factors Manual (MCO P7000.14), Washington, D.C., HQMC, 14 June 1991 Table 4B1. Costs in millions of FY 91 dollars.

MEU TYPE	REQ.	TRNG	PIPELINE	INV.	ADJ INV	UC	TC W/SUPT AC	TC Of AC on T/E
AV-8B	6	0.2	0.1	8.33	9	$25.20	$226.80	$151.20
F/A-18	0	0	0	0.00	0	$36.90	$0.00	$0.00
A-6E	0	0	0	0.00	0	$44.90	$0.00	$0.00
EA-6B	0	0	0	0.00	0	$39.60	$0.00	$0.00
CH-53	4	0.15	0.1	5.23	6	$22.60	$135.60	$90.40
AH-1W	4	0.16	0.1	5.29	6	$9.80	$58.80	$39.20
CH-46E	12	0.11	0.1	14.98	15	$17.00	$255.00	$204.00
UH-1N	4	0.12	0.1	5.05	6	$9.80	$58.80	$39.20
MEB TYPE								
AV-8B	40	0.2	0.1	55.56	56	$25.20	$1,411.20	$1,008.00
F/A-18	36	0.16	0.1	47.62	48	$36.90	$1,771.20	$1,328.40
A-6E	10	0.2	0.1	13.89	14	$44.90	$628.60	$449.00
EA-6B	6	0.05	0.1	7.02	8	$39.60	$316.80	$237.60
CH-53	28	0.15	0.1	36.60	37	$22.60	$836.20	$632.80
AH-1W	12	0.16	0.1	15.87	16	$9.80	$156.80	$117.60
CH-46E	48	0.11	0.1	59.93	60	$17.00	$1,020.00	$816.00
UH-1N	12	0.12	0.1	15.15	16	$9.80	$156.80	$117.60
MEF TYPE								
AV-8B	60	0.2	0.1	83.33	84	$25.20	$2,116.80	$1,512.00
F/A-18	72	0.16	0.1	95.24	96	$36.90	$3,542.40	$2,656.80
A-6E	10	0.2	0.1	13.89	14	$44.90	$628.60	$449.00
EA-6B	6	0.05	0.1	7.02	8	$39.60	$316.80	$237.60
CH-53	44	0.15	0.1	57.52	58	$22.60	$1,310.80	$994.40
AH-1W	24	0.16	0.1	31.75	32	$9.80	$313.60	$235.20
CH-46E	60	0.11	0.1	74.91	75	$17.00	$1,275.00	$1,020.00
UH-1N	24	0.12	0.1	30.30	31	$9.80	$303.80	$235.20

Table 3.8 Capital Stock Value Of Aircraft

The formula used to determine aircraft requirements is:
Requirements = number of aircraft+training requirements+maintenance requirements based on .90 Opperational Availability (Ao).
Ex: For MEU AV-8B 1.00/(1.00-.20)=1.25, 1.25/(1.00-.10)=1.39, 1.39X6=8.34, 9.0+5=14.00

Costs estimated from "The Revised Fiscal Requirements Model. (CRM 93-158)." (Alexandria, VA., Center for Naval Analyses, August 1993), Table 2. Factors obtained from "Naval Combat Aircraft: Issues and Options." Congress of the United States, Congressional Budget Office, November 1987, p. 38. All costs in thousands of FY 91 dollars.

NOTIONAL MAGTF CAPITAL STOCK VALUE	UNIT COST	qty	MEU	qty	MEB	qty	MEF
TANKS M60A1	$1,468,441.00	4	$5,873,764.00	14	$20,558,174.00	44	$64,611,404.00
AAV	$969,140.00	10	$9,691,400.00	38	$36,827,320.00	167	$161,846,380.00
LAV	$762,154.00	6	$4,572,924.00	22	$16,767,388.00	88	$67,069,552.00
155HOW	$553,714.00	6	$3,322,284.00	18	$9,966,852.00	56	$31,007,984.00
105 HOW	$21,000.00	4	$84,000.00	0	$0.00	0	$0.00
81mmMortar	$13,753.00	6	$82,518.00	18	$247,554.00	56	$770,168.00
60mmMortar	$11,602.00	9	$104,418.00	27	$313,254.00	86	$997,772.00
MK19 MG	$9,006.00	20	$180,120.00	90	$810,540.00	480	$4,322,880.00
TOW	$11,970,861.00	6	$71,825,166.00	38	$454,892,718.00	115	$1,376,649,015.00
DRAGON	$14,194.00	18	$255,492.00	56	$794,864.00	172	$2,441,368.00
.50cal MG	$15,243.00	16	$243,888.00	110	$1,676,730.00	348	$5,304,564.00
M60 MG	$3,342.00	40	$133,680.00	164	$548,088.00	480	$1,604,160.00
HAWK Lr	$517,000.00	0	$0.00	8	$4,136,000.00	16	$8,272,000.00
STINGER	$27,000.00	5	$135,000.00	45	$1,215,000.00	90	$2,430,000.00
AV-8B	$25,200,000.00	14	$352,800,000.00	62	$1,562,400,000.00	91	$2,293,200,000.00
F/A-18A/D	$36,900,000.00	0	$0.00	53	$1,955,700,000.00	101	$3,726,900,000.00
A-6E	$44,900,000.00	0	$0.00	17	$763,300,000.00	17	$763,300,000.00
EA-6B	$39,600,000.00	0	$0.00	8	$316,800,000.00	8	$316,800,000.00
CH-53E	$22,600,000.00	14	$316,400,000.00	47	$1,062,200,000.00	69	$1,559,400,000.00
AH-1W	$9,800,000.00	9	$88,200,000.00	20	$196,000,000.00	37	$362,600,000.00
CH-46E	$17,000,000.00	23	$391,000,000.00	68	$1,156,000,000.00	83	$1,411,000,000.00
UH-1N	$9,800,000.00	17	$166,600,000.00	27	$264,600,000.00	42	$411,600,000.00
TOTAL Wpns			$96,504,654.00		$548,754,482.00		$1,727,327,247.00
TOTAL A/C			$1,315,000,000.00		$7,277,000,000.00		$10,844,800,000.00
TOTAL			$1,411,504,654.00		$7,825,754,482.00		$12,572,127,247.00

MAGTF-2015 CAPITAL STOCK VALUE	UNIT COST	qty	MEU	qty	MEB	qty	MEF
TANKS M1(a)	$2,643,193.80	3.2	$8,458,220.16	11.2	$29,603,770.56	35.2	$93,040,421.76
AAAV(b)	$1,938,280.00	8	$15,506,240.00	30.4	$58,923,712.00	134	$258,954,208.00
LAV(a)	$1,143,231.00	4.8	$5,487,508.80	17.6	$20,120,865.60	70.4	$80,483,462.40
LW 155HOW(b)	$1,107,428.00	4.8	$5,315,654.40	14.4	$15,946,963.20	44.8	$49,612,774.40
81mmMortar(a)	$20,629.50	4.8	$99,021.60	14.4	$297,064.80	44.8	$924,201.60
60mmMortar(a)	$17,403.00	7.2	$125,301.60	21.6	$375,904.80	68.8	$1,197,326.40
MK19 MG(a)	$13,509.00	16	$216,144.00	72	$972,648.00	384	$5,187,456.00
TOW(a)	$172,500.00	4.8	$828,000.00	30.4	$5,244,000.00	92	$15,870,000.00
DRAGON(a)	$21,291.00	14.4	$306,590.40	44.8	$953,836.80	138	$2,929,641.60
.50cal MG(a)	$22,864.50	12.8	$292,665.60	88	$2,012,076.00	278	$6,365,476.80
M60 MG(a)	$5,013.00	32	$160,416.00	131	$657,705.60	384	$1,924,992.00
HAWK Lr(a)	$775,500.00	0	$0.00	6.4	$4,963,200.00	12.8	$9,926,400.00
STINGER(a)	$40,500.00	4	$162,000.00	36	$1,458,000.00	72	$2,916,000.00
AV-8C(c)	$37,800,000.00	15	$567,000,000.00	66	$2,494,800,000.00	97	$3,666,600,000.00
F/A-18(e)	$36,900,000.00	0	$0.00	53	$1,955,700,000.00	101	$3,726,900,000.00
A-6F(e)	$44,900,000.00	0	$0.00	17	$763,300,000.00	17	$763,300,000.00
EA-6C(e)	$39,600,000.00	0	$0.00	8	$316,800,000.00	8	$316,800,000.00
CH-53F(c)	$22,600,000.00	15	$339,000,000.00	49	$1,107,400,000.00	74	$1,672,400,000.00
AH-1X(c)	$9,800,000.00	10	$98,000,000.00	21	$205,800,000.00	39	$382,200,000.00
CH-46F(c)	$17,000,000.00	24	$408,000,000.00	73	$1,241,000,000.00	89	$1,513,000,000.00
UH-1M(c)	$9,800,000.00	18	$176,400,000.00	28	$274,400,000.00	45	$441,000,000.00
TOTAL Wpns			$36,957,762.56		$141,529,747.36		$529,332,360.96
TOTAL A/C			$1,588,400,000.00		$8,359,200,000.00		$12,482,200,000.00
TOTAL			$1,625,357,762.56		$8,500,729,747.36		$13,011,532,360.96

Note:
(a) current qty x .8 x 1.5(cost)
(b) current qty x .8 x 2(cost)
(c) current qty x 1.08 x 1.5(cost)
(d) current qty x 1.08 x 2(cost)
(e) current qty x 1.5(cost)

APPENDIX D. AMPHIBIOUS SHIP PROJECTIONS

SHIP CLASS	TROOPS	VEHKSQFT	CARGOKCUFT	AIR SPOTS	LCAC SPOTS
LPH	1654	4.8	54	27	0
LHA	1903	28.7	141.2	43	1
LHD	2102	25.5	166.6	46	3
LPD-4	876	14	51.1	4	1
LPD-17	700	25	25	4	1
LSD-36	336	8.8	1.8	0	3
LSD-36M	336	19.7	1.8	0	2
LSD-41	504	14.6	6.8	0	4
LSD-49	504	20.2	67.6	0	2
LST	386	17.5	4.5	0	0
LKA	231	47	88.1	0	0

Ship Class	91	93	95	97	99	01	03	05	07	09	11	13	15
LPH	7	5	2	1	0	0	0	0	0	0	0	0	0
LHA	5	5	5	5	5	5	5	5	5	5	5	5	5
LHD	2	3	4	5	6	6	6	6	7	7	7	7	7
LPD-4	11	11	11	11	11	11	11	6	2	0	0	0	0
LPD-17	0	0	0	0	0	0	0	5	9	12	12	12	12
LSD-36	2	2	2	2	2	2	2	2	0	0	0	0	0
LSD-36M	3	3	3	3	3	3	3	2	1	0	0	0	0
LSD-41	8	8	8	8	8	8	8	8	8	8	8	8	8
LSD-49	0	0	2	3	4	4	4	4	4	4	4	4	4
LST	18	15	0	0	0	0	0	0	0	0	0	0	0
LKA	4	3	0	0	0	0	0	0	0	0	0	0	0
TOTAL	60	55	37	38	39	39	39	38	36	36	36	36	36

Note: Information for Appendix D taken from "Integrated Amphibious Operations & U.S. Marine Corps Air Requirements Study", Washington, D.C., Department of the Navy, 26 September 1993. and "Weak Link In Lift?", Navy Times, 20 June 1994, and author's estimate.

LIFT	91	93	95	97	99	01	03	05	07	09	11	13	15
TROOPS	48517	45922	37587	38539	39491	39491	39491	38275	38665	38677	38677	38677	38677
VEHSQFT	1078.6	995	643	683.9	724.8	724.8	724.8	760.1	792.3	819.6	819.6	819.6	819.6
CARGO	2476.1	2433.1	2241.1	2421.3	2601.5	2601.5	2601.5	2469.2	2526	2497	2497	2497	2497
AIR SPOTS	540	532	497	516	535	535	535	535	581	585	585	585	585
LCACS	66	69	76	81	86	86	86	84	79	78	78	78	78

LIFT	91	93	95	97	99	01	03	05	07	09	11	13	15
TROOPS	1	0.95	0.77	0.79	0.81	0.81	0.81	0.79	0.80	0.80	0.80	0.80	0.80
VEHSQFT	1	0.92	0.60	0.63	0.67	0.67	0.67	0.70	0.73	0.76	0.76	0.76	0.76
CARGO	1	0.98	0.91	0.98	1.05	1.05	1.05	1.00	1.02	1.01	1.01	1.01	1.01
AIR SPOTS	1	0.99	0.92	0.96	0.99	0.99	0.99	0.99	1.08	1.08	1.08	1.08	1.08
LCACS	1	1.05	1.15	1.23	1.30	1.30	1.30	1.27	1.20	1.18	1.18	1.18	1.18

APPENDIX E. O&M COST CALCULATIONS

TYPE	$ FLT HR	ANN FLT HR	REWORK	ANN COST	OP RATIO	TEMPO	O&M/AC
AV-8B	$1,862.70	282.3	$1,039,500.00	$1,565,340.21	0.891	1	$1,363,197.50
F/A-18	$1,768.10	391.5	$657,740.00	$1,349,951.15	0.87	1	$1,147,914.76
A-6E	$2,452.30	291.5	$842,700.00	$1,557,545.45	0.781	1	$1,188,951.38
EA-6B	$2,097.60	951.6	$840,410.00	$2,836,486.16	0.835	1	$2,314,938.61
CH-53	$1,949.40	294.6	$411,700.00	$985,993.24	0.877	1	$845,173.49
AH-1W	$529.40	219.6	$457,870.00	$574,126.24	0.9	1	$505,035.89
CH-46E	$13,350.90	284.4	$437,800.00	$4,234,795.96	0.912	1	$3,774,849.69
UH-1N	$529.30	219.6	$457,870.00	$574,104.28	0.9	1	$505,016.57

Notional MAGTF	TYPE	O&M $ MEU	O&M $ MEB	O&M $ MEF
	AV-8B	$12,268,777.48	$76,339,059.86	$114,508,589.78
	F/A-18	$0.00	$55,099,908.53	$110,199,817.05
	A-6E	$0.00	$16,645,319.39	$16,645,319.39
	EA-6B	$0.00	$18,519,508.91	$18,519,508.91
	CH-53	$5,071,040.93	$31,271,419.07	$49,020,062.32
	AH-1W	$3,030,215.33	$8,080,574.21	$16,161,148.42
	CH-46E	$56,622,745.34	$226,490,981.34	$283,113,726.68
	UH-1N	$3,030,099.43	$8,080,265.14	$15,655,513.70
	TOTAL	$80,022,878.50	$440,527,036.43	$623,823,686.25

MAGTF 2015	TYPE	O&M $ MEU	O&M $ MEB	O&M $ MEF
	AV-8C	$0.00	$0.00	$0.00
	F/A-18C	$0.00	$0.00	$0.00
	A-6F	$0.00	$0.00	$0.00
	EA-6C	$0.00	$0.00	$0.00
	CH-53F	$0.00	$0.00	$0.00
	AH-1X	$0.00	$0.00	$0.00
	CH-46F	$0.00	$0.00	$0.00
	UH-1M	$0.00	$0.00	$0.00
	TOTAL	$0.00	$0.00	$0.00

SHIP TYPE	UNIT O&M Cost	MEU	MEB	MEF
LP	$25.3	$25.3	$126.5	$354.2
LPD	$12.1	$12.1	$48.4	$133.1
LSD	$9.9	$9.9	$49.5	$128.7
LST	$6.9	$6.9	$48.3	$124.2
LCAC	$.33	$1.98	$7.92	$25.7
TOTAL		$56.18	$280.62	$765.9

O&S Costs For Amphibious Ship Mix

Costs estimated from The Revised Fiscal Requirements Model, (CRM 93-158).(Alexandria, VA. Center For Naval Analysis, August 1993), Costs in millions of FY 91 dollars.

	UNIT COST			Steam Hrs	$ per steam	Steam hrs	$/steam hr		
SHIP CLASS	millions $	OFF	ENL	Underway	hr Underway	not underway	not underway	Depot Cost	O&M Cost
LPH	396	49	593	2225	2.845	1451	0.615	8021	19393036
LHA	990	58	818	2237	5.308	1485	1.199	13869	26145111
LHD	1160	65	956	1325	3.918	1388	0.568	13869	30366962
LPD-4	299	28	377	2153	1.063	1697	0.567	5609	12127719
LPD-17	360	28	377	2153	1.063	1697	0.567	5609	12127719
LSD-36	245	21	314	2039	2.106	1700	0.493	4053	9955140.6
LSD-36M	265	21	314	2039	2.106	1700	0.493	4053	9955140.6
LSD-41	245	23	311	2039	2.106	1700	0.493	4053	10000439
LSD-49	245	33	370	2039	2.106	1700	0.493	4053	12255121
LST	103	16	217	2214	1.407	1237	0.197	4172	6976236.3

Note: Information taken from The Revised Fiscal Requirements Model, Appendix B, p. 50. O&MN=(Ship Inventory)x(Steaming Hrs UnderwayxOpTempo factorxO&MN Cost Per Steaming Hr Underway+Steaming Hrs Not UnderwayxFuel Cost Per Steaming Hr Not Underway+Depot Level Maintenance Costs)

APPENDIX F. DENSITY ANALYSIS

The change in weapons and transportation densities displayed in Figure 3.5 was not expected. Instead of a roughly linear relationship, a pronounced "V" marks the transition from the small, MEU-size MAGTF capability to that of a full-fledged MEF. This unexpected finding deserves furter comment.

The density distribution can be analyzed by looking at the changes in force structure and the quantities of major weapons associated with each MAGTF. Figure F.1 shows the force structure for each MAGTF broken down intoits four basic elements; CE, GCE, ACE, and CSSE. For the MEU, the GCE constitutes the major portion of total personnel strength, followed by the ACE, then CSSE, and finally the CE. The relatively large GCE and small CSSE indicate a high readiness and lower sustainment capability.

The MEB structure reveals personnel increases in all four elements. However, it is interesting to note that the ACE surpasses the GCE as the largest component of the MEB. The large increase in the ACE can be explained by the inclusion of fixed wing tactical aircraft to the MEB T/E. This is not present in the MEU. Adding to the increased size of the ACE are the additional aircraft support and maintenance personnel required to support the additional tactical aircraft. It is important to note that for this analysis all units organic to the GCE are classified as "tooth;" this is not true for the ACE. That is to say, that increases in GCE personnel strengths directly add to the "tooth" but increases to the ACE may add to either the "tooth" or the "tail", depending on the functions they perform i.e., combat or support. (See Appendix B for the detailed assignment of ACE units to combat or support functions.) While Figure F.1 shows that in the case of the MEB the ACE comprises the largest percentage of personnel, it must be understood that the ACE structure is actually divided into combat and support functions. When Appendix B is examined in detail, it can be seen that the increases in the ACE actually represent an increase in both combat functions (tactical aircraft) and combat support functions (C3I, Supply, Maint, etc.) The force structure for the MEB ACE contributes to a tooth-to-tail ratio which reflects increases in sustainment over readiness.

The MEF breakdown shows that the personnel strengths have shifted so that the GCE is again the largest element , followed by the ACE, the CSSE, and finally the CE. In moving from the MEB to the MEF on sees an increasingly larger portion of the ACE dedicated to support of tactical aircraft. Units assigned to these support functions in effect contribute to increased readiness and account for the shift in the tooth-to-tail ratios described in Chapter III.

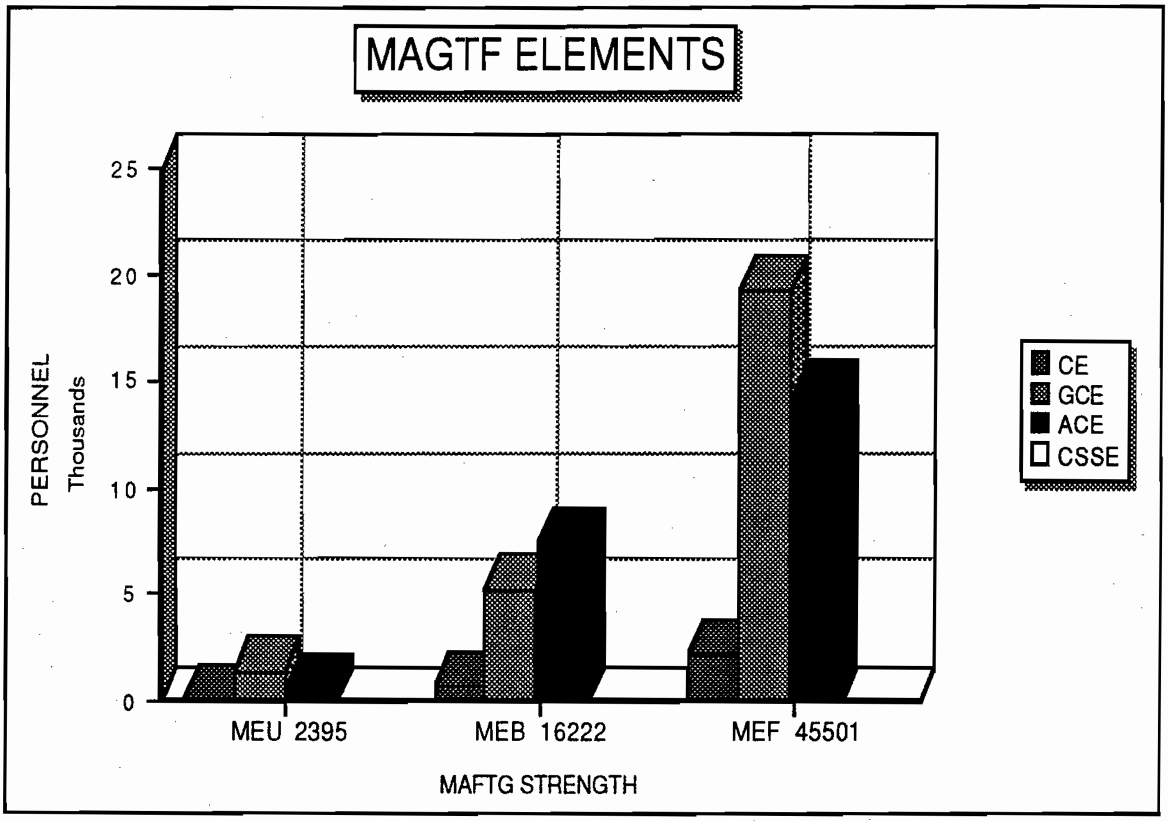

Figure F.1 Personnel Breakdown By MAGTF Element

As discussed in Chapter III, the size of the CSSE grows as the size of the MAGTF increases. Changes to CSSE structure play an important role in establishing a support capability that directly contributes to the level of readiness enjoyed by each MAGTF. Figure F.2 shows the changes that occur in each functional support area within the CSSE as the MAGTF size changes.

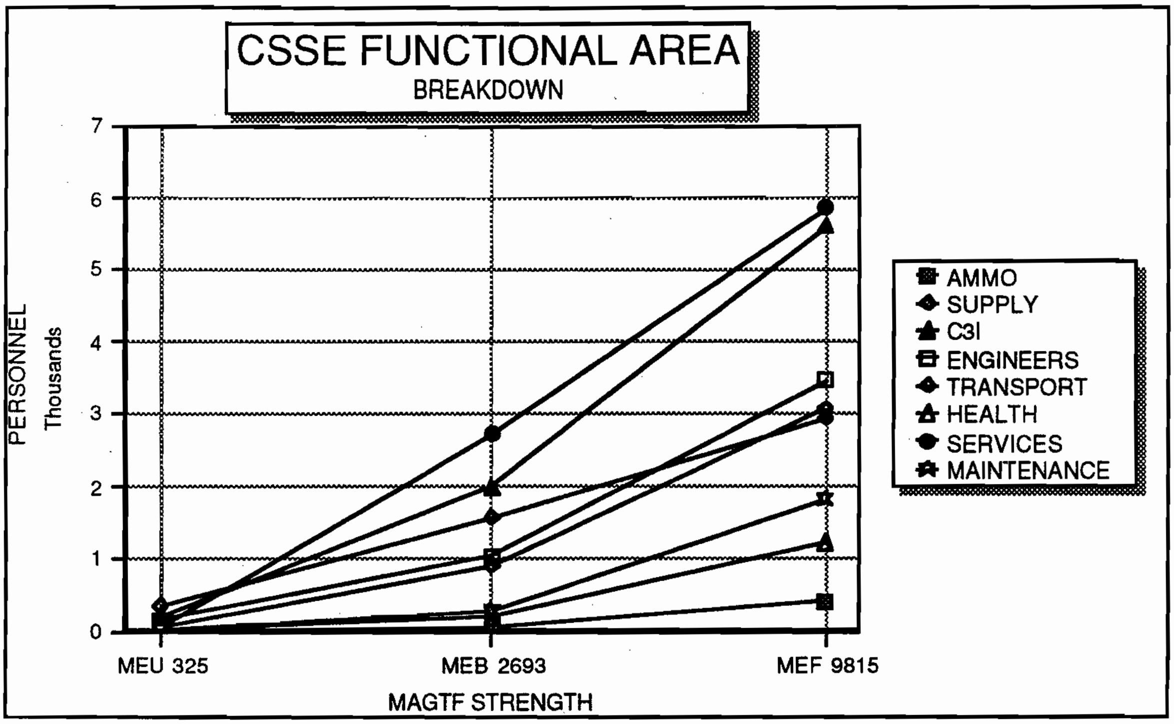

Figure F.2 MAGTF CSSE Functional Area Plot (Not to scale)

The plot shows that services and transportation exhibit linear growth, while the remaining functional areas show large increases when moving from the MEB to MEF size MAGTF. These large growths appear to contribute to the shift in the MEF's readiness and sustainment as evidenced in its tooth-to-tail ratio of .90:1.

The number and types of weapons possessed by the MAGTF play an important role in the determination of the densities. The representative major weapons systems for the notional MAGTF used in this analysis were developed from tables contained in "Marine Air-Ground Task Force: A Global Capability (FMFRP 2-12)." The types of weapons used in this analysis are not meant to be all inclusive of the weapons held in the MAGTF arsenal, but serve as a representative measure and basis for making comparisons. A drawback to this method is that very different weapons (e.g., tanks, and machineguns) are "homogenized." In calculating densities the number of major weapons possessed by each MAGTF are divided by certain troop strengths as explained in Chapter III. In examining the quantities of major weapons possessed by MAGTFs the analysis again shows the non-linearity between MAGTFs. Figure F.3 graphically show the changes in the numbers of weapons possessed by each MAGTF.

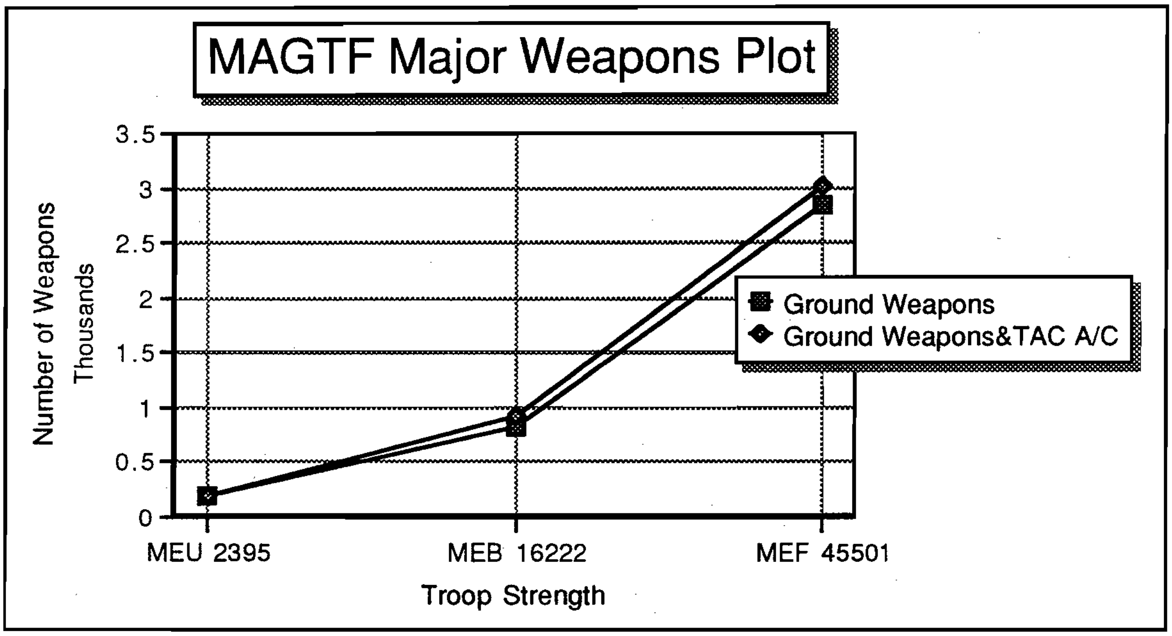

Figure F.3 MAGTF Major Weapons Plot (Not to scale)

Figure F.3 shows the sharp growth in weapons inventories when the MAGTF expands from a MEU to a MEF. Figure F.3 shows two plots of MAGTF weapons quantities. The first plot shows the changes in ground weapons (no tactical aircraft included) and the second plot shows the changes in total weapons (ground weapons and tactical aircraft). Both plots follow the same general trends.

At this point it is interesting to examine the issue of non-linearity in MAGTF structure again. As discussed in Chapter III, MAGTF force structure is not linear, 3 MEUs can not make a MEB and 3 MEBs can not make a MEF. This point can be emphasized by taking the quantities of weapons and personnel in a MEU, and multiplying that quantity by 3 to arrive at the quantity of weapons and personnel for the MEB. This same exercise can be done using the MEB to extrapolate a MEF. The results of this "linear extrapolation" exercise are displayed in Figure F.4. It is interesting to see that MAGTFs structured in this fashion would be much smaller than the notional MAGTFs, again pointing out the non-linearity in MAGTF force structure.

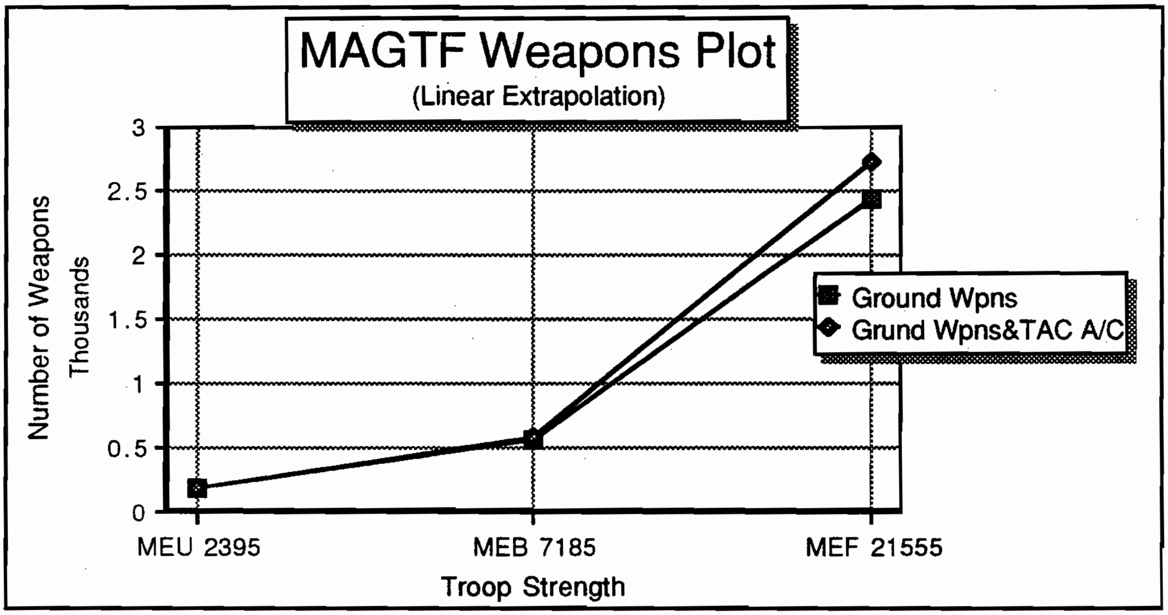

Figure F.4 MAGTF Weapons Plot (Linear Extrapolation, Not to scale)

Note: Results were obtained by multiplying weapons and personnel quantities possessed by the MEU by 3 for MEB estimates. MEF estimates were obtained by multiplying weapons and personnel quantities possessed by the MEB by 3.

Figure F.4 shows that the MAGTFs created by this "linear extrapolation" method follow the same pattern as those shown in Figure F.3 but possess a smaller increase in total quantities of weapons and personnel. Again, these results show that the notional baseline MAGTFs enjoy an increase in readiness over that of sustainment as the size of the MAGTF increases. To understand the impact that individual weapons systems can have on the MAGTF densities each aircraft has been plotted in Figure F.5, and each ground weapons system has been plotted in figure F.6.

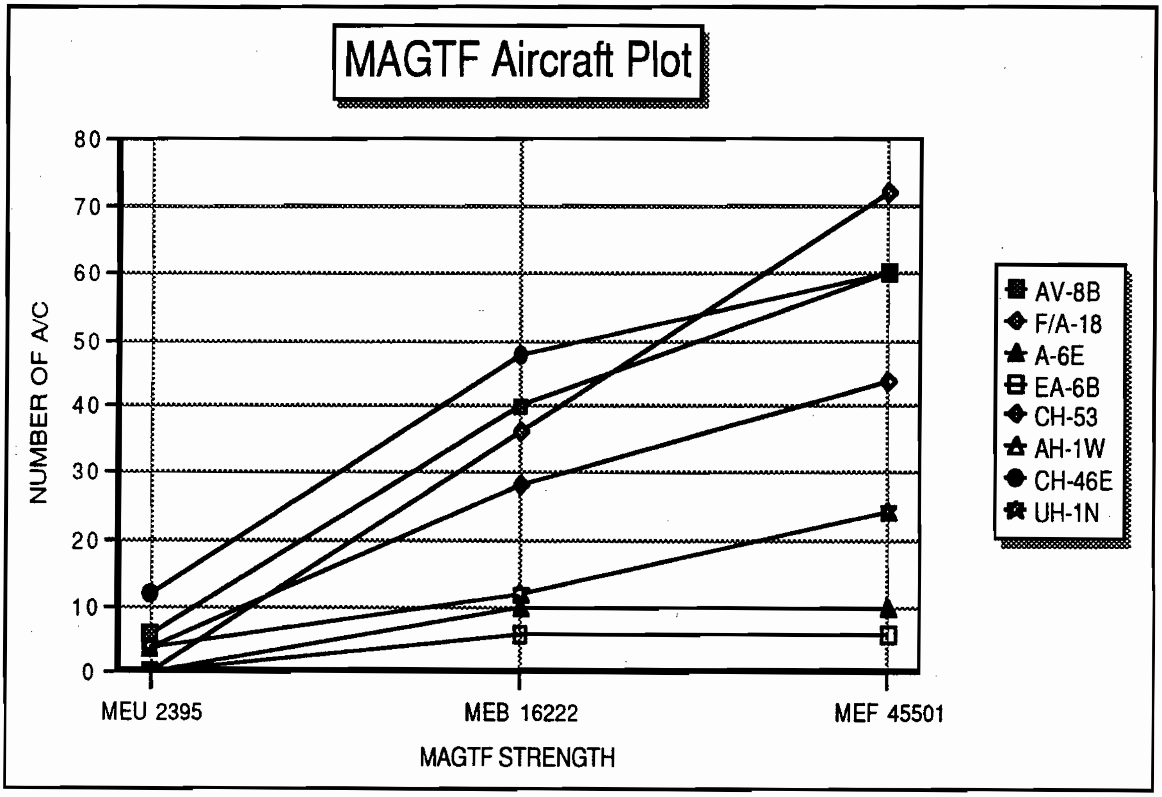

Figure F.5 MAGTF Aircraft Plot (Not to scale)

Figure F.5 shows the changes in quantities of aircraft possessed by MAGTFs. It is interesting to observe that several type aircraft follow a linear increase (AH-1W, UH-1N, F/A-18) while others do not. Figure F.6 shows the individual plots of ground weapons possessed by each MAGTF.

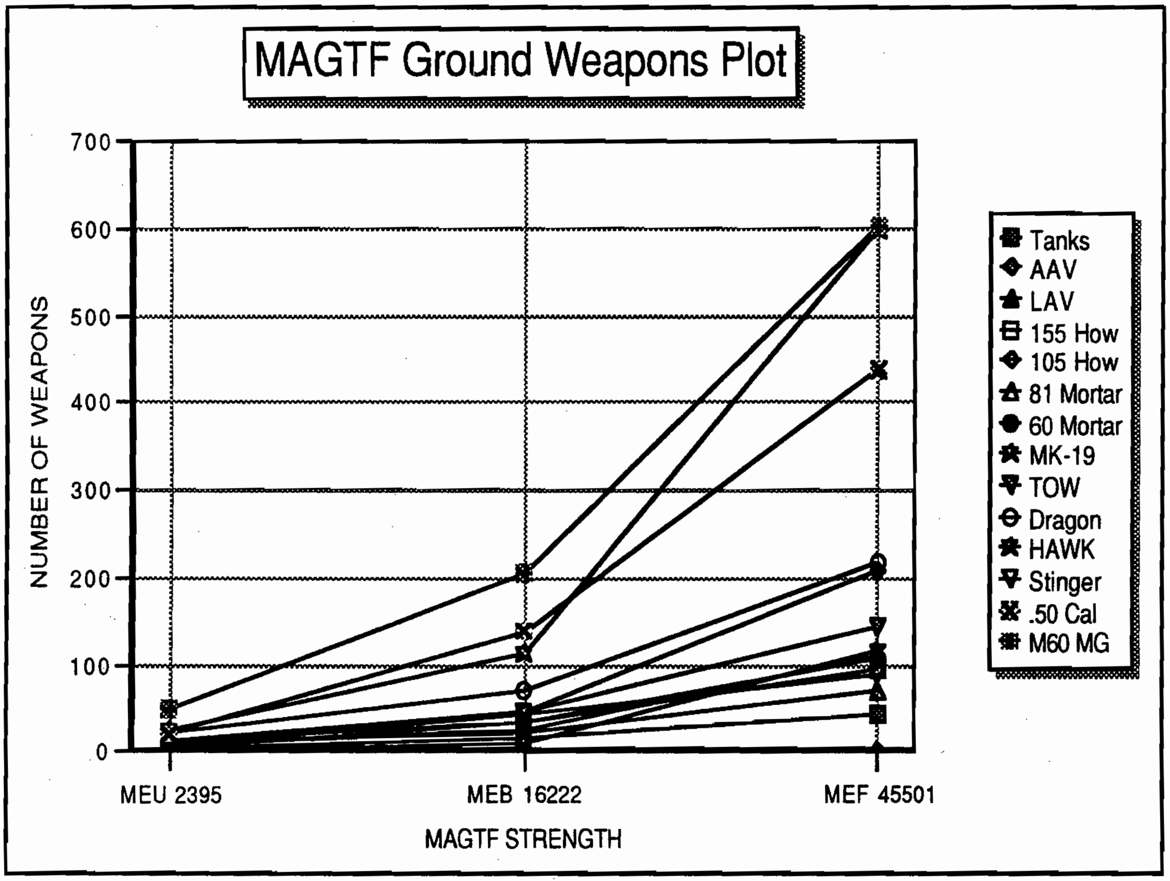

Figure F.6 MAGTF Ground Weapons Plot (Not to scale)

Figure F.6 shows the changes in quantities of ground weapons possessed by each MAGTF. It is interesting to note that the M-60, MK-19 and .50 Cal machineguns show changes that do not follow the pattern of the rest of the weapons. One reason for the disparity in machinegun changes is that many CSS units possess all three machine guns as a means of providing organic self defense, while the remaining weapons systems are possessed by combat units only. So, increases in support units also effects the increases of machine guns which in turn effects the aggregate weapons density. Figure F.7 shows the weapons plot for MAGTF weapons with the number of machine guns included in total weapons numbers and again with the machineguns removed. The results of this plot show that the large numbers of machineguns possessed by the MEB and the MEF could account for density changes increasing as displayed in Figure 3.5.

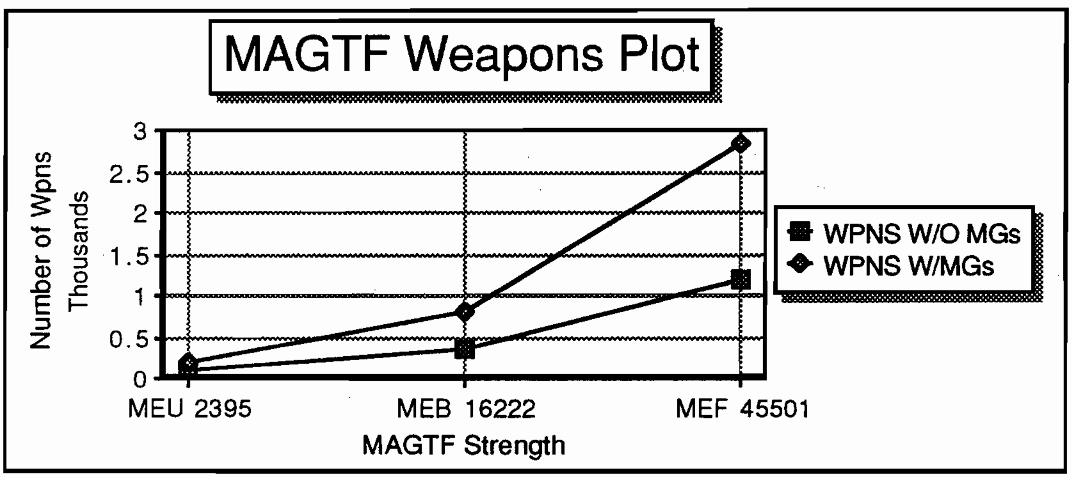

Figure F.7 MAGTF Weapons Plot (Not to scale)

Figure F.8, on the following page, shows the plot of MAGTF weapons densities when machineguns are included in the total weapons and when they are not. The plot shows that the number of machineguns does have a significant effect on the overall weapons density.

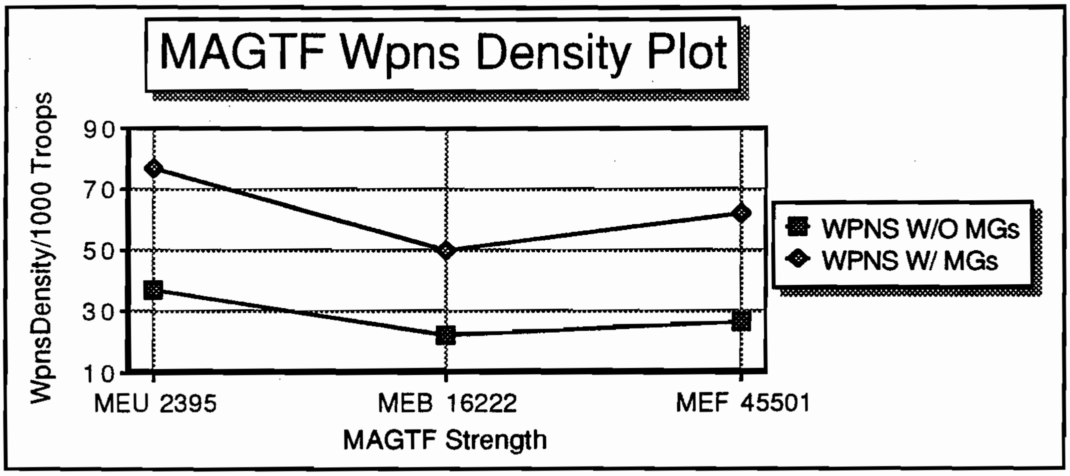

Figure F.8 MAGTF Weapons Density Plot (Not to scale)

To gain an understanding of the magnitude of capital investment involved in achieving and maintaining a MAGTF capability the capital stock value and capital services value of all MAGTF ground weapons (less aircraft) have been plotted in Figure F.9, on the following page. The plot shows increase in capital stock value and capital services value that occurs in moving from a small to a medium and to a large MAGTF capability.

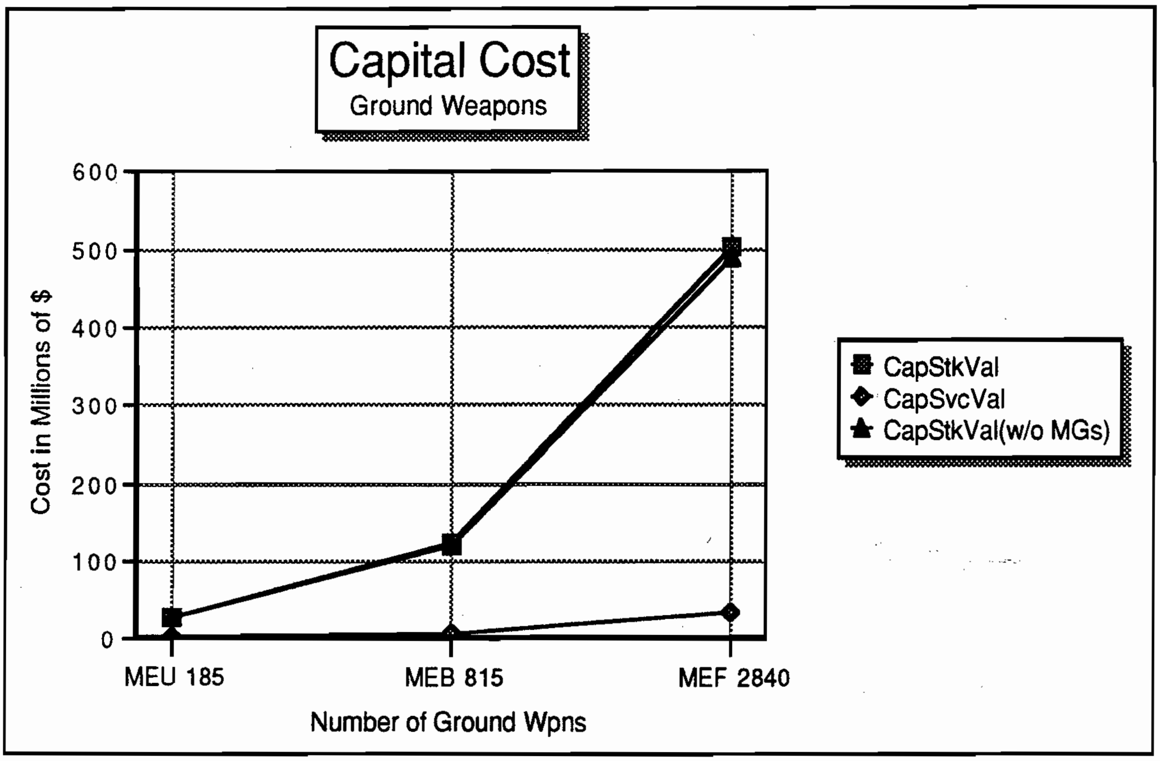

Figure F.9 MAGTF Capital Cost For Ground Weapons (Not to scale)

While the number of machineguns has an impact on the MAGTF weapons density the capital stock value and resulting capital services value do not have that much of an effect on investment cost associated with achieving and maintaining a MAGTF capability. Figure F.10, on the following page, shows the plot of capital stock value and capital services value for MAGTF aircraft.

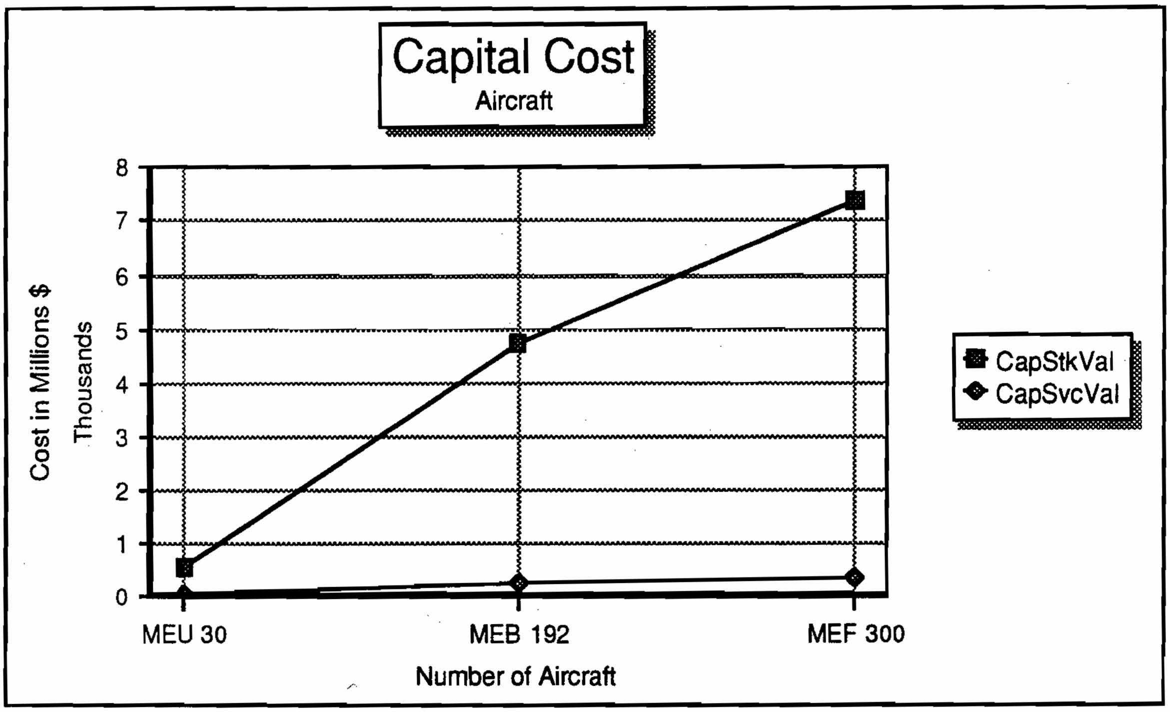

Figure F.10 MAGTF Capital Cost For Aircraft (Not to scale)

The plot shows a steeply increasing curve reflecting the significant increase in aircraft assets that occurs in moving to larger MAGTFs. The capital services value plot reflects a much shallower increase, due to the 20 year service life of all aircraft, compared to a 15 year service life for vehicles and weapons.

GLOSSARY

A-6	Navy/Marine Attack Jet
AAV	Marine Amphibian Assault Vehicle, amphibious light armored personnel carrier currently in service.
AAAV	Marine Advanced Amphibian Assault Vehicle, development program designed to replace the AAV.
ACE	Aviation Combat Element, aviation component of a MAGTF.
AE	Assault Echelon
AFOE	Assault Follow-on Echelon
AH-1	Marine Attack Helicopter
APN	Aircraft Procurement, Navy
AV-8B	Marine VSTOL Attack Aircraft
BA	Budget Authority
BUR	The "Bottom Up Review"-DoD document
C3I	Command, Control, Communications and Intelligence
CBO	Congressional Budget Office
CE	Command Element, provides command and control for a MAGTF
CH-46	Navy and Marine Medium Lift Transport Helicopter
CH-53	Marine Heavy Lift Helicopter
CSSE	Combat Service Support Element, provides logistical sustainment functions to a MAGTF.

DoD	Department of Defense
DRAGON	Man Portable Wire Guided Missile
EA-6B	Navy and Marine Electronic Warfare Aircraft
F/A-18	Navy and Marine Fighter and Attack Aircraft
FH, N&MC	Family housing, Navy and Marine Corps
FIE	Fly-in Echelon
FMF	Fleet Marine Force, deployable forces of the Marine Corps
FY	Fiscal Year
GPS	Global Positioning System
HAWK	Marine Surface-to-Air Missile
K	Thousands of Units
LAV	Marine Light Armored Vehicle
LCAC	Landing Craft Air Cushioned
LHA	Tarawa-class Amphibious Assault Ship
LHD	Wasp-class Amphibious Assault Ship
LPH	Amphibious Assault Ship
LSD	Landing Ship Dock
MAGTF	Marine Air-Ground Task Force, a task organized and integrated combined arms team
M60A1	Marine main battle tank
M1A1	Marine Abrams battle tank
MCN	Military Construction Navy
MCNR	Military Construction Naval Reserve

MEB	Marine Expeditionary Brigade, reinforced regimental landing team
MEF	Marine Expeditionary Force, reinforced Marine division
MEU	Marine Expeditionary Unit, reinforced battalion landing team
MPMC	Military Personnel, Marine Corps
MPN	Military Personnel Navy
MRC	Major Regional Conflict
MTR	Military Technological Revolution
NEF	Naval Expeditionary Force
NMS	National Military Strategy
OMB	Office of Management and Budget
O&M, MC	Operations and Maintenance, Marine Corps
O&M, N	Operations and Maintenance, Navy
OPN	Other Procurement, Navy
O&S	Operating and Support Costs
PE	Program Element
PMC	Procurement Marine Corps
RI	Resource Identifier
RICs	Resource Identification Codes
RPMC	Reserve Personnel, Marine Corps
RPN	Reserve Personnel, Navy
SPMAGTF	Special Purpose MAGTF, task organized to perform specific missions as required

SLEP	Service Life Extension Program
STINGER	Marine Shoulder-Launched Anti-Air Missile
TOW	Tube-Launched, Optically-Tracked, Wire-Guided Anti-Tank Missile
V-22	Advanced Tilt-Wing VSTOL Replacement Aircraft for the CH-46
WPN	Weapons Procurement, Navy

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