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Preparing for change within naval aviation maintenance

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THESIS

PREPARING FOR CHANGE WITHIN
NAVAL AVIATION MAINTENANCE

by

Thomas Edward Jacobs
and
William Patrick Englehart

June 1982

Thesis Advisor: J. W. Creighton

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(strategic) planning, while ensuring clarity-of-purpose both within the naval aviation maintenance organizational structure and the Aeronautical Maintenance Duty Officer community.

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Preparing for Change Within Naval Aviation Maintenance

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ABSTRACT

This thesis classifies changes most likely to have an impact on naval aviation maintenance through the year 2000, and describes planning mechanisms currently in place to deal with these changes. Through a compilation of views of senior level aviation maintenance managers concerning the planning and change process, a variety of comments and problem areas are listed. Conclusions indicate a need to place greater emphasis on long-range (strategic) planning, while ensuring clarity-of-purpose both within the naval aviation maintenance organizational structure and the Aeronautical Maintenance Duty Officer community.

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I. INTRODUCTION

A. BACKGROUND

Highly complex weapons systems and equipments are the result of modern strategies and tactics. Aircraft and equipment performance requirements and operating conditions are increasingly demanding while development schedules are tight and funds are often limited. As a result, modern military hardware is highly complex and continually stressing the "state-of-the-art." Combat aircraft, on the average, have experienced a tenfold increase in production costs every 15 years. At the same time, mission-capable rates decrease and ownership costs increase. Cost, complexity of weapons systems, and the criticality of resource management are major factors driving change. In light of these considerations, the aviation maintenance management system must prepare for change without, at the same time, becoming overloaded with marginal value functions and complexities.

Obviously, aviation maintenance is of predominate importance in the attainment of the overall goal of naval aviation. The successful operation of complex maintenance activities requires expert, innovative management at all levels. Effective aircraft maintenance is a combination of many factors, not the least of which is proper planning, change implementation and efficient utilization of assets.

The evolution of aircraft and their systems, overtime, has intensified the demand for improved maintenance management. The evolution of maintenance management is embodied in the Naval Aviation Maintenance Program (NAMP) which, in its present form, is the culmination of changes implemented over the years.

B. SCOPE AND APPROACH

This thesis attempts to serve as a forum for suggestions which could lead to improvement of the current planning and change process. Additionally, this study is intended to stimulate thought and discussion within the naval aviation maintenance management community regarding the many planning and change issues facing naval aviation maintenance now, and as it prepares for the future.

The future of naval aviation maintenance cannot be assessed without first projecting the future of naval aviation in general. Chapter II provides insight into the scope and degree of change which is likely to take place both in sea-based naval aviation in general and in Naval Aviation Maintenance in particular.

Chapter III provides a general discussion of some of the long-range planning processes currently in place within the naval aviation community, as well as the organizational/procedural processes through which naval aviation maintenance prepares for and implements change.

Chapter IV is a compilation of the views of senior level maintenance managers concerning the planning and change process. Of some concern is the question of adequacy of data and the level of objectivity attained from this data. The response vehicle utilized was a questionnaire (Appendix A), designed to anonymously solicit the candid views, concerns, and suggestions of senior level maintenance managers. Subject areas focused upon were: the futuristic aspects of naval aviation maintenance, current planning and change processes, impediments to change, and methods for improvement of the change process. The responses, covering a multitude of concerns and issues, were exceptionally candid. Although the feedback is considered valid, it does not represent the official views of the Navy Department.

Chapter V summarizes and concludes findings based on deductive reasoning. Areas requiring further study are identified.

II. THE DYNAMICS OF CHANGE

A. NAVAL AVIATION FOR THE FUTURE: DISCUSSION

1. Mission

DoD and the Navy agree on the following set of naval missions:

-- To deter nuclear war

-- To maintain a worldwide naval presence

-- To contain crises:

by superiority at sea

by projection ashore

-- To be able to protect ships at sea

-- To be able to reinforce our allies

-- To be able to place pressure against the Soviets.

Disagreement lies in the assessment of risk and of the fighting ability of the naval forces we can construct with the budgets we anticipate. [Ref. 1: p. 68]

Broadly defined, the mission of the U.S. Navy is to be ready to conduct immediate and sustained combat operations at sea in support of our national interests. The Navy must be able to defeat the potential threats to its continued free use of the high seas whether the threat be hostile aircraft, surface ships, and/or submarines. [Ref. 2: p. 19]

According to Admiral Stansfield Turner:

"It would be very unwise to build the U.S. Navy on the assumption that we can predict whether a war will be long or short. That choice may very well not be ours to make. If that estimate should prove wrong, and if the Navy were not ready to maintain a sustained sea control effort, the country's basic security would be at risk. All Chiefs of Naval Operations, all Secretaries of Defense know in their inner recesses that being able to meet the threat to our use of the sea is the core reason for having a navy. And if war comes, they will not be likely to divert the Navy to any other task until this key issue is resolved." [Ref. 3: p. 66]

Admiral Turner further states that the Navy cannot be designed to satisfy the requirements of sea control alone, even if it is the highest priority mission. Power projection may be of lesser consequence than sea control but we may be called upon more frequently to carry it out. Carriers have been utilized mainly in power projection for the past 35 years. Today and for the foreseeable future, the United States will have critical national interests in the Indian Ocean which must be protected. The absence of land bases excludes such options as in-place armies or air forces. The Navy presents the single means of positioning forces in proximity to this vital region and provides the ability to respond to crises quickly and to the degree warranted by the circumstances. [Ref. 3: p. 67]

Despite the importance of sea control, since World War II the only combatant use of the U.S. Navy has been in power projection in the Third World. There are those who do not agree that carriers are essential to winning the battle for sea control. Too often sea control is relegated to P-3 patrol planes, destroyers and submarines. [Ref. 3: p. 66]

Naval aviation is the primary element in protecting our convoys and military forces at sea; to denying free use of the sea to an enemy; and to projecting power by means of amphibious assault and air strikes. In order to prepare naval aviation for the future there must be a strategic concept, an objective, an understanding of what aviation must be prepared to do in the next twenty years. What part will naval aviation play in sea control? What part will it play in power projection? Will we have an aviation Navy capable of fulfilling the needs of both functions? [Ref. 3: p. 66]

2. Platforms

a. The Aircraft Carrier

The aircraft carrier represents an essential unit of the defense posture of the United States. It is the essential general-purpose weapon system enabling the Navy to carry out the sea control mission of ensuring freedom of use of critical sea lanes. The aircraft carrier is the primary element of powerful, mobile battle forces made up of antisubmarine, fighter and attack aircraft, surface combatants, and nuclear submarines. In any comparison of the United States Navy to the Soviet Navy, the measure of difference between the two fleets is the sea based air power of the United States carrier force, which provides the United States Navy with what is currently a slight margin of superiority. The significance of a sea based tactical air arm is realized by the Soviet

Navy, in that it has commenced construction of a large-deck, nuclear aircraft carrier. [Ref. 4: p. 4-3(u)]

Aircraft carriers are exceptionally mobile air bases that can move from area to area, providing a wide range of military capabilities. They are able to do this without the political disadvantages and deployment constraints associated with land based air units or ground troops. The aircraft carrier is versatile and can be employed in a wide range of conflict including: The maintenance of a political presence in peace time, operations in limited war and general nuclear warfare. Through substantial logistic self-sufficiency, the aircraft carrier can maintain its readiness posture for long periods at distant trouble spots. [Ref. 4: p. 4-3(u)]

Naval aviation planning has centered around large aircraft carriers since the end of the 1940's. The Navy's budget and its justification for shipbuilding, with the one exception of the submarine force, have centered around the large carrier. Ever changing world conditions and technology have influenced the stated justification for carriers which has emphasized variously the symbolic use in peacetime, use in limited war, and use in general war roles of the aircraft carrier. The emphasis may change, but the concept is essentially the same: A large aircraft carrier, preferably with nuclear propulsion and defended by escort ships and aircraft [Ref. 5: p. 21]. Because of the combination of flexibility, offensive power, defensive capability and mobility, carriers have continued to be the keystone of United States Naval strength and a major instrument of foreign policy since World War II [Ref. 6: p. 24]. Critics often cite the "problem of vulnerability" as a key issue in arguing against the building of aircraft carriers. However, carriers have demonstrated that they can withstand numerous non-nuclear attacks and still retain an adequate level of operational capability to carry out their mission. As an example, in World War II, the Japanese launched 2,314 aircraft in Kamikaze attacks against the U.S. fleet, singling out carriers as the main target. For all practical purposes, the Kamikaze was a guided missile (utilizing the most sophisticated guidance system possible--a human being) yet not one U.S. carrier was sunk in these attacks. The ability of the World War II carrier to turn back the Kamikazes was the result not only of the defenses the carriers put up, but also the toughness of the ships themselves. [Ref. 6: p. 22]

The heavily armored CVN of today is much more survivable in combat than its World War II predecessors. Its high speed makes it a more difficult target to find and to hit, and its heavy armor and high degree of compartmentation ensure that, if it is hit (by anything less than a nuclear weapon) it probably would not even have to cease regular operations [Ref. 7: p. 25]. According to former Secretary of the Navy, J. William Middendorf, II, and Admiral

Thomas H. Moorer (Chief of Naval Operations 1967-70 and Chairman of the Joint Chiefs of Staff 1970-74):

> "The myth of 'carrier vulnerability', is just that: A myth. A heavily armored high-speed ship at sea presents a rapidly moving, and maneuvering, target extremely difficult to find, much less to hit and to hurt. It is infinitely easier to target and destroy our fixed-site shore based ammunition dumps, fuel depots, and air fields." [Ref. 7: p. 25]

The punishment that a modern nuclear carrier can take was demonstrated in an unfortunate incident in 1969 when nine 500-pound bombs (equivalent to six Soviet cruise missiles) exploded on the flight deck of the U.S.S. Enterprise. "Despite the damage done, the Enterprise could have resumed flight operations within a matter of hours." [Ref. 7: p. 25] The NIMITZ CVNS, with a higher degree of compartmentation, better sprinkling systems, and generally improved fire-fighting and damage control procedures are even tougher and more survivable. [Ref. 7: p. 25]

The odds are much higher the United States will be involved in non-nuclear conflicts than in an atomic war (it seems safe to say a nuclear war would be the first and last such conflict) and the carrier's record of invulnerability in conventional wars is unmatched. A U.S. carrier has not been damaged by enemy action since World War II. By way of contrast: In the Korean War, all friendly tactical air fields were captured by enemy forces at least once [Ref. 6: p. 22]. In Vietnam, over 400 allied aircraft were lost from ground attack, and an additional 4,000 aircraft were damaged. In contrast, during the entire Vietnam War not one sea based aircraft was lost or damaged on board any U.S. carrier as a result of enemy action [Ref. 7: p. 23].

According to Warwick writing for "Flight International", aircraft carriers fulfill both nationalistic and international roles. It is the international impact of the carrier which most appeals to the Soviet Union and United States. The supercarrier with its attack aircraft can be an effective weapon of peace all over the world. Warwick states: "Any sane nation should be able to read the message written in the self-contained air force floating on its doorstep." [Ref. 8: p. 85]

"Calling out the carriers" is nothing new. Former Secretary of State Henry Kissinger, in a speech at the Naval War College said, "In the crises in which I was involved, the use of naval power, particularly the carrier, turned out to be almost invariably the crucial element." [Ref. 7: p. 23]

The flexibility of the aircraft carrier is recognized by the Soviet Union. U.S. Intelligence reports that the Soviets are building at least one Forrestal sized (78,000 tons) nuclear-powered aircraft carrier to be equipped with conventional take-off and landing (CTOL) aircraft. The Soviet Navy already operates two 40,000 ton V/STOL carriers--KIEV and MINSK--and has at least two more under construction. [Ref. 8: p. 86]

The U.S. Navy considers 12 deployable large deck carriers as minimally adequate [Ref. 4: p. 4-4(u)]. At this time, the Navy has 13 carriers (CVs/CVNs), one of which is undergoing a two-year-plus service life extension program (SLEP) modernization. As soon as the first SLEP carrier, Saratoga (CV-60), leaves the yard, another will enter for SLEP, thus keeping 12 deployable carriers, of which 4 would normally be deployed and the others would be involved in training, transit, or overhaul [Ref. 9: p. 109].

Two more NIMITZ class nuclear carriers are now under construction. VINSON (CVN-70) should be delivered in 1982. At that time, current planning calls for CORAL SEA (CV-43), completed in 1947, to become a training ship (AVT-16). When the recently authorized CVN-71 is completed about 1987, CORAL SEA would be decommissioned and the then 42-year old MIDWAY (CV-41) would be relegated to the AVT role. [Ref. 9: p. 109]

This program of combined new construction and extension of the service life of existing carriers will provide 12 deployable large-deck carriers through the 1990s [Ref. 4: p. 4-4(u)]. During testimony before the House Armed Services Committee on March 11, 1981, the Chief of Naval Operations, Admiral Thomas B. Hayward stated:

> "With the new attitude about really facing up to what we need, we are talking about a 15 battle group Navy as what is required to get back to that point where the risk is such that one can be more comfortable that [we are] buying enough naval insurance." [Ref. 10: p. 47]

Obviously, carriers will be around for many years to come. With the planned major modernization of our existing carriers giving them 15 more years of useful life, the Forrestal class will be in the fleet at the turn of the century. The planned CVN-71 will not have reached its mid-life point in the year 2000. [Ref. 6: p. 26]

Admiral James L. Holloway III (Chief of Naval Operations 1974-1978) states:

> "Critics say the day of the carrier is past, and they point out the battleship came and went in 50 years--therefore, so will the carrier. That argument has no foundation. Ships don't automatically and inevitably phase out by type in half a century." [Ref. 6: p. 26]

Holloway further states:

> "The carrier's future is inextricably tied to the manned aircraft it flies. When piloted aircraft become obsolete, so will carriers. If and when carriers do become more vulnerable to conventional weapons, so will airfields--only more so--but as long as piloted aircraft are still needed, the United States will commit the resources necessary to defend those carriers and airfields." [Ref. 6: p. 26]

b. CVV's and V/STOL

In the spring of 1979, the recently retired Deputy Chief of Naval Operations (DCNO) for Air Warfare, Vice Admiral Frederick C. Turner, referring to the much discussed aircraft carrier concept called the CVV stated, "It's not a NIMITZ or a KENNEDY. But, within cost constraints, it is a very good ship." [Ref. 11: p. 8]

In 1972 a feasibility study for a cost-constrained carrier was undertaken. A conceptual design was ready for review within two years. The design presented a minimum-cost carrier of sufficient size to operate modern fleet aircraft and capable of replacing MIDWAY-class CVs. The study was completed coincidental with a statement of intent by Congress that henceforth all major combatant ships would be nuclear-powered. This resulted in a rapid loss of interest in a medium-sized, conventionally-powered ship. Selection of a repeat of the NIMITZ design was chosen as the best alternative. [Ref. 11: p. 8]

A surprise move by President Ford in 1976 deleted the "repeat" NIMITZ (CVN-71) from the Navy's shipbuilding plan and substituted two ships called CVVs. No one was exactly sure just what CVV meant. The general concept was that the CVV would be medium in size, conventionally powered and designed to operate vertical short take-off and landing (VSTOL) aircraft; hence the second "V" in the title stood for VSTOL. However, VSTOL technology had not progressed to a point where an all-VSTOL air wing was possible by the time this ship would be ready (1987), so the 1972 study for a minimum-cost carrier was dusted off to become the basis for the CVV. [Ref. 11: p. 8]

Continuing debate centered around the question of whether nuclear-powered or oil-powered carriers would be built. President Carter vetoed the congressionally-favored CVN nuclear carrier in 1978, promising a conventionally-powered carrier in FY 1980. The Chief of Naval Operations

(CNO) sought a more capable conventionally-powered alternative to the CVV, and after the President's veto, directed a study to determine the feasibility of building a follow-on to USS JOHN F. KENNEDY (CV-67). The study favorably endorsed this course of action and a recommendation was made to the President that a "repeat" KENNEDY replace the CVV in the budget. The CVV, however, remained as the administration's favored ship. [Ref. 11: pp. 8-9]

The Secretary of Defense stated at this time that the CV and CVN are more capable but cost $5 to $6 billion more over their life cycle when the cost of the greater quantity of aircraft these carriers could carry is considered. In the President's view, therefore, the CVV was considered as affordable and sufficient to meet the Navy's needs while the dollars saved could be spent on other naval programs. [Ref. 11: p. 9]

Smaller, non-nuclear carriers would have less financial impact on a given year's budget, could be constructed in almost any shipyard and would be easier to man. A number of "small" carrier designs have been put forward, from the sea control ship (SCS) of some 14,000 tons to the CVV of about 55,000 tons. [Ref. 9: p. 110]

According to the fiscal year 1981 authorization conference report, the Navy has been investigating various sea-based aircraft platform alternatives for over three years. This study effort has not produced a forthcoming program to increase naval air capability at sea. Challenging technological changes in warfare can best be met by air-at-sea. According to N. Polmar, writing in "United States Naval Institute Proceedings", failure to provide air capable platforms in this era of increasing naval capability would indeed be shortsighted. [Ref. 9: p. 110]

If the Navy continues to marshal all of its offensive firepower into twelve carriers the time will come in the mid-80s when the Soviets can have strong forces where we too are strong, and strong forces where we are weak, by dispatching surface action or VSTOL groups. [Ref. 1: p. 74]

Although the approved plan is for at least 13 large-deck carriers into the 21st century, it seems increasingly possible to multiply the number of our primary aircraft-carrying platforms at sea, our carriers, by building significantly smaller and more numerous ones. This is, of course, contingent upon the further development of advanced powered-lift aircraft. Despite the fanfare surrounding V/STOL, the development of sufficiently capable powered-lift aircraft is still far into the future. However, the possibility of tripling our carrier force should not be taken lightly. [Ref. 12: p. 147]

Building a completely new V/STOL ship before we have a fully operational plane should be studied in the light of history. The "drone antisubmarine helicopter" (DASH) program was an early 1960s Navy program. Some 120-odd destroyers were converted to take the DASH before the concept was fully tested. The after section of the destroyer was converted to a flight deck complete with a small hangar. The program never worked, and most of the hangars wound up being used for storage. The point is that ships were changed before the concept was fully developed, and the concept never worked. [Ref. 13: pp. 28-29]

There will most likely be a new look in carriers in the future--but not until the vertical/short takeoff and landing (V/STOL) aircraft has matured. V/STOL cannot yet compete with conventional aircraft in speed, altitude, range, and payload. It will not become the Navy's first line fighter-attack aircraft until it does become competitive in all those areas. Until V/STOL can match conventional aircraft in mission capability, a total commitment to the vertical risers cannot be made, and construction of pure V/STOL carriers would not be prudent. [Ref. 6: p. 26]

In the view of J. L. George, writing for U.S. Naval Institute Proceedings, the West must proceed with current V/STOL programs and research and development for the long run. To do otherwise could have disastrous conclusions. It will be difficult to develop V/STOL aircraft that are interchangeable with CTOL aircraft. The Marine Corps is considering V/STOL for ground support (AV-8B), but V/STOL aircraft as replacements for an F-14 fighter or the S-3 antisubmarine plane will be well into the future. [Ref. 13: pp. 24-28]

V/STOL aircraft are the only hope of providing substantial tactical air capability in smaller hulls, and we must develop a supersonic V/STOL fighter as a matter of national priority. In the same light, V/STOL platforms capable of bridging the offensive gap between large-deck carriers and major surface combatants must be developed. In order to optimize individual ship capability these ships should be a new design and not just smaller versions of the large-deck carrier. [Ref. 14: p. 50]

c. Air Capable Navy

Perspective: Recognizing the advantages of sea-based, manned, tactical aircraft in recent years, the Navy has maintained an effort to develop high-performance aircraft which could operate from warships other than aircraft carriers in order to apply the advantages of sea-based air (SBA) across a wide range of ships. Aircraft operating from various types of surface combatants enhance the individual mission effectiveness of these ships. [Ref. 2: p. 20]

The operational interrelationships between aircraft (whether Conventional Take-off and Landing (CTOL), Vertical/Short Take-off and Landing (V/STOL), Short Take-off and Landing (STOL) or Short Take-off Vertical Landing (STOVL), and the ships from which they operate could take four different forms. The aircraft could be based on a few relatively large ships and the fleet could have a tighter formation. In this situation, neither the aircraft nor the ships are dispersed. As an alternative, the ships could be dispersed with the aircraft concentrated on a small number of platforms. These operational relationships between aircraft and surface ships are not exclusive operational characteristics of CTOL aircraft operations, but are also viable options for STOL, STOVL and V/STOL aircraft. Two remaining options would be to have aircraft broadly dispersed on numerous ships with the ships in concentrated formation or to have the ships themselves dispersed. The vertical landing capability of V/STOL and STOVL would provide greater basing flexibility associated with the last two options. [Ref. 15: p. 5]

The limited deck space on surface combatants other than aircraft carriers, make V/STOL aircraft, including helicopters, very attractive to the Navy. Of all the technological factors which are influencing the character and form of the Navy of the future, perhaps none is as all-encompassing as the concept of the "air-capable Navy". The "air capable Navy" is commonly considered a navy utilizing tactical aircraft aboard a large number of small ships. [Ref. 16: p. 93]

Aircraft vastly extend the combat horizon of the surface ship and they can carry offensive weapons to ranges unattainable by other means. Additionally, they extend the perimeter defense against all threats. [Ref. 16: p. 94]

At the close of World War II, the U.S. Navy possessed more than 100 carriers of varying classes. With its present number of 13 carriers, the Navy's ability to cover many areas simultaneously is limited. According to Captain G. G. O'Rourke, writing for "U.S. Naval Institute Proceedings", the strongest reason for future development of the U.S. Navy into an air-capable one is to ensure naval superiority over large areas for extended periods. The air-capable Navy would provide a means to accomplish this task. [Ref. 16: p. 94] Captain O'Rourke states:

> "The additional aircraft at sea pay off in many ways. Surveillance coverage can be improved, even with V/STOL aircraft of significantly poorer overall performance than conventional carrier (CTOL) types. Their bases can be moved to compensate for shorter ranges, and their flexibility of take-off and landing times is not tied to a carrier's cycle. To have more aircraft aboard more ships makes possible shorter reaction time, permitting the quick deployment of force to a scene of action." [Ref. 16: p. 94]

The LAMPS (light airborne multi-purpose system) MK III is at the forefront in integrating the endurance of the surface ship with the versatility of the aircraft. LAMPS will allow the small surface escort to operate as a more independent unit with greatly expanded tactical capabilities. It is envisioned that LAMPS III will pave the way for V/STOL to do the same. [Ref. 17: p. 117] More than 200 LAMPS III helicopters are in the U.S. Navy's current procurement plan [Ref. 10: p. 5].

The air-capable Navy concept is not without potential shortcomings. The most immediate problem is the development of a suitable, practical, and financially feasible V/STOL aircraft. The success the RAF and U.S. Marines have had with the Harrier notwithstanding, the development of

V/STOL remains in its infancy. On board sensors, computers, and displays which make up an effective aircraft weapons system are weak when compared with those aboard CTOL aircraft. In order to minimize weight, their engines are "overblown" and reliability is reduced. Problems such as these will require solutions before an air-capable Navy can become reality. [Ref. 16: p. 97]

New V/STOL designs may initially begin their service aboard large carriers. This would provide a focus of operational expertise, logistics/maintenance know-how, and increased environmental safety. Later, it would be possible to stage V/STOL aircraft from carriers to smaller ships [Ref. 16: p. 103].

Possibly in the near future, with the reactivation of the battleship NEW JERSEY and the current DoD plan calling for reactivation of the remaining three IOWA class battleships over the next three years [Ref. 10: p. 28], the Navy may modernize the after section of these ships to facilitate air operations with either helicopters or AV-8's. [Ref. 18: p. 54]

Supporting naval aircraft in small numbers on various types of ships is a matter of policy, and the Navy is continuing to investigate the possibility of all surface combatants with an air capability. [Ref. 15: p. 1]

In an effort to assess the feasibility of V/STOL aircraft, the Navy conducted exploratory studies in 1975 and

1976 into the feasibility of V/STOL, to determine whether or not a fully mission-capable V/STOL aircraft could be developed. If this were possible, it was also necessary to determine if these aircraft would be at least as operationally effective as the CTOL aircraft they would replace. [Ref. 4: pp. 3-8]

It was decided in August 1977 to transition Sea Based Air (SBA) to V/STOL aircraft provided that the V/STOL concept was validated. The Chief of Naval Operations, Admiral James L. Holloway, issued the V/STOL concept source document which provided the basic guidance to plan for transition to an all-V/STOL force, along with the conceptual plan for V/STOL aircraft development and fleet introduction. This transition was to occur at the end of the normal service life of the Navy's present aircraft inventory. The primary objective was to maintain the current capability of the Navy's SBA throughout the transition. Initial V/STOL aircraft (V/STOL A) were to be phased into the fleet in the early 1990s, followed by high performance V/STOL B aircraft in the mid-to-late 1990s. [Ref. 4: pp. 3-8]

Budget austerity and the Congressional Authorization Conference Report associated with the FY 80 budget delayed the timetable. The report stated it was too early to make a commitment to any type of V/STOL and tasked the Navy with continuing its investigation of advanced aircraft technology. [Ref. 4: pp. 3-8]

In his report to the House Armed Services Committee on the Fiscal Year (FY) 83 Budget of the Navy, the Chief of Naval Operations, Admiral Thomas B. Hayward, stated:

> "You will find a V/STOL program once again, as we seek to examine new options for providing TACAIR at sea later in this decade. In all candor, I am most dissapointed with the constraining action of Congress over the past five years, which has seriously inhibited our ability to delve into the potential offered by vertical lift aircraft. On the one hand the Navy is criticized for not having sufficient vision to realize the potential of distributing its TACAIR (Tactical Air) assets on platforms other than carriers. Yet, on the other hand, the Congress has made it impossible to proceed with any alacrity in search of such potential." [Ref. 10: pp. 27-28]

Admiral Hayward went on to state:

> "The major reduction in our FY 82 request for V/STOL technology illustrates the point. I urge your full support for our FY 83 V/STOL program which will permit us to proceed logically with the medium-speed range lift fan for such missions as ASW, AEW, tanker and carrier on board delivery (COD). For missions requiring higher speeds, we seek to investigate augmented deflected engine nozzle technology (ADEN) using an A-6 airframe." [Ref. 10: pp. 27-28]

Obviously, Admiral Hayward is committed to the further development of alternative approaches to the employment of TACAIR at sea.

3. Aircraft

The time worn motto "find, fix and strike" is as valid today as it ever was. However, the means have changed and are continually developing. The aircraft still has a vital role to play in finding surface ships, submarines and other aircraft. Satellites and missiles with "smart" heads may well eclipse the aircraft in the future but, neither the satellite nor the missile has the flexibility provided by the piloted aircraft. The F-14 Tomcat has been cited as an exceptional weapon system and the F/A-18 incorporates the latest advanced technology. The F/A-18, the Navy's first combined fighter-strike aircraft, will soon join the fleet. [Ref. 19: p. 26]

The Armed Forces of the United States face an era where both the military threat and technological environment are changing rapidly. While recognizing the need for future planning and preparation for the day when the "big-decks" will be retired, the Navy must face a more immediate problem of replacing aging F-4s and A-7s. The F/A-18 appears to be the necessary interim solution. [Ref. 20: p. 389]

The battle group, centered around the large-deck carrier (60,000-90,000 ton displacement), represents the offensive striking power of the U.S. Navy. Despite the speed, toughness, and survivability of the "big-decks", Commander R. C. Powers, writing for "Military Engineer", considers survivability an issue. The rapid and sustained growth in capability of Soviet maritime forces, particularly in the areas of antiship missiles and nuclear submarines (coupled with the fact that Soviet doctrine calls for tactical use of nuclear weapons under certain conditions), has caused increased concern for the survivability of the limited number of U.S. large-deck carriers. [Ref. 20: p. 390]

If the U.S. continues to build large carriers, the force levels would continue to decline (due to single unit procurement costs) and vulnerability would tend to increase. An alternative would be to procure a larger number of smaller V/STOL carriers which would increase survivability significantly through dispersal. According to Powers, this is a great idea except for the fact that there is an absence of high-performance, air superiority V/STOL aircraft that can meet the projected Soviet threat. [Ref. 20: p. 390]

> "V/STOL aircraft development evokes comparison with a TV soap opera: An abundance of activity, substantial sound, and, on occasion, more than a little fury, but no matter how infrequently revisited, always a certain sameness about the plot--projections no closer to reality, technology no closer to closing the gap with conventional aircraft, and mission requirements no closer to defining a role that makes V/STOL clearly worth the cost." [Ref. 21: p. 24]

It would be unfair to say that no progress has been made in the twenty-five-odd year gestation period of V/STOL. Exploratory development efforts have produced the following approaches to V/STOL:

a. The AV-8A **Harrier** is a small aircraft, weighing 11,890 lb. It has a maximum take-off gross weight of 24,600 lb. with a 1500-ft. ground roll making its gross-to-empty-weight ratio roughly comparable with other light attack aircraft. It can take off and land vertically at a lower gross weight of 17,050 lb. Operating in the VTOL mode the 5,000 lb. payload, divided between ordnance and fuel, is a miniscule amount by conventional take-off and landing (CTOL) aircraft standards. [Ref. 21: p. 25]

b. The AV-8B (the follow-on to the AV-8A) has completed testing at Naval Air Test Center Patuxent River, Maryland. New technology along with fuselage, nozzle, and flap modifications have boasted the vertical take-off weight to nearly 20,000 lb. at a cost of only 580 lb. more in empty weight. The AV-8B is the state-of-the-art in V/STOL aircraft. Only about 3 percent of its empty weight is directly connected with the vertical flight provision. In the short take-off mode it compares well with operational CTOL attack aircraft in the same weight class. [Ref. 21: p. 25]

c. The XV-15 TILT ROTOR bridges the capabilities gap between V/STOLs and CTOLs. This is done by using large helicopter-like rotors mounted on tilting nacelles at each wing tip. These rotors provide forward thrust in the airplane mode and vertical lift in the helicopter mode. The Navy joined the tilt rotor program in 1979 when studies showed tilt rotors could be applicable to Anti-submarine Warfare (ASW), Marine Corps assault support, Air Early Warning (AEW), and search and rescue missions. [Ref. 22: p. 23]

d. The XFV-12A is a thrust-augmented-wing design originated in 1973 when Rockwell and the U.S. Navy considered the potential performance improvement obtainable from STOL vice VTOL operations. A shortage of funding and the lack of sufficiently new technological information will likely result in cancellation of this program. [Ref. 23: p. 71]

e. The "X" WING is a new VTOL aircraft being developed for the U.S. Navy. It has a four-bladed rotor for the helicopter mode, but unlike a normal helicopter, at speeds of about 200 knots, the rotor is stopped and locked into place. The blades then function as conventional wings for flight up to high subsonic speeds. A single-seat aircraft incorporating the X-WING technology is being built by Lockheed for test and evaluation and should be flying soon. [Ref. 24: p. 115]

Aircraft for land and maritime air superiority have proven essential and CTOL aircraft are the only means of providing the required high performance today. A high performance V/STOL aircraft is technologically possible; however, it will not be here tomorrow--it will take long term development. Mid-range performance V/STOL aircraft can increase force survivability and flexibility in a number of ways and they are here today. Current air superiority aircraft will remain in the force until high-performance V/STOL aircraft are available. [Ref. 20: p. 399]

The decision to adopt new V/STOL concepts can probably be postponed for a number of years without damaging force credibility. However, V/STOL aircraft seem inevitable, and there are important steps that can be taken in the near term. [Ref. 20: p. 390] Not unreasonably, it is still deemed more essential that the Navy acquire the aircraft it needs to keep its carriers the viable force they must remain through the end of the century. Nonetheless, as important as these present problems are, history has provided sufficient evidence of the folly of mortgaging the future to pay for the present. [Ref. 21: p. 30]

4. Technology

Doctor William J. Perry, Under Secretary of Defense for Research and Engineering, in testimony before the Senate Armed Services Committee on December 4, 1980, stated:

> "I believe the technology that we are incorporating today will improve reliability, make the equipments easier to maintain and easier to operate relative to equipments that are now in the field." [Ref. 25: p. 10]

Doctor Perry further stated:

> "...it is important to note that modern technology--especially microelectronics--not only allows us to achieve superior performance, but also allows us to reduce cost, maintenance and operating problems, and to increase reliability. These advantages are only now beginning to be felt in the field because systems incorporating microelectronics technology have only been in production in military systems for a few years." [Ref. 25: p. 46]

a. Aircraft

The latest in Naval aircraft technology is represented by the F/A-18 Hornet currently in transition in VFA-125, and the AV-8B Harrier which will soon be introduced into the Marine Corps. [Ref. 4: pp. 1-22]

The multi-mission F/A-18 is designed to bring forth a quantum improvement in aircraft reliability and maintainability. The Hornet includes a Forward-looking Infrared Receiver (FLIR) system, a laser spot tracker, and a high resolution ground map radar. [Ref. 4: pp. 1-22]

The cockpit layout of the F/A-18 is unique in that a Heads-up Display (HUD) of advanced design is used. An Up Front Console (UFC) is located directly below the HUD and controls all Communications, Navigation, and Identification functions. Three cathode ray tube (CRT) displays take up most of the main instrument panel. [Ref. 26: p. 27]

The flight control system is a quadruple redundant fly-by-wire system, with a mechanical backup to the aircrafts stabilators. The system is controlled by two flight control computers, which allow fine tuning of the flying qualities of the aircraft. [Ref. 26: p. 31]

The F/A-18 is powered by two General Electric F-404-GE-400 low bypass turbofan engines in the 16,000-pound thrust class. The F-404 power plant is approximately one-half the size of the F-4 Phantom's GE J-79 engines, yet it is in the same thrust class. Employing the modular philosophy, the F-404 engine contains 7,700 fewer parts than the GE J-79. [Ref. 27: p. 12]

The engines of the F/A-18 are not removed from the aircraft for inspections. Inspections are performed by borescoping the installed engines and monitoring engine condition data recorded on a tape in the aircraft. All accessories and most components are easily replaced through the engine bay doors. The engines are designed to be replaced in 20 minutes. [Ref. 26: pp. 27-29]

The aircraft is equipped with two mission computers located in the avionics compartment along with the flight control computers. Most weapon replaceable assemblies (WRAs) are single deep for quick access. The F/A-18 is designed so that modular plug-out, plug-in technology will provide quick repairs without the use of work stands. [Ref. 27: p. 12]

Built-In-Test (BIT) is incorporated in most of the avionics systems, and the hydroelectromechanical systems incorporate Non-Avionics-Built-In-Test (NABIT). Faults are indicated as a code on the maintenance monitor panel (MMP) in the nose wheelwell.

b. Structures

Combat aircraft currently in service are built almost entirely of aluminum alloy, with some other metals such as titanium and steel. Increasing demand for improved performance has accelerated development of a new generation of composite materials. [Ref. 28: p. 33]

Composites have been in use for well over a decade. In 1968 Grumman aircraft was the first company to build production examples of a primary load-bearing structure (one on which the aircraft depends for safe flight) using composite material. This was the horizontal stabilizer (the tailplane) for the F-14, using boron-epoxy skins covering an aluminum-honeycomb core. The structure proved to be 19 percent lighter than the titanium component it replaced and the new tailplane entered routine service in 1970. In 1971, Grumman developed a boron/carbon/glass-fibre/epoxy hybrid which is utilized in the fairings on top of the swing wings of the F-14; these are 26 percent lighter and only 60 percent of the cost of their metal counterparts. [Ref. 28: pp. 33-35]

More recently, the AV-8B, which will be delivered to the U.S. Marine Corps in 1983, has been design modified to use composite materials, and the wing is made entirely of graphite composite material, including its inner structure. This is perhaps the most outstanding application of composites to date. [Ref. 29: p. 21]

McDonnell Douglas, contractor for the AV-8B, has also been investigating an alternative method of joining metal sections under the U.S. Air Force's adhesive bonding program--Primarily Adhesively Bonded Structure Technology (PABST). Adhesive bonding, in which pieces are "glued" together with resin rather than riveted, provides a lighter structure that is highly durable and cheaper to build and maintain than conventional methods of construction. [Ref. 28: p. 35]

Although there are prospects for further improvement in aluminum alloys and in titanium, the greatest scope for structural development would appear to be in the more widespread adoption of composite materials such as carbon-carbon. [Ref. 30: pp. 6-7] The use of composites in aircraft structures offers substantial weight savings with associated increase in structural efficiency. [Ref. 31: p. 10]

Studies by the North American Aircraft Division of Rockwell International Corp. indicate that glass fibre/composite materials would account for about 15 percent of a simplistic baseline bomber in 1990, but would increase to 55 percent by the year 2000. In general, the aluminum content would decline in favor of composite materials, with the percentage of other materials remaining approximately the same. [Ref. 32: p. 143]

c. Engines

Engine technology continues to develop particularly with respect to thrust-to-weight ratio and engine specific fuel consumption. Engines are becoming smaller and lighter for a given level of thrust. An important aspect of engine development over the past decade, and one not normally noticed, is that engines are becoming relatively shorter. This has been the result of improved stage efficiency in compressors and turbines, resulting in fewer compressor or turbine discs; higher compression ratios also mean smaller combustion systems. [Ref. 33: p. 291]

Increased thrust-to-weight ratio capability can provide increased supersonic maneuverability, smaller and less expensive aircraft as well as V/STOL capability, or some combination of all these features. [Ref. 34: p. 80] The cumulative effect is most noticeable in reducing the weight of the engines; however, the reduction in length can be particularly important in relation to future vectored thrust V/STOL aircraft. [Ref. 33: p. 291]

Besides a higher thrust-to-weight ratio, the 1990s engine will probably feature rectangular exhaust nozzles with thrust-vectoring capability (Thrust vectoring or reversing involves deflecting engine exhaust gases to achieve better takeoff, landing, and maneuvering characteristics). [Ref. 34: p. 81] The Rolls Royce Pegasus engine, currently utilized in the AV-8B, through its swivelling nozzles provides the ability to generate the 21,500 lb. of thrust vertically or horizontally at an installed thrust-to-weight ratio of 6 to 1. Thrust weight ratio for this engine is projected to increase further to 8 to 1. [Ref. 30: p. 5] Additionally, a Pegasus type of engine with thrust boosting matching supersonic thrust requirements may be provided by burning fuel in the front nozzles. This principle, known as Plenum Chamber Burning (PCB) has been the subject of experimental programs in preparation for the possible launch of a supersonic V/STOL aircraft in the mid to late-80s. [Ref. 30: p. 5]

If this approach continues, the next generation of engines will reach a thrust-to-weight ratio of 10 to 1 [Ref. 34: p. 80]. The Rockwell studies anticipate that engine thrust-to-weight ratios would increase by about 40 percent during the decade from 1990 to the year 2000 for engines in the same general size and weight category. [Ref. 32: p. 143]

In reaching a nearer term thrust-to-weight ratio of 10 to 1, the most significant contribution will come from increasing engine operating temperature. Generally, higher operating temperatures will provide higher performance. The effect of higher temperatures and heat load on turbine airfoil durability must be compensated for by a combination of improved materials, more efficient cooling schemes, or additional cooling air. Increased coolant levels, however, result in efficiency losses. Recent breakthroughs in cooling technologies and materials are just now allowing for simultaneous increases in the temperature capability and cooling efficiency of advanced airfoils. This permits significant increases in turbine inlet temperature. The trend toward higher operating temperatures is ensured through introduction of new engine alloys. In parallel with alloy developments, advances have been made in the sophistication of the internal cooling configurations that can be cast into the airfoils. [Ref. 34: pp. 81-82]

Another important contribution to improved engine reliability, as well as reduced cost and weight, is the development and application of advanced microprocessor technology in engine controls. Where the engines of today are controlled by a combination of electronic and hydromechanical computers, advanced powerplants will use digital electronic controls. Eventually all hydromechanical components, with the possible exception of hydraulic pumps and actuators may be replaced by electronics. Control systems of this type will be produced and maintained at a lower cost, incorporate comprehensive fault detection, provide substantial improvements in reliability and durability, and provide more accurate control of all engine variables. [Ref. 34: p. 83]

It is envisioned that the next generation engine will not achieve these performance improvements at the expense of acquisition cost, durability or reliability and that concurrent improvements are predicted in each of these areas. [Ref. 34: p. 81]

d. Avionics

During the past two decades, unforeseen technical developments in avionics have occurred. The favorable trend in equipment weight, volume and cooling requirements will obviously have a cumulative effect on aircraft size reduction as well as increased capability. There has been a steady improvement in new generation avionics equipment reliability and it is anticipated that there will be an even greater improvement in the next few years. [Ref. 33: p. 289]

Where the commercial world is continuing to emphasize greater density, the military sees a greater need for higher processing speeds. The Defense Department's answer to this is the Very High Speed Integrated Circuit (VHSIC) program. In testimony before the Senate Armed Services Committee on the subject of VHSIC (December 4, 1980), Dr. Perry stated:

"A major thrust of our advanced technology program today--the largest single advanced technology program we have--is the VHSIC program. It is intended to accelerate the introduction not only of large scale integrated (LSI) circuits into military equipment, but very large scale integrated (VLSI) circuits as well. For a given size chip, it will increase the number of functions, the number of bits on that chip by a factor of about 100 over present capabilities and it will at the same time increase the speed of operation." [Ref. 25: p. 14]

DoD is investing $225 million in its VHSIC program over a six year period that began in 1979. [Ref. 35: p. 4] The program is a broad, joint service program which is designed to benefit DoD systems of the future. Its goal is to push the integrated circuit technology of the DoD contractor base to a point well beyond the reach of Soviet System designers. The second area of concentration is to design chips and subsystems which maximize reliability, commonality, and performance and which minimize test, maintenance and other support requirements.

The rationale for maximization of reliability is that increased maintenance and decreased reliability are not inherent in complexity and that integrated circuits have proven this. As the capability built into a given silicon chip has increased from one transistor to 100 thousand transistors, the reliability of the chip has remained roughly constant. In the end, if a system can be built into a single chip, it can be extremely reliable. [Ref. 36: p. 52]

The concept of "Fly-by-wire" (the well-known phrase for the replacement of the rods and levers in the pilot's controls by electric signals) is also dependent upon modern computing to take a considerable amount of the load off the pilot, making the aircraft easier and safer to fly. It can ensure the pilot does not inadvertently get into dangerous situations (for instance stall or spin avoidance). This is an advanced system and its increased use is assured. [Ref. 37: p. 50]

Yet another area where future improvements are expected is in Built-in-Test (BIT) capability. In some aircraft applications today, the BIT features of avionics, stores management sets, and weapon release systems are more sophisticated than the system itself. The ability to automatically test and isolate faults is a difficult engineering task and it is anticipated that in the future BIT will be perfected further so that it provides a great deal more precision, reliability and capability. [Ref. 38: p. 90]

During the next 15 years avionics (and electronics in general) will probably see a period of upgraded hardware technology and increased software complexity in computer technology. Additionally, voice-stimulated and controlled electronics, lasers operating as radars and landing guidance systems will be introduced. Real-time signal processing will be the heart of most systems. Automatic Test Equipment (ATE) can not handle most real-time problems today and the support of improved BIT concepts will be required to ensure testability.

Electronic components will have achieved several orders of magnitude more complexity per integrated circuit. The system on a chip will be widespread, and single printed circuit boards may house all of the aircraft's electronics. [Ref. 39: pp. 6-33]

The latter half of the 1970s has seen military aircraft technology advance with fly-by-wire, digital avionics, carbon-fibre structures and digital flight controls. It is expected that through the remainder of the 1980s, 1990s and beyond the year 2000 a steady rate of evolutionary change will continue. [Ref. 33: p. 297]

5. Personnel

LCDR R. E. Gonzales, Jr., writing for "U.S. Naval Institute Proceedings" in 1979 posed the question: "...where are we going to get the people to train?" [Ref. 40: p. 37] He further stated:

> "The signs are that our supply of young adults is becoming scarcer as well as less capable. The decline in College Board test scores which began about 1963 is only one indication that our educational systems are not turning out the bright-eyed workers of years past. To aggravate the problem of lower quality, the quantity is dwindling fast as well. Population trends indicate that the supply of young adults available for military service peaked about 1978 and will decline 25% by 1990." [Ref. 40: p. 37]

VADM M. S. Holcomb, also writing for "U.S. Naval Institute Proceedings", in 1980 stated:

"Having adequate numbers of qualified people is of at least equal importance to the Navy as are its inventories of ships and aircraft. But here, newer is not necessarily better. Older is better.

Since 1977, we have met our recruiting goals fairly well, but we have failed to meet retention goals with respect to either first-term or second-term personnel. Nor have we retained the customary numbers of career people." [Ref. 41: p. 45]

In contrast to the preceding statements, Admiral Hayward stated in his FY 83 Military Posture Statement before the House Armed Services Committee in 1982:

"There is much good news to share with the Congress this year with respect to the military manpower situation in the Navy, in stark contrast to the alarm I registered with you during the 1979 and 1980 Congressional Hearings.... It is a pleasure indeed to be able to report to Congress that in the last 14 months, or so, there has been a major turnaround in the attitude, morale, and retention of our experienced careerists....there is every reason to believe we can fully man the 600-ship Navy given sustained retention performances like this." [Ref. 10: pp. 38-41]

For the past few years, a number of articles presented a running commentary of Navy manpower and personnel problems. Recruiting shortfalls, record-high desertion rates, and declining levels of literacy among incoming recruits have become routine headlines in the press. According to Captain B. Harris, in his article "How Will We Man the Fleets?", the headlines fail to reveal that applicants for officer programs today bring the highest average test scores on record; 75 percent of today's recruits test above the 50th percentile and more than 75 percent are high school graduates; the number of people reenlisting for a second hitch is at record high levels. [Ref. 42: p. 72] Capt. Harris goes on to state that the Navy is faced with some serious personnel problems but is aware of this fact, is dealing with the problems and stands ready to carry out any assigned mission. [Ref. 42: p. 72]

Regardless of the present "turnaround" in retention of experienced careerists, there is a continuing concern over the Navy's inability to recruit, train, and retain adequate numbers of qualified men and women to operate and maintain aviation systems in the 1980s and beyond. The development, installation, and deployment of sophisticated combat systems within the U.S. Navy is a direct result of the sophistication of the threat facing U.S. Naval forces at sea. The increasing technical requirements for training the personnel to maintain these sophisticated systems has reduced the number of new entry personnel qualifying for training. At the same time this has placed a commercial premium on those personnel who have successfully completed training programs. The ever increasing demand for experienced, trained personnel together with changing national attitudes and the real or perceived decreasing military benefits, have adversely affected retention of quality personnel in the Navy. [Ref. 4: p. 6-1(u)]

The requirement for high quality recruits is driven by a need for large numbers of personnel capable of absorbing the training and able to operate and maintain exceptionally sophisticated equipment. The technical manuals for the World War II Navy fighters ran about 950 pages. A good mechanic with a set of wrenches and a circuit tester could keep ahead of the problems. The technical manual for today's F-14 has 300,000 pages and requires special skills in electronics and data processing rather than basic electricity and mechanics. There are an increasing number of people who want to join the Navy today but could not begin to deal with such complexity and must be turned away. The truth is, there are not enough simple jobs to accommodate every motivated but marginally qualified applicant. [Ref. 42: p. 77]

Admiral Hayward summarized the Navy's personnel problems in his latest Military Posture Statement when he stated:

> "The Navy remains some 22,000 Petty Officers short. That shortage, while declining steadily over the next five years, will nevertheless remain significant, which means there will be little let-up in the extraordinary demands we place upon the individual sailor and marine. Without continued Congressional support, we cannot hope to eliminate the present deficit in trained, experienced manpower. With Congressional support, we can be completely confident of our ability to do so--and of our ability to man the growing Navy that is so vital to our Defense posture." [Ref. 10: p. 41]

6. Summary

Whatever the Navy's mission during the next 20 years, it is apparent that sea based air will continue to play a significant role, with the large-deck carrier clearly remaining the prominent platform through the year 2000. As the century draws to a close, the possibility exists that the high cost of the large deck CV/CVNs may usher in smaller V/STOL equipped carriers as part of the force mix. Should further V/STOL development progress to a point allowing greater dispersal of TACAIR, a mix of large-deck CTOL carriers and smaller CVV's might be supplemented with V/STOL aircraft aboard smaller combatants in an "air-capable" Navy concept. Further breakthroughs in aircraft design could result in other combinations of force structure.

The F/A-18, AV-8B, and LAMPS III aircraft are currently in the forefront of what may very well be a quantum leap in Naval aircraft technology through the year 2000. Included in a wide range of technological developments will be: greater use of composite aircraft structures; lighter, smaller, higher thrust engines; highly miniaturized VHSIC avionics systems; greater use of fly-by-wire systems and BIT capabilities. While technology continues to advance rapidly, future demographic trends may affect the Navy's ability to attract sufficient numbers of high quality personnel.

B. NAVAL AVIATION MAINTENANCE FOR THE FUTURE: DISCUSSION

1. Perspective

In the 1940s, comparatively simple weapon systems were manufactured in large quantities. As time passed, complexity increased. As design margins decreased in the 50s and 60s in order to obtain the last bit of performance out of the state-of-the-art, system effectiveness technology began to lag. [Ref. 43: p. 20]

Assumption of responsibility for maintenance policy by the ASD (S&L) in 1959 gave recognition to the increasing cost of equipment maintenance. The Naval Aviation Maintenance Program, which provides an integrated system for performing aeronautical equipment maintenance and all related support functions, was established 26 May 1959 by the Chief of Naval Operations. [Ref. 44: p. i]

It is generally accepted that when a new weapon system enters initial production, over 80 percent of future maintenance requirements are already locked in as a result of the design. In the early 1960s, equipment designed for minimum practical maintenance was perceived as yielding the largest single improvement on maintenance workloads and cost. DoD Directive 4100.35, "Integrated Logistics Support Planning," issued in June 1964, was a quantum leap toward reducing maintenance demand by requiring detailed support plans for new systems [Ref. 45: pp. 5-6]

The Naval Air Systems Command initiated the Analytical Maintenance Program (AMP) in 1972 to improve its capability to define, justify, and execute the most efficient maintenance programs possible for sophisticated aircraft weapon systems. AMP was prompted by the realization that the cost of "maintenance as usual" on new or planned aircraft was becoming prohibitive. The purpose of AMP, specifically, was to implement the Reliability Centered Maintenance (RCM) philosophy (i.e., additional maintenance cannot improve the reliability inherent in the design of hardware). The results to date are generally favorable. An increased awareness of cost implications of maintenance requirements and program decisions exists at all levels. [Ref. 46: pp. 16-18]

In the continuing effort to improve the management of equipment maintenance, to improve both technical and production performance while reducing costs, the risk that managers will redouble their efforts but lose sight of the objective is always present. The objective is readiness at minimum cost. The "minimum cost" part of the objective must hold equal weight with, but not overshadow, readiness. [Ref. 45: p. 9]

Readiness of current U.S. forces and weapons, however, has been declining despite the large portion of the Defense Department budget allocated to Operations and Maintenance. The effective maintenance and operation of the current hardware inventory is a problem for the Department of Defense and questions as to whether we are fielding "leading-edge" technology which is beyond our capability and dollar resources to maintain are increasing. [Ref. 25: p. 2] These concerns are generally recognized; however, current maintenance technology, training, and management systems have culminated in the best national defense maintenance capability to date. Even with improved capability, increased complexity of weapon systems have increased the maintenance burden. On the other hand, technological innovations that have created today's maintenance capabilities must be followed by more if maintenance is to respond to changing readiness requirements. [Ref. 47: p. 1]

2. Reliability and Maintainability

Reliability and maintainability as goals in design and development will have a lot more clout in the 1980s than they had in the past. The spectacular performance and capability of a weapon system is meaningless if it is not flyable or launchable. The Defense Department's dissatisfaction with the high failure rates of systems resulted in a bill of particulars being drawn up in 1976 by the principal deputy director of defense research and engineering. Efforts to improve reliability up to that time included tightening requirements, use of standard high reliability parts and incentive or penalty fees. None succeeded to any degree. [Ref. 48: p. 13] It was emphasized that the key to designing for reliability and maintainability is front-end investment during engineering development. However, because the added cost is now, and the life-cycle cost saving is years down the road, front-end investment is a potential victim of the budget cutter. [Ref. 48: p. 13]

The Navy has been leading the fight to improve the reliability of its weapons systems, in part because the shipborne environment exacts a higher price to support undependable equipment. In the early 1970s, the Navy Material Command hired reliability specialists from the National Aeronautics and Space Administration's Saturn/Apollo lunar landing program in an effort to enhance the readiness of its fleet systems. A new reliability directorate, Deputy Chief of Naval Material for reliability, maintainability and quality assurance, was headed up by Willis J. Willoughby, Jr., former director of Apollo reliability, quality and safety. Willoughby has become the Navy's reliability authority, stressing dependable performance through design from the beginning. The F/A-18 and its General Electric F404 engines are the first examples to incorporate reliability engineering principles which have been applied essentially from the beginning. [Ref. 49: pp. 42-43]

Critics often say they have heard great and wondrous things about technology in years past. They heard it in the 1950s, they heard it in the 1960s, they heard it in the early 1970s and they are hearing it again today about the 1980s. We always seem to have things on the drawing board that are going to make dramatic improvements in every direction. They just don't ever seem to make it to the field in large quantities. Responding to this criticism, Doctor William J. Perry, Under Secretary of Defense for Research and Engineering, in testimony before the Senate Armed Services Committee on December 4, 1980 stated:

> "Technology can be employed in many ways. It can be used to make weapon systems simply elegant. But it can also

be used to make weapons systems elegantly simple, and in so doing decreases the requirements on military manpower." [Ref. 25: p. 6]

Technology has been used to gain the performance edge critical to our forces in the face of a numerically superior opponent. Technology can also be applied to reduce maintenance and simplify the operation of our systems. [Ref. 25: p. 6]

Critics also point out that only about 50 percent of our combat aircraft are mission capable directly as a result of oversophistication. Dr. Perry argues that it is too simplistic to state that oversophistication is the reason that combat aircraft are not mission capable. Many of the problems with reliability and maintainability which are blamed on high technology are actually the result of older systems in need of modernization. According to Dr. Perry, the problems we are having are largely with equipment which was designed in the 1950s and 1960s and built in the 1960s and 1970s, not equipment that incorporates the technology of the 1970s. This 1970s technology is not yet in very many of the systems we currently have in the field. Even as we deploy the F/A-18 with this new technology, the systems that are replaced (F-4's and A-7's) will still be in the field into the 1990s. We will therefore continue to have these problems. Dr. Perry does not suggest that our maintenance and support problems are going to get easier in the next 5 years or maybe even the next 10 years. It will not happen immediately but, over the long term, support problems will ease. [Ref. 25: pp. 11-41]

While we are applying technology to greatly improve the reliability and maintainability of our weapons systems, we are faced with growing shortages of qualified maintenance personnel. The requirements for exceptionally high levels of training in personnel operating and maintaining equipment will tend to decrease over the long run; however, there will be an increased requirement in the short term, according to Doctor Perry. Specifically, training requirements will increase over the next five years because of the number of new, highly sophisticated systems that will be introduced. From about the mid-1980s on, we should begin to see real benefits in terms of operating and maintaining equipment. [Ref. 25: p. 6]

3. Impact of Dispersal

A brief description of support concepts as they exist today is pertinent. Aircraft carriers (CV/CVN) operating large numbers of CTOL aircraft, have full Organizational ("O") and Intermediate ("I") maintenance capability. These ships in essence are full support bases capable of extended periods of independent operations. The LPH class ship, though smaller in size also has full "O" and "I" capability for its embarked helicopter force. [Ref. 15: p. 5]

Although fleet operators and maintainers request more spare parts and more reliability, they will usually concede the present support systems for aircraft are efficient, though highly centralized and complex. The centralization focuses in the large aircraft carrier, where more and more self-contained repair and replacement capabilities have been integrated into the ship, each bringing along a train of essential requirements for space, repair benches, power, test equipment and personnel. [Ref. 16: p. 108]

In an air-capable Navy where dispersal will prevail, a very different maintenance philosophy will emerge. In contrast to centralization of repair and storage in the present aircraft carrier, a dispersed system requires increased distribution of aircraft support among several, or even many, different ships [Ref. 15: p. 5]. This concept is in use today, where numerous air-capable ships support small-detachment helicopter operations with limited numbers of aviation personnel, utilizing tailored pack-up kits designed to handle most "O" level maintenance demands. Other demands are met through augmentation of maintenance and/or supply resources from other ships or support sites ashore. [Ref. 15: p. 5]

Clearly, it is not possible to predict with certainty the logistics support requirements to the year 2000 and beyond. Without question however, the support of dispersed, air-capable surface combatants, many equipped with relatively high performance aircraft, will present formidable logistics challenges. [Ref. 15: p. 1]

The aircraft carrier of today will continue to be a major part of naval aviation in the year 2000 [Ref. 50: p. 26]. Advanced technology and V/STOL aircraft could permit all sea-based air missions to be performed by one supersonic and two or three subsonic aircraft types, with helicopters still playing an important role. A new generation of ships ranging from 8,000 to 50,000 tons may be developed to operate V/STOL aircraft. Some of these ships may be limited to five or six aircraft onboard, others may base 12 to 15 aircraft, while the larger ships may carry up to 50 aircraft. [Ref. 51: p. 1]

The diversity of ship types utilizing V/STOL aircraft and the dispersed ship formations utilizing V/STOL aircraft will require a greater variation of support capabilities in the future. A Seven Echelon Concept (Table I) is envisioned to replace today's three levels of maintenance. These seven echelons would provide minimal staging capability, three levels of organizational capability, two levels of intermediate capability, and a depot capability. It is envisioned that this concept will provide a cost-effective balance between onboard support and external support for any size ship. [Ref. 51: p. 2]

Small ships in the force would have less than today's full "O" Level capability, while ships of intermediate size might have full "O" Level and no "I" Level capability. Other ships might be equipped for full "O" Level and partial "I" Level. In any structure, either somewhere in the force or at a nearby shore site, there would be an Aviation Support Unit (ASU). The ASU would have spare parts, personnel, and test equipment to fill out the missing support functions on the small and intermediate size ships. The CV/CVN support

TABLE I: SUPPORT ECHELON CAPABILITY

ECHELON	LOCATION	MAINTENANCE FUNCTION/LEVEL
1	• Host Ship for Staging Operations	• Refuel • Walkaround Preflight • Short-Term Flight Crew Accommodation/Weather Protection
2	• Host Ship for Task Force Dependent Operations	<u>ORGANIZATIONAL (3)</u> • Replenishment of all Consumables and Expendables (Fuel, Ordnance, etc.) • Fault Isolation Using Airborne Support Equipment Engine Health Monitoring System (EHMS)/Built-In-Test (BIT) • Remove and Replace at the Weapons Replaceable Assembly (WRA) Level-Core Avionics and Flight Essential Systems • Turnaround and Daily Inspection • Corrosion Control (Washdown) • Engine Module Remove and Replace by ASU Task Team • Tethered Propulsion Check
3	• Host Ship for Independent Operations (Surge) • Aviation Support Unit • Independent Logistics Support Base	<u>ORGANIZATIONAL (2)</u> • Comprehensive Remove and Replace of all High Failure Rate WRAs including Engine Modules • Remove and Replace some Shop Replaceable Assembly (SRAs) for Core Avionics and other Flight and Mission Essential Subsystems • Limited Battle Damage Repair Capability including Structures, Hydraulics and Safety Systems • Limited Scheduled Maintenance
4	• Aviation Support Unit • Independent Logistics Support Base Unit	<u>ORGANIZATIONAL (1)</u> • Comprehensive Remove and Replace of all High Failure Rate SRAs • Complete Scheduled Maintenance including Phase Inspections
5	• Aviation Support Unit • Independent Logistics Support Base	<u>INTERMEDIATE (2)</u> • Moderate Battle Damage Repair of Structures (including composites) • Aircraft Change/Modification Incorporation • Fabrication of some High Failure Rate Assemblies • Some Bit and Piece Part Repair Capability
6	• Facility Ashore • Aviation Support Unit • Independent Logistics Support Base	<u>INTERMEDIATE (1)</u> • Major Battle Damage Repair of Structures Beyond the Range of Modularity • Fabrication of all Assemblies from Raw Material Stocks • Comprehensive Test and Repair of all Removed WRAs and SRAs • Contractor Maintenance Interface
7	• Facility Ashore	<u>DEPOT</u> • Complete Aircraft Rework including Major Modification and Phased Overhaul • Contractor Maintenance Interface

[Ref. 15: p. 7]

operations of today might be relatively unchanged; however, the ASU to support the smaller air-capable ships would likely be placed on the CV/CVN. [Ref. 51: p. 2]

Echelon One represents a minimum aircraft refueling/ handling capability. Echelon Two is the least capable level of support for sustained aircraft operations and would be planned for the smaller ships. For increased ship size, Echelon Three capability would be added to Echelon Two and for still larger ships, Echelons Two, Three, and Four would be combined. This progression would apply on up to the CV/CVN with Echelons Two through Six. Echelon Seven equates to the current Depot Level of maintenance. [Ref. 51: p. 2]

Other required support features would likely include:

-- An effective logistics management information and control system.[Ref. 15: p. 8]

-- Initial outfitting involving packup kits tailored to support echelons.[Ref. 15: p. 8]

-- Cross training of personnel in basic tasks to raise efficiency of small deck-loadings of aircraft.[Ref. 15: p. 8]

-- Consistent maintenance concepts among similar functional systems in aircraft and ships to provide logistics advantages (hydraulics, communications, computers, and navigation equipment are examples.[Ref. 51: p. 2]

-- Resupply by Mobile Logistics Support Force (MLSF) ships. This would likely be on a direct basis to each air-capable ship in turn (door-to-door), dependent on the degree of dispersion. The alternative of replenishing CV/CVNs with follow-on replenishment of the smaller ships from the CV/CVNs could pull the small air-capable ships off station for major portions of their total operating time. [Ref. 15: p. 8]

-- High-speed support ships such as Surface Effect Ships (SES) would have application in the support forces as ASU vessels, for resupply, and for recovery of unflyable aircraft from dispersed ships. [Ref. 15: p. 8]

The general maintenance enhancing features currently in planning or that will be needed to ensure the success of a dispersed basing concept and V/STOL operation are:

-- Inflight performance monitoring of selected parameters

-- Automated readout capability of maintenance data

-- Fault detection and isolation capability of avionics and nonavionics systems to at least the Shop Repairable Assembly (SRA) level

-- Condition Monitoring of structural components

-- Corrosion resistant materials

-- Modular design for most systems

-- Self start capability

-- Accessibility of components

-- Logistics communication/data link

-- Onboard computers/microprocessors usable for diagnostics. [Ref. 51: p. 2]

The power plants of aircraft utilized in the dispersed concept would most probably have to include the following maintenance features:

-- Scheduled inspections performed with the power plant installed in the aircraft

-- Modular power plants, replaceable with minimum personnel and support equipment

-- Modules and replacement components repairable at the intermediate level, with complex component repair accomplished at the depot level. [Ref. 51: p. 3]

Future weapons systems will attempt to reduce the need for Ground Support Equipment (GSE) by designing into the system the required test and support capability. Where this is not feasible, a mobile, modularized support capability will be required. These GSE packages will have to be designed for specific repair tasks with transportable fly-on maintenance teams dispatched from the ASU to the dispersed ship [Ref. 51: p. 5].

Additional considerations concerning logistics support of a dispersed air-capable Navy are:

-- Ship motions will have a greater effect on maintenance and supply support operations than they do on flying operations (launch and recovery).

-- Demographic and social trends indicate declining manpower availability to meet the needs of SBA forces circa 2000 (dispersal will require greater numbers of personnel).

-- Support requirements of the future can be met in an evolutionary fashion through tailored application and enhancement of existent logistics facilities, resources and support concepts. [Ref. 15: p. 13]

It is apparent that the concepts and procedures for closely coordinating a dispersed concept will originate in the LAMPS world. Maintenance and logistics concepts will further develop to suit the needs of LAMPS and these concepts will serve as forerunners to multi-purpose V/STOL, and to the high performance V/STOL forces which may follow closely behind. [Ref. 16: p. 101]

4. Summary

In recent years, the Navy has been placing greater emphasis on the need for reliability and maintainability in an effort to improve weapons system readiness. It is envisioned that this emphasis will result in significant benefit, not only for systems just now coming on line, but for future systems as well. Problems of readiness undoubtedly will persist for older systems that will remain a part of the naval aviation inventory for years to come. As these older systems are phased out, and as technology continues to design reliability and maintainability into new systems, it is anticipated that fewer, less highly trained maintenance personnel will be required. On the other hand, complicating aircraft support in the future would be the logistics and maintenance support challenges posed by an air-capable navy. This concept, employing a diversity of ships equipped with relatively high performance aircraft, will require extensive modification of today's logistics support capabilities--possibly including as many as seven levels of maintenance.

The next chapter addresses some of the planning and change mechanisms by which naval aviation maintenance attempts to prepare for the future.

III. THE PLANNING AND CHANGE PROCESS

A. PERSPECTIVE

Planning is usually divided into two general concepts: Long-range (Strategic) Planning and Functional (Tactical) Planning.

Long-range planning is concerned with change--change in the future environment, change in mission, change in technology, etc. [Ref. 52: p. 7]. It is necessary because decisions can be made only in the present, yet decisions cannot be made for the present alone. The most expedient, most opportunistic decision--let alone the decision not to decide at all--may commit an organization for a long period of time, if not permanently and irrevocably. It follows then that long-range planning is risk-taking decision making. [Ref. 53: p. 5]

Long-range planning is less formalized and structured than functional planning. It is more intuitive and concerned for the most part with factors beyond the organization's control. The product is a statement of ends and means. [Ref. 54: p. 60]

By contrast, functional planning initiates getting the actual work done that is envisioned in the construction of objectives and goals at the long-range planning level. Functional planning is accomplished to serve an organization's annual programming and budgeting process--these plans are usually expressed in the form of budgets, schedules and procedures [Ref. 55: p. 10-11].

B. LONG-RANGE PLANNING

Long-range planning is not forecasting, or masterminding the future. It is necessary precisely because organizations cannot forecast or predict the future. It does not deal with future decisions, but rather with the futurity of present decisions. The question facing the long-range planner is not what the organization should do tomorrow. Rather, it is: what should be done today to be ready for an uncertain tomorrow? The question is not what will happen in the future. It is: what futurity has to be factored into present thinking and doing, what time spans have to be considered, <u>and how can this information be used to make good decisions now?</u> [Ref. 53: pp. 1-5]. Essentially, long-range planning is a process by which top managers identify long-term objectives and develop broad policies and strategies to assist in acquiring, allocating and using resources to reach those objectives [Ref. 54: p. 60].

The long-range planning process, besides producing a statement of ends and means, often has the added benefits of assisting in the development of strategic issues, integrating and coordinating complex organizations, and stimulating innovative thinking throughout the organization [Ref. 54: p. 62].

1. Office of the Chief of Naval Operations (OPNAV)

As chairman of an ad-hoc committee appointed in 1954 to study long-range shipbuilding plans and programs, Vice Admiral Ralph A. Ofstie observed:

"It is too much to expect that the average OPNAV officer, heavily burdened with making the best of today's inadequacies, can satisfactorily project himself in odd hours into imaginative, yet sound contemplation of another world ten or more years hence. If nothing more, his mind will be slow to view unfavorably for 1965 the type of weapon or force he is daily supporting as essential for 1955 or 1958." [Ref. 54: p. 63]

Although a degree of long-range planning is currently accomplished within the general Navy staff structure, the pressures of short term demands on small staffs limit the scope of what can be accomplished. [Ref. 54: p. 62]

In recognition of this problem, the Long Range Planning Group (OP-OOX) was established within the OPNAV staff on 15 January, 1980. The purpose of this group is to assist the Chief of Naval Operations in identifying long-range objectives, setting priorities, analyzing alternative strategies for achieving the objectives, and evaluating the impact of limited resources on future naval capabilities. The Director, Long Range Planning Group, is a Staff Assistant reporting directly to the CNO on long-range planning matters. [Ref. 56: p. 1]

Within the OP-OOX structure, there are four planners representing the following planning areas: Technology, Politico-military, Resources, and Programs. The Technology

Planner, for example, is specifically responsible for: assisting in the conduct of studies pertaining to the future technology environment; analyzing intelligence assessments to identify promising Navy technological initiatives; acting as a principal liaison between the OP-OOX staff and the civilian technological community; coordinating with other staff offices in their research and development planning functions, contributing to CNO policy guidance for the annual Planning, Programming, and Budget System (PPBS) cycle. [Ref. 57]

In relating the role of technology to the Navy's need for effective long-range planning, CDR G. G. Riggle writing for U.S. Naval Institute Proceedings observes:

> "As yet, one can only speculate about the ultimate impact of such developments as precision guided standoff munitions, advanced surface hull forms, and powered-lift aircraft on the future character of naval warfare. A great deal more study and planning certainly will be required before there can be any confidence that these or other new technologies will offer alternatives which are economically affordable and operationally desirable. But to wring maximum advantage from technological opportunities, a closer relationship must be established between the Navy's future capability objectives, operational employment concepts, and weapon system development and acquisition strategies." [Ref. 54: p. 64]

In describing OP-OOX long-range planning, as opposed to functional planning within the Navy's Program and Budgeting System, Riggle further states:

> "Both [strategic and functional planning] involve similar planning procedures, but while the Long Range Planning Group will usually describe preferred outcomes for the whole Navy, most existing Navy planning focuses on specific action programs designed to produce more precisely defined results. Despite these theoretical differences, in practice the two forms of planning should be complementary and therefore often difficult to separate." [Ref. 54: p. 64]

2. OPNAV/Naval Air Systems Command (NAVAIR)

Each warfare mission sponsor in the Navy must annually prepare a 20-year plan. The Naval Aviation Plan (NAP) is signed jointly by the Deputy Chief of Naval Operations (Air Warfare) (DCNO AIR, OP-05) and by the Commander, Naval Air Systems Command. Specifically, the Aviation Plans and Requirements Division (OP-50) and the Deputy Commander for Plans and Programs (AIR-01) are designated as the focal points for their respective organizations. [Ref. 58: p. 1]

The NAP is used as the basic aviation planning reference for air weapons system research, development and acquisitions. [Ref. 57: p. 4] It provides guidance to all elements of naval aviation for better coordination and focusing of all elements toward the aspects of mid and long-range planning [Ref. 4: p. 1]. Additionally, the NAP is used as a basic input to the Program Objectives Memorandum (POM) process and as the basis for OP-05 submission to the Extended Planning Annex (EPA) to the POM. [Ref. 58: p. 4]

The NAP is necessitated by the fact that the complexities of Naval Aviation require that planning be conducted beyond the five-year time span of the POM/Five-year Defense Plan (FYDP). This planning must also reflect current policy and guidance which is generated annually as a result of the PPBS process. It is, therefore, necessary that the NAP contain, as a minimum:

"...current FYDP approved force levels, FYDP procurements/ modification plans, and 15 year extended mission projections of those plans which require further definition to meet requirements/force levels." [Ref. 58: p. 1]

The NAP is also designed to provide overall program planning guidance to the naval aviation community. The CNO policy statement regarding the NAP specifies:

"It will include objectives and planning data required to develop, procure and maintain an aviation force structure responsive to current and projected naval roles and threats, and will identify long-range requirements. All facets of Naval Aviation will be addressed; i.e., aircraft carriers, air stations, aircraft, weapons, and other systems, RDT&E (Research, Development, Test and Evaluation), manpower and training, aviation logistics and the major studies dealing with requirements of force structure." [Ref. 58: pp. 1-2]

It is intended that the NAP be used by all segments of the aviation community--the planners in OPNAV and Marine Corps Headquarters, NAVAIR, and the major fleet aviation commands. Additionally, the NAP is meant to serve as a valuable tool in educating the many people who review, or who may have an interest in, where naval aviation is headed and why. [Ref. 59: pp. 8, 9]

In updating the NAP, there are basically three data sources which are used as guidance. CNO's Program Planning Guidance (CPPG), which reiterates Secretary of the Navy and Secretary of Defense guidance and provides CNO direction for structuring the POM and the longer-range plans. CNO's guidance provides the direction which shapes the Navy's future by today's actions and the NAP represents the application and implementation of this guidance within the aviation community. [Ref. 59: p. 9]

The requirements of the fleet are a second source of data. One source of information in this area is the Air Board which is chaired by OP-05 and is composed of senior Navy and Marine aviators. The board meets semi-annually to discuss policy and problems affecting Naval Aviation. Additional sources of information are the requirements submitted to OPNAV, and meetings with fleet personnel. [Ref. 59: p. 9]

The third source of requirements is generated from analysis of the capabilities and age of the current inventory of aircraft and weapons systems. From this analysis, a plan for replacement is developed, if required. [Ref. 59: p. 9]

The Naval Aviation Plan is designed as an evolving document. Although its basic framework doesn't change yearly, it does encompass change which reflects near-term program decisions or changes in Secretary of Defense or CNO guidance. The essence of the NAP is to provide the basis for understanding the long-range impact of program changes so that alternative solutions are ready. [Ref. 59: p. 12]

C. THE NAVAL AVIATION MAINTENANCE PROGRAM (NAMP)

1. Background

The NAMP is promulgated by OPNAV instruction (OPNAVINST) 4790.2 series which sets forth the maintenance policies, procedures and responsibilities for naval aviation maintenance at all levels--it is the basic document and authority governing the management of all naval aviation maintenance. It delineates command, administrative, and management relationships and establishes policies and procedures for the assignment of maintenance tasks and/or responsibilities for the conduct of the Naval Aviation Maintenance Program. [Ref. 60: p. 1]

The dynamic nature of the NAMP has resulted in periodic revision to the program since it was first established by CNO in October 1959. Following its introduction, the three levels of maintenance concept and other significant changes have been introduced. The Naval Aviation Maintenance and Material Management (3M) System was implemented in 1965 to incorporate maintenance data collection, man-hour accounting, and aircraft accounting systems into the NAMP. OPNAVINST 4790.2 was issued in July 1970 to provide a cohesive, command-oriented NAMP publication. This revision was made up of four volumes including the Maintenance Data Collection Subsystem (MDCS). In June 1972 a major revision was issued as OPNAVINST 4790.2A. This was followed by another revision in October 1979 when the format of the document was changed to make the instruction more useful at all levels of maintenance management. This revision, OPNAVINST 4790.2B, embodies the "stand-alone" approach utilizing five separate volumes: a volume establishing policy, a separate volume for each level of maintenance (3), and a volume devoted to data processing requirements. [Ref. 60: p. 1]

2. Coordination

The NAMP is under the sponsorship and direction of the CNO. Administration is through the chain of command and material and technical support is provided by the Chief of Naval Material (CNM) and appropriate systems commands. The NAMP planning and change process is coordinated through a two-tier committee structure. [Ref. 60: p. 3]

The Policy Committee is charged with monitoring continued development of the NAMP. This committee meets annually under the sponsorship of the Director Aviation Programs Division (OP-51) and consists of nine members. The Head, Aircraft Maintenance and Material Branch (OP-514) acts as chairman and the committee is composed of representatives from: the Chief of Naval Material; Commander, Naval Air Systems Command; Commandant of the Marine Corps; Commander, Naval Air Force, Atlantic; Commander, Naval Air Force, Pacific; Chief of Naval Air Training; Chief of Naval Reserve; and Commander, Naval Supply Systems Command. The Policy Committee's primary function is to recommend to the CNO policy and procedures required for the continued development, refinement, and utilization of the NAMP. [Ref. 60: p. 3]

The NAMP Working Committee is also established under the sponsorship of the Director, Aviation Programs Division (OP-51). The Head, Aircraft Maintenance and Material Branch (OP-514) or his designated representative, acts as chairman of the NAMP Working Committee. The committee is composed of ten members. Each member of the NAMP Policy Committee appoints a representative to serve on the Working Committee. Additionally, the Commanding Officer, Aircraft Intermediate Maintenance Support Office (AIMSO) appoints a representative to serve on the Working Committee. The committee normally meets biannually, or as directed by the chairman. [Ref. 60: pp. 4-5]

The purpose of biannual Working Committee meetings is to assemble an agenda for the Policy Committee, based on guidance provided by the Policy Committee the previous year. As an example, the Policy Committee decided in September 1981 that the 1982 theme would deal with aircraft engine support improvement. With this guidance, the Working Committee assembles an agenda of engine-related topics to be ruled upon by the Policy Committee at a later date. Since there are other NAMP issues before the Working Committee, in addition to preparing the Policy Committee agenda, biannual meetings are necessary. Issues which cannot be decided upon at the Working Committee level are assembled into decision packages for referral to the Policy Committee. [Ref. 61]

The Commanding Officer, AIMSO, is the coordinator of the NAMP instruction (OPNAV 4790.2 series). Included in his responsibilities is the development and promulgation of recommended changes (upon CNO approval). The Navy Maintenance and Supply Office (NAVMASSO) provides assistance to AIMSO in coordinating the NAMP instruction for Maintenance Data System (MDS) requirements [Ref. 60: p. 6].

Modification to OPNAVINST "4790" falls into two main categories:

- Interim Change: A change issued by rapid means (usually by message to AIMSO) to correct a procedure, policy, practice or situation which adversely affects maintenance, aircraft/personnel safety, readiness, or a critical function in the NAMP [Ref. 62: C-1].

- Change: A modification to the content of OPNAVINST "4790" involving a revision of, addition to, or deletion of existing policies or procedures [Ref. 62: C-1].

Fleet units are encouraged to participate in the NAMP functional change process utilizing the procedures outlined in Appendix C to OPNAVINST "4790" [Ref. 61]. Recommendations to modify the policies/procedures in the NAMP are forwarded to AIMSO (Code 50) via the chain of command [Ref. 62: p. C-1]. AIMSO reviews change recommendations and upon completion of review either:

- Returns the change recommendations to the submitting activity via the endorsing activities, pending development of additional information/clarification (or cancellation) or

- Forwards the change recommendation, including additional comments/modification/recommendations developed during the review process, to the NAMP Policy Committee members and other cognizant activities for review and comments. [Ref. 62: p. C-2]

Following receipt of comments from the NAMP Policy Committee members and other appropriate activities, AIMSO prepares and submits a consolidated change proposal to CNO (OP-51) with recommendations. Upon receipt of the consolidated change proposal CNO (OP-51) evaluates and approves or disapproves the recommendations. If required, CNO (OP-51) may refer the change proposal to the NAMP Policy or Working Committee for further review. Upon final approval by CNO (OP-51), the change recommendation is returned to AIMSO and the approved change is consolidated into a change package and promulgated. [Ref. 62: p. C-2]

Recommended changes surface (ultimately reaching OP-51) in any one of three major ways:

- Change recommendations submitted at the unit level via the chain of command.
- Change recommendations originating through decisions/ briefs presented during Working Committee/Policy Committee meetings.
- Change recommendations originating at the headquarters level (OPNAV) that move downward. [Ref. 61]

Regardless of whether change recommendations surface from user activities, whether they originate from Working/ Policy Committee meetings, or whether they originate from special information available only at the headquarters level, all change recommendations are routed through the review and routing process described above. [Ref. 61]

The requirement to evaluate the direction OPNAVINST "4790" will take in the future, as well as appropriate sub-issues, is specifically addressed through the two-tier committee structure. These issues may relate to questions such as:

- Is OPNAVINST "4790" too detailed?
- Is it detailed enough?
- Is it too redundant due to the need to duplicate material in the various volumes of the instruction?
- In what ways can it be made a better document? [Ref. 63]

The Working Committee utilizes a dedicated period of time during each biannual meeting session to deliberate issues of this nature in order to continue to improve OPNAVINST "4790" in a general and systematic way. This process is designed to reassess the instruction for viability on a recurring basis. [Ref. 63]

With the one exception of the future requirement to integrate the Naval Aviation Logistic Command Management Information System (NALCOMIS) into OPNAVINST "4790", it is envisioned, at the OP 514 level, that the change process for the instruction will continue to be an evolutionary one. Members of the Policy Committee and their representatives on the Working Committee will continue to develop an array of alternatives for the conduct of the NAMP by considering longer-range Naval Aviation Maintenance issues in addition to those they must deal with in the near-term. [Ref. 63]

D. SUMMARY

CNO's need of a focal point for strategic planning resulted in the recent establishment (within OPNAV) of the Long Range Planning Group (OP-00X). This group serves in an advisory capacity to CNO concerning planning matters extending far beyond the time limits of the PPBS and Five Year Defense Plan.

Within naval aviation, the Deputy Chief of Naval Operations (Air Warfare) and the Commander, Naval Air Systems

Command coordinate mid and long-range planning efforts through their respective planning focal points (OP-50 and AIR-01). The product of this joint planning effort is the Naval Aviation Plan, which is made available to all elements of naval aviation in order that the various aspects of mid and long-range planning may be better coordinated.

The particular planning and change requirements associated with the Naval Aviation Maintenance Program (NAMP) are the ultimate responsibility of OPNAV. The NAMP (OPNAVINST 4790.2 series) planning and change process is effected in an evolutionary manner, through a two-tiered committee structure under the sponsorship of OP-51. Change recommendations are originated as a result of: headquarters level (OPNAV) initiatives; decisions/briefs presented during NAMP Committee meetings; unit level submissions via the chain of command. Additionally OPNAVINST "4790" is systematically reassessed for general viability through the deliberative processes of the NAMP Working Committee.

These then, are the general organizational/procedural processes through which naval aviation maintenance prepares for and implements change. A compilation of "Senior Management's" views (Senior level Aeronautical Maintenance Duty Officers) concerning the naval aviation maintenance change process is presented in the next chapter.

IV. SENIOR MANAGEMENT'S VIEW OF THE CHANGE PROCESS

A. BACKGROUND

1. Selection of Questionnaire Recipients

In order to determine how senior level management views the change process in Naval Aviation Maintenance, a questionnaire was designed to provide selected indicators for appraisal of the naval aviation maintenance change process.

The questionnaire (see Appendix A) was sent to all captains and commanders holding Aeronautical Maintenance Duty Officer designators (1520). Of 65 questionnaires administered, 40 were completed and returned by 20 captains and 20 commanders. An analysis of the responses contained in these 40 questionnaires is presented in this chapter.

2. Design of Questionnaire

A discussion of the reasoning for, and wording of, the questions contained in the questionnaire is considered appropriate for clarity of purpose. Of prime importance is the insight into question meanings, and their relevance to the appraisal of the Naval Aviation Maintenance Change process.

The first, second and third questions are empirical questions bearing on the future; how much change can be expected, in what areas, and how will it affect naval aviation maintenance.

Question four asks how the respondent views the <u>current</u> naval aviation maintenance environment (including NAMP) as it relates to the following facets of the change process: Planning for Change, Vertical Communication (top-down), Vertical Communication (bottom-up), Dealing with Resistance to Change, and Implementation of Change. This question was designed to solicit experienced opinion concerning what is right, as well as what is wrong, with the current naval aviation maintenance environment.

Question five asks: "What do you consider to be impediments to change within the naval aviation maintenance environment?" This question was designed to draw out specific problems that are best identified by experienced, senior level management.

Question six asks: "In your view, how can the current change process be improved?" This question was designed to sample top management's thinking on possible redesign of the current process.

It was not the intention of the authors to solicit a "negative" commentary on the aviation maintenance change process. Perhaps the questionnaire could have been written with less bias toward "what are we doing wrong?", and more emphasis toward "what are we doing right?" It is a credit to the respondents that, in many instances, both the positive and negative aspects of a particular area were addressed.

Since the purpose of this thesis is to serve as a forum/instrument for discussion for the 1520 community, it is the opinion of the authors that highlighting problem areas would prove beneficial for improving the effectiveness of naval aviation maintenance.

The casual reader, not directly involved in the naval aviation maintenance environment, should understand that the many successfully implemented changes to naval aviation maintenance have not been addressed. Without question, naval aviation maintenance has been very successful in the maintenance of highly complex equipment. As is the case in any complex management system, there is always room for improvement.

3. Methodology

Quantifiable questionnaire data were tabulated in bar-graph form to summarize responses. No attempt was made to quantify or weight respondents' written comments.

B. RESPONDENTS' VIEW OF THE FUTURE

The degree of technological change envisioned by the respondents over the next 10 year, and 10 to 20 year time frames is presented in Figures 4-1 and 4-2. Respondents' comments concerning technological change follow the figures.

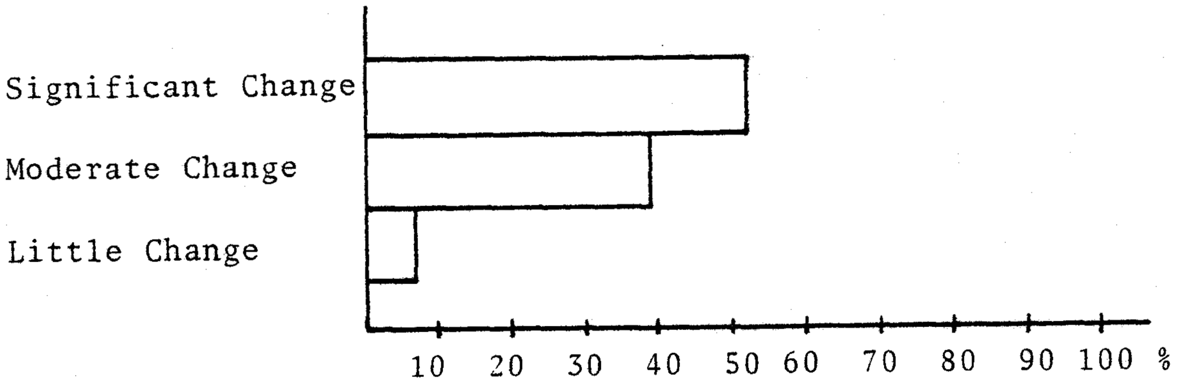

Figure 4-1. Degree of technological change expected next 10 years. (% of respondents)

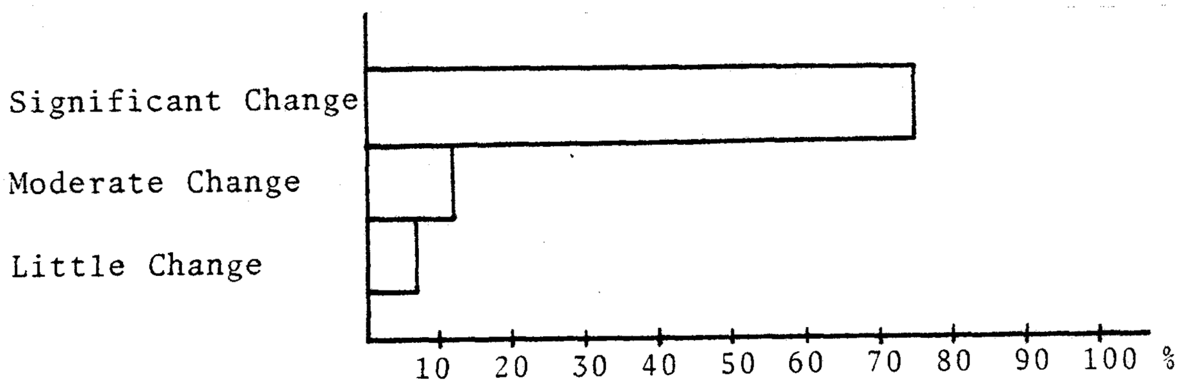

Figure 4-2. Degree of technological change expected next 10 to 20 years. (% of respondents)

Figures 4-1 and 4-2 reflect a consensus that significant technological change will be experienced in Naval Aviation Maintenance to the year 2000. Respondents' comments in this area are listed as follows:

"Technological change rate will increase in the future, not decrease, as major advances are made in the state-of-the-art....we must learn to deal better and faster with it. Our advantage in the future will lie in technology, not quantity."

"...changes in technology will be driven somewhat by affordability. We need to insure that maintenance technology changes as rapidly as system and equipment technology--any large disparity, and readiness will turn into a negative number."

"R & D money is not being spent on technology for aviation maintenance...."

"Every sign points directly to new technological advances in our aviation maintenance and material management arena. I think that the significant growth in both use and utility of data processing equipment at the organizational and intermediate levels will force this change. Certainly the manner of maintaining the airfoil, engine and avionics equipments will be driven by this new technology. My only concern is that we do not allow the technology to overcome us by continuing the present policy of not training our enlisted and officer talent in the fleet to deal with the technology; thereby making us victims of myriad contractor and civil service technicians aboard our ships."

Question 2, "What degree of personnel change do you think can be expected in Naval Aviation Maintenance?", is a logical follow-on to question 1. Respondents are afforded an opportunity to link a perception of significant technological change over the next 20 years to the personnel resources which will be required to cope with new technology. Figures 4-3 through 4-6 represent the respondents' views on "personnel change" in four areas:

- the quality of maintenance personnel over the next 10 years.
- the quality of maintenance personnel over the next 10-20 years.
- the quantity of maintenance personnel over the next 10 years.

- the quantity of maintenance personnel over the next 10-20 years.

Question 2 elicited a wide range of expectations with the predominant view indicating moderate change in quality during the next 10 year and 10 to 20 year periods, with little to moderate change in quantity during the next 10 year and 10 to 20 year periods. Opinions concerning the direction of change were approximately equally divided. Correlated responses are depicted in Figures 4-3 through 4-6 below, with subjective comments following.

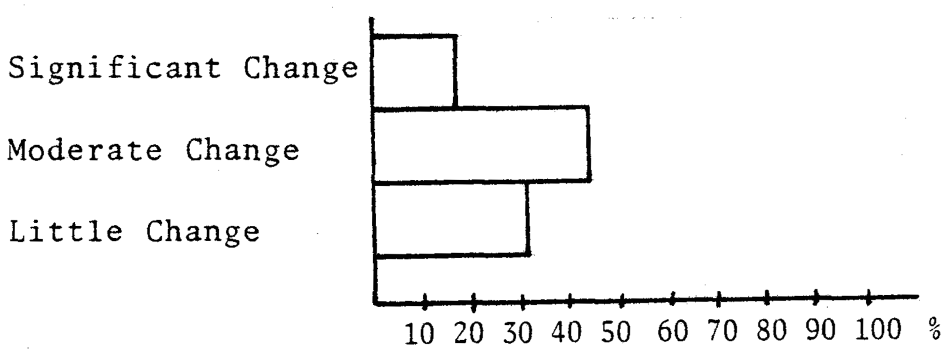

Figure 4-3. Degree of change in personnel quality next 10 years. (% of respondents)

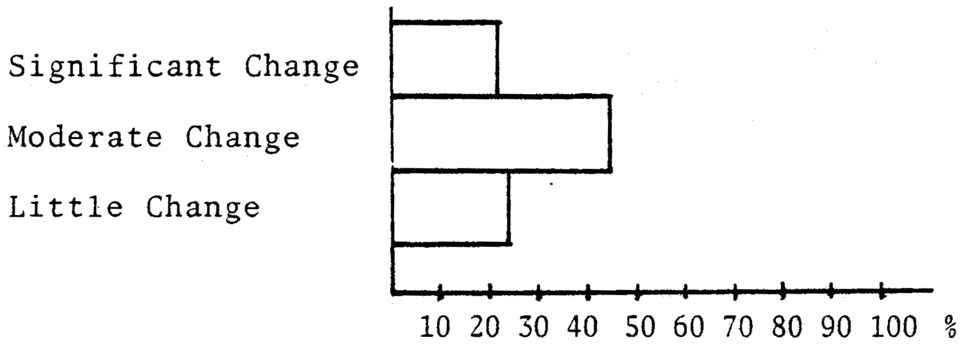

Figure 4-4. Degree of change in personnel quality next 10 to 20 yrs. (% of respondents)

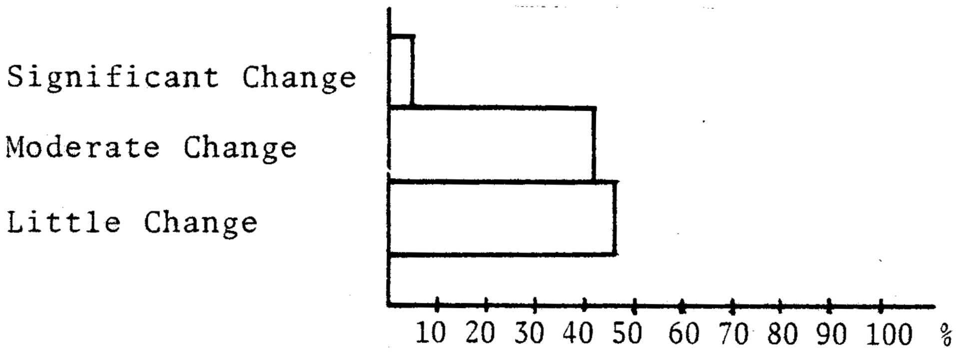

Figure 4-5. Degree of change in personnel quantity next 10 yrs. (% of respondents)

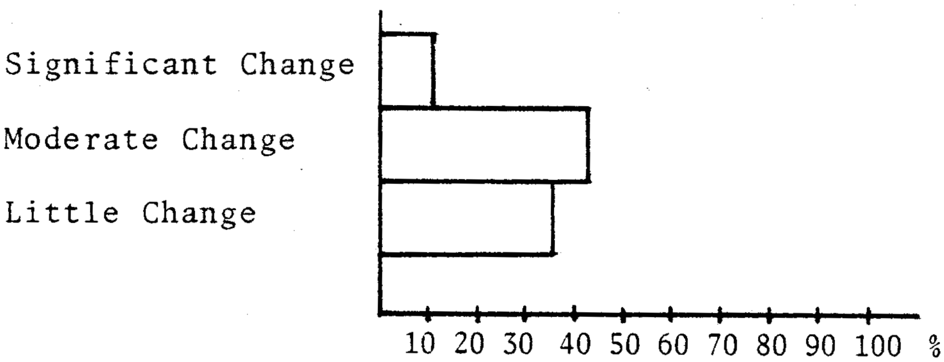

Figure 4-6. Degree of change in personnel quantity next 10 to 20 yrs. (% of respondents)

"I do not think that aviation is going to attract more of the available talent in the future than it does today. I do not necessarily agree with the position of the bureacracy that says we need more talent. I think we have the talent in both our officer and enlisted ranks in aviation maintenance, but we do a poor job of making them aware and capable of coping with the technology. It is awfully difficult for a good man to be afforded an opportunity to obtain any training. I think we sometimes take the second team and train them because the first team has to keep the airplanes flying. There must be a plan that is sacred in how we train and utilize our fleet maintenance officers. I am speaking specifically of the 1520s and LDOs, and how we train and utilize the aviation enlisted ratings. I submit that there is no plan or at best an unworkable plan."

"I don't see aviation maintenance getting more people in the near future. The trend, if any, is the opposite direction. 'Contracting out' is politically popular. I look for the quality of our people to improve as the civilian school systems get their act together and get back to basics."

"Personnel quality must increase--current 'A' school graduates do not have even the most basic skills. From E-4 thru E-7 we need hands on technicians not leaders. If our personnel were skilled we would not require 45 technical representatives when a CV goes to sea. Additionally, we would not require tech assists when benches fail."

"I continue to be optimistic that each succeeding generation will be better educated and more scientifically oriented; accordingly, I believe the quality of officers (1520) and enlisted group IX maintenance ratings will be higher in the next 10-20 years. Contradictorily, I suspect the quantity to remain relatively stable or even to decline."

"The quantity and quality of maintenance personnel will go down as less qualified, intuitive individuals are attracted to maintenance; (less 18-24 yr. olds available next 10-20 yrs.). The incentives for young maintainers are not there."

"I think there's going to be some accommodation to weapons systems that are deployed independently. There is no doubt in my mind that the key to their readiness will be in durability and high reliability. As we grow to 15 Carrier Wings there certainly will be an expansion of those in support roles to match the fleet's needs, but other than that, I don't see a proliferation in either maintenance enlisted personnel or officers in squadrons or staffs. There's every reason to believe that billets might be cut if we could achieve a higher state of readiness training among our maintenance crews. My view is that a lot of the staff work is caused by squadrons with inadequate skills. Perhaps with increased retention and recruiting we'll be able to attract and retain a higher skill base than we've had in the last decade."

"Every officer will not be CNO, Admiral, or Captain; some will not make 05/04 and the only way we will ever be able to choose future leaders will be to look for the innovators, iconoclasts, and those who have the visionary approaches to solve maintenance problems--not those who can follow cookbook tactics as though they were robots."

Having addressed technological and personnel change, it is logical to determine to what degree senior management perceives a resulting change to the organizational structure. A correlation of the degree of change to organizational structure envisioned by the respondents, over the next 10 year, and 10 to 20 year periods, is presented in Figures 4-7 and 4-8.

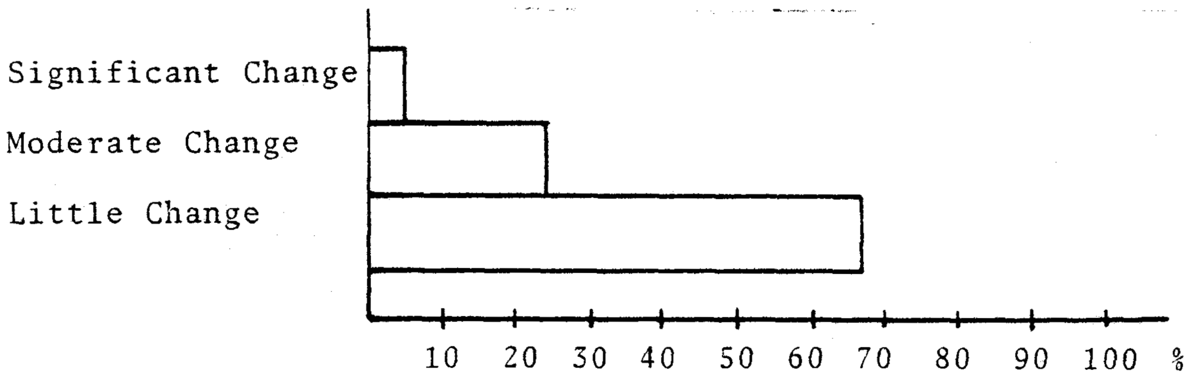

Figure 4-7. Degree of change to organizational structure expected next 10 yrs. (% of respondents)

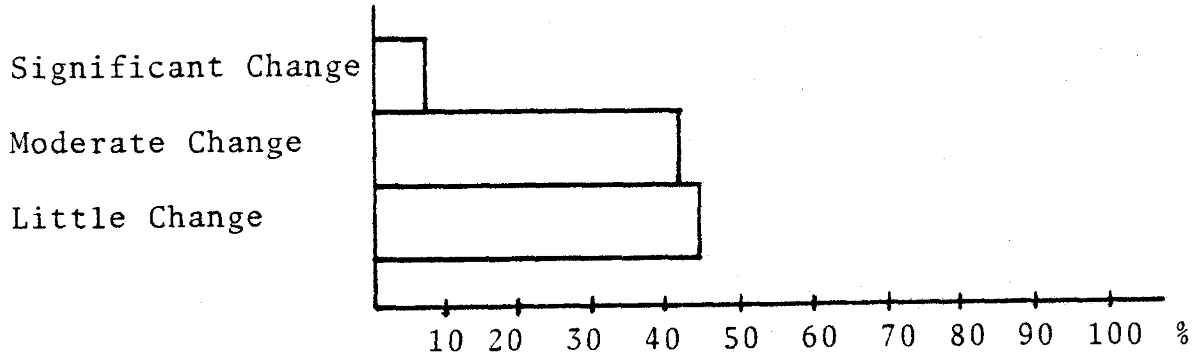

Figure 4-8. Degree of change to organizational structure expected next 10 to 20 years. (% of respondents)

Clearly, the consensus is that there will be little change in the naval aviation maintenance organizational structure over the next 10 years with little to moderate change from 10 to 20 years out. Respondents' comments concerning change in organizational structure are as follows:

> "We have been over organizational structure much too often over the past years. I think we have a good baseline with the three levels of maintenance concept and I would hope that we will keep the organizational, intermediate and depot levels of maintenance basically as they are now. My concern is, however, primarily with the O&I level. There I feel that budget constraints will drive us to consolidate our maintenance organizations ashore more than we have in the past. Also, aboard ship, we are going to have to look at different performance standards to measure readiness. We must talk about intermediate maintenance activity (IMA) because the IMA includes supply, facilities, equipment, and many other elements that are beyond the capability of an AIMD officer to deal with. The 'bottom line' is that the organization is good, we ought not to change it to solve the problem, but we ought to make certain that we understand which functions are O-level, which functions are I-level, and then train people for those functions and put them in that spot. We do a very poor job of detailing in my judgment, and we do a very poor job of matching the skills required to the mission placed on the squadron or AIMD."

"The organizational structure can be changed to more clearly define actual skill, pay grade, training and numbers required--if we permit the management skills in the personnel field to actually and realistically define their procedure requirements. SHOROC, ACMO Series and other measurement standards need to be taught to the maintenance manager who may then assist in the identity of requirements. Given all these factors we should be better prepared to staff to actual requirements."

"Little or no change to organizational structure; however, there is room for personnel/organization reductions if forced to that choice."

"Cost will make changes to organizational structure mandatory--we may have two flying squadrons maintained by one organizational unit. Maximize both tools and talent. 'I' level may increase in size to reduce pipeline assets and transportation cost."

"Changes are controlled primarily by people, not organizational structures. With bureaucracy naturally resistant to change, only through intelligent strong leadership at the top supported by progressive individuals throughout the bureaucracy will change come about."

"I believe the current organizational structure is relatively sound. We need more knowledgeable personnel at higher levels of management. More visibility for O&I levels in the budget would force this issue."

"...we resist change in organizational structure probably more than in any other area. I don't see much change in the future. However, I think we should look at the staff area. I think we have too many staffs who's only product is paper; who add absolutely nothing to operational readiness."

C. RESPONDENTS' VIEWS OF THE CURRENT CHANGE PROCESS

No section of the questionnaire produced a wider range of opinions/comments than did question 4. This question solicited respondents' views concerning the current naval aviation maintenance environment, including NAMP, as it relates to the following facets of the change process:

- Planning for Change

- Vertical Communication (top-down)

- Vertical Communication (bottom-up)

- Dealing with Resistance to Change

- Implementation of Change

Correlated responses are presented in Figures 4-9 through 4-13. Following each table are respondents' comments pertaining to each specific area.

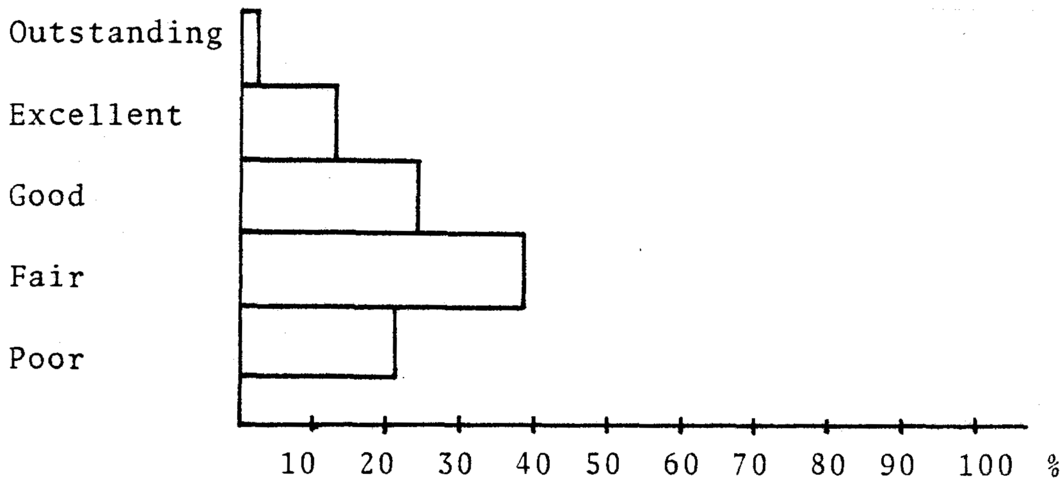

Figure 4-9. Planning for Change.
(% of respondents)

"I would add to the NAMP process an element called long range planning, brainstorming, research and development, aviation maintenance in the year 2000, or whatever you choose to call it. Yesterday's wildest dreams may be tomorrow's policy. We need to be more in tune with the operational planning instead of following along after the fact. It's difficult to get an operational planner to think about maintenance, let alone spell it. What kind of maintenance will we have/should we have in the year 2000? Will we have robots in our AIMD's; will we have 'Star Trek' and 'Battle Star Galactica' technology? Will we even be able to afford naval aviation and aircraft carriers in the year 2000? The British couldn't and I suspect the Russians will also find the carrier an expensive item. We should not hesitate to take a bold and challenging look into the future. I would look to our bright young junior officers to do this. There is no such thing as a dumb idea; some are just ahead of their time."

"...we normally do not see plans in the field. Plans are not well formulated to include all required elements."

"We never plan enough, we certainly never communicate enough (although we think we do) and implementation is always too slow. I don't know how to make it better."

"We are for the most part, very poor at planning for change. We preach that all ILS elements must be accounted for before changes take place, i.e. new equipment, programs, etc. But we always seem to implement with 'can do' before we're completely ready because 'operators' are in the driver's seat."

"Planning for change is 'unsatisfactory'...The strength of useless organizations in resisting their demise is unparalleled, unwarranted and unwanted. No easy cure in sight."

"I think by looking at the entire maintenance logistics program we see a pitiful situation caused by fragmented and conflicting responsibilities at the very top levels between OPNAV, AIMSO, NAVMAT, NAVAIR, NALC, CINC's, TYCOMS, FUNCWINGS. We need to hire a surgeon quickly before this proliferation of responsibilities spreads."

"It appears to me that [higher levels] do not do a very good job of planning for changes and adequately funding changes far enough in advance."

"This question reached to the heart of our problem. Planning for change is mission impossible because of the individual interests that exist primarily in the Washington environment....I have been on the cutting edge of trying to be visionary over the years, and I quite honestly reflect and say-is it worth it? The Navy has allowed itself to become mired by the bureaucracy of civil service in most areas, and the 'blue suits' are not in charge of their own destiny. That statement is not made lightly. I wish I felt differently, but I do not know how to say it anymore truthfully."

"A7 FLIR, F/A-18, TARPS, SIDMS, HARPOON....all examples of limited support, limited training/pubs, undertrained and late arrival of personnel, yet operators pushing for full utilization. Over 300 cross deck items required, of major support equipment, to get CVs back in shape to support Airwing with new aircraft....Down 50 personnel in AIMD during TYT....Very short AVCAL depth or range....Trying to do too much with too little."

The above comments would indicate that planning for change is perceived to be a weak area in the naval aviation maintenance environment.

Communication, both up and down the chain of command, evoked an equal number of diverse comments. Overall, however, communications rated slightly higher than the other sub areas of question 4. Figures 4-10 and 4-11 represent correlated responses in the area of communication.

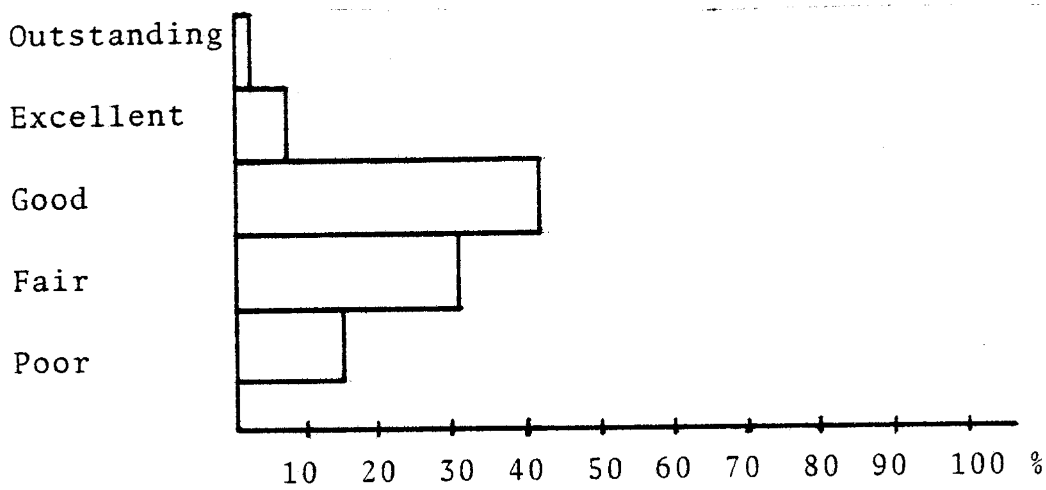

Figure 4-10. Vertical Communication (top-down). (% of respondents)

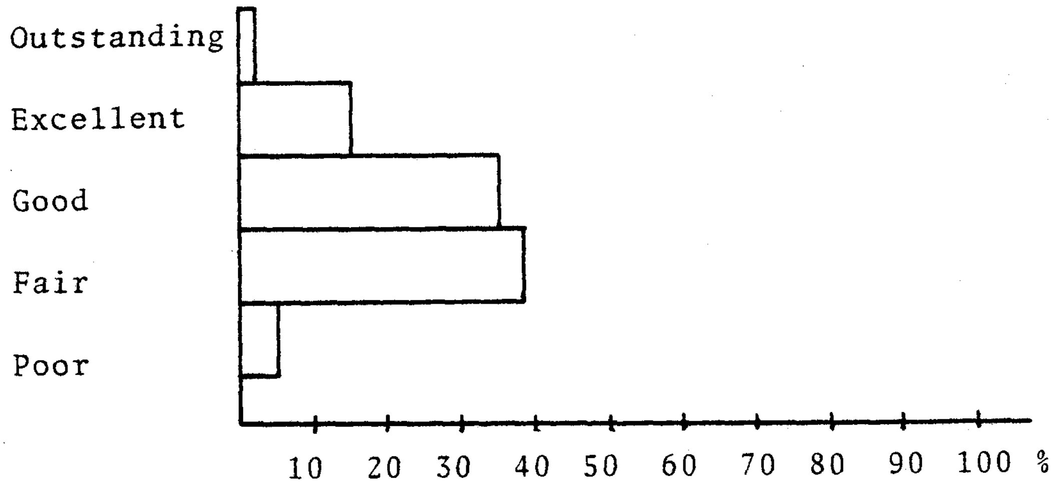

Figure 4-11. Vertical Communication (bottom-up). (% of respondents)

"The NAMP, though a travesty upon the precept of briefly stating policy, is the best vehicle we have and we use it well. We must contain the content of the NAMP to keep it usable at the worker level. Communication down needs to improve. Too many decisions are made which affect the fleet without fleet input. Communication up is worse due to apparent inefficiencies of the staff levels. We are in the process of overcoming the inertia of resistance to change. Wish us luck (spelled w-o-r-k)."

"How can there be any vertical communication when no one can decide who's in charge?"

"Vertical communications from the top down--if we could ever find out who had the helm and who was giving us the direction, we could then allude to communication from the top down."

"Communication from the bottom up--it tries and we get all of our efforts set up, but we have so many folks trying to perpetuate their own ego without concern for the big picture of the Navy. Priorities of endeavor are often determined by what is best for me and my present role."

"Improve communication. There must be an easier way to communicate new ideas and those ideas must be received and acted upon in a timely manner; after which, timely and meaningful feedback must take place in order to stimulate more ideas."

"We can improve our communications in the 1520 community by working together to meet our future needs. I think this is being done now better than ever. Again, we have a long way to go--but we are getting there."

Dealing with resistance to change is a difficult concept to evaluate. The term smacks of academic "organization theory" and is difficult to deal with objectively. The fact that resistance to change exists, or is perceived to exist, is borne out by the majority of the respondents' comments in this area. Figure 4-12 correlates responses concerning this topic, with associated subjective comments following.

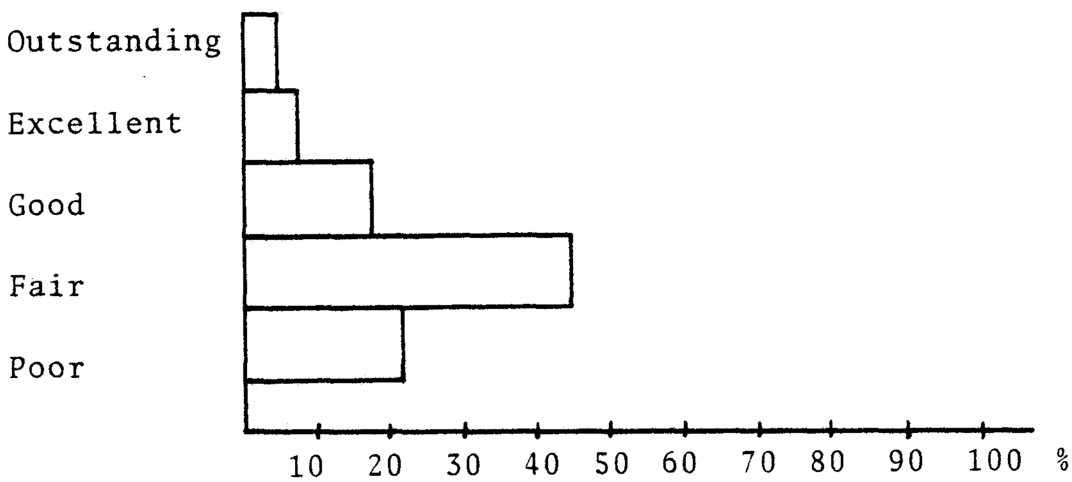

Figure 4-12. Dealing with Resistance to Change. (% of respondents)

"Resistance to change has always been advertised as <u>High</u> at the working (fleet) level, when in fact that is not as true as it is at higher levels....New ideas are difficult to sell with budget demands and promotion risks associated with new ideas."

"Dealing with resistance to change is difficult because we really have not and do not make significant changes in our organization. Our priorities are still based on the old standards; i.e. cats, traps, flight hours, sorties, etc. If top management can institute real world change in our system then we may see other echelons accept change more easily."

"A lot of our maintenance and logistics problems are definitely a result of too much change in Logistic/Maintenance support systems. Because of weak headquarters discipline, field activities are burdened with far too many unique systems that circumvent the Navy supply and maintenance program. An advantage to these programs is usually their 'dollar fenced' budget so they don't suffer from the system's unfunded backlog. For example, the Navy has great difficulty competing with contractor maintenance because, where implemented, it's 100% or more funded. The rest of the Navy shows a prioritized deficit. Who wouldn't vote for [contractor maintenance] under those circumstances?"

"In the field, my perspective is that we have brought in a lot of change where there's actual hardware involved. People in technical skill areas have done a creditable job. We lead the world in high performance airplanes and our technology is unsurpassed. The fact that the designers probably could have done simpler things shouldn't detract from the achievements they have made. Our weakness is not with those in squadrons and air wings that carry the burden of aviation maintenance everyday; our weakness is back in the Washington arena, where naval aviation maintenance has traditionally been a stepchild. Only now are we developing career maintenance officers with the professional tools to deal with these problems at the higher levels....there are, however, few people who want to grow to serve in Washington because of frustrations there. ...there appears to be no discipline, or at least very little, among the incumbents. Each one, by himself, is a well equipped, well trained, highly innovative officer. But not many of us have self destructive impulses; that goes for organizations as well. Someone must assume the lead and some must follow. The leader has yet to emerge."

"There are many proposed changes to the way we do business which <u>must</u> be <u>resisted</u> (e.g., contracting out, emasculating the TAD concept, etc.) There are other changes that must be pushed (e.g., NALCOMIS; present CNO initiatives on drug abuse; pride and professionalism; control of fraud, waste, and abuse, etc.). Technological change is easy compared to the others."

Figure 4-13 correlates responses to the change process as it relates to "Implementation of Change", with respondents rating the process as fair to good.

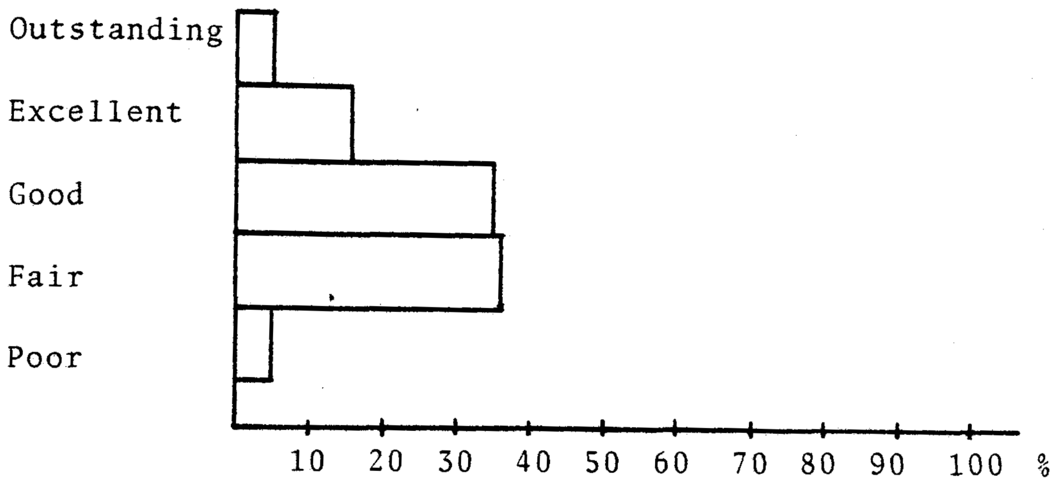

Figure 4-13. Implementation of Change.
(% of respondents)

"Implementation of change is generally good. New systems have been implemented in the fleet with creditable success despite their early deployment in some cases. Implementation of organizational change is unsatisfactory."

"Implementation of change--if you have a specific change, we are good at that. But we are only fair at the strategic broad objectives/determinations. I think this is due to the high degree of fragmentation in our community (1520). No one can tell me who is really in charge and whose drum we march to. OP-05 should be the pinnacle of power for aviation maintenance material management. Actually, specifically, OP-51."

"...I believe we generally do a good to excellent job in this area, but we often move at glacial speed despite the dynamics of the NAMP."

"Decision process is hard--not implementation."

Question 5 solicited senior management's views concerning impediments to change within the naval aviation maintenance environment. This is necessarily a negative question; however, the range of answers given by the respondents reflect both positive and negative aspects. It is difficult to find a common thread among all the responses. Subjective comments are as follows:

"Good change--dumb people; bad change--smart people.... Where dollars are required, change in the maintenance world, especially on the management side, will come slowly and will require a lot of energy to bring about. This is because of the priority order of things military, and I have difficulty disagreeing with that. There are, however, many new ideas--cheap ones--yet to be surfaced out in the fleet which can and will improve management in the future.... the NAMP change process is a good one. Suggested changes get aired thoroughly and ruled on relatively quickly."

"Having too many people in decision making positions who have spent too much of their naval or civilian careers in D.C. and don't know what the operating forces are like. They appear to resist changes because they don't understand what's happening in the fleet."

"Surely one of the impediments to change is euphemistically called 'rice bowling'. The aviation maintenance program development, to a degree, is tied to the civil service system. You cannot hire people one year and fire them the next simply because somebody hasn't....figured out the correct way to organize to begin with. The people [civilian] we have in Naval Aviation Support Administrative billets are experts at holding on to their jobs and the status quo and something has to be done about that. But I don't blame it on the civil servants, I blame it on those who have created all these organizations with overlapping responsibilities--and I'm being charitable when I say overlapping."

"Impediments to overall change, as I see them, are directly related to our attitude and acceptance of less than directed implementation. We are still not satisfactorily reporting under the Maintenance Data System which has been with us for over 15 years. I feel we really do not provide an adequate transition to make a change and therefore frequently operate a new system under old rules--which defeats any change."

"A bureaucracy feeds on itself and few people want to admit their job may not be needed. If the energy expended in keeping bureaucracies alive was aimed at improving aircraft readiness we would gain a lot."

"Short range management, conservatism, lack of proper visibility, lack of knowledge, budget process from Congress down encourages cuts in operation & Maintenance Navy (O&MN) accounts because cuts are immediately evident; no political support for O&MN budgets as compared with big production dollars and present unwritten philosophy of senior managers of 'don't make waves'."

"...personal attitude of many managers makes the change system appear to be less than effective. Short range solutions may sometimes be required to keep the business going,but long term solutions are frequently not explored because to do so is not expedient compared to the other important things which must be dealt with. Well planned, long term solutions for many of our problems would assist us in the change process area."

"I feel that the greatest impediment to change is the vast size of the organization vs. the austere funds we have to run it."

"The bureaucracy of government. We are not able to respond to the needs of the Fleet in a timely manner due to limitations imposed by regulations. Mainly in the areas of personnel and material support. We haven't done well in keeping up with the need for ADP service either. Too many restrictions on acquiring local computer systems."

"There are too many in influential positions that support only their own philosophies. There is no sense of unity, i.e. east and west coast navies."

"Impediments to change result from the different views held by the major claimants (AIRPAC, AIRLANT, CNAVRES)."

"The elements underlying impediments to change are:

A. We haven't done it that way before.
B. What we have now works--why screw it up.
C. It was good enough for Orville and Wilbur....
D. Why should we change that when we don't know if a new system will work better?"

"A total cohesive organization is lacking (i.e. LANT vs. PAC, NAVAIR vs. NAVMAT, NALC vs. NAEC). We don't work together at the top level of management."

"We feel good (comfortable) with the 'status quo'. 'Don't rock the boat'....'my responsibility--my area--hands off.'
-Maintenance is the 'stepchild of procurement'.
-We put out fires instead of solving the basic problem by changing the system."

"Impediments to change caused by lack of understanding of direction we need to go, of positive attitude toward needed change, a better understanding of communication problems between old breed and new breed coming up."

"There are no impediments to change; however, the changes take a while to be promulgated because of time required to print and distribute the change and any required software."

"Impediments are generally not the change itself. The change is the easiest part. The dollars and people requirements associated with any change are the driving force behind implementation. Software is also a strong element in determining when implementing a change can be accomplished."

"...ILS elements are not sufficiently coordinated together to achieve the best, smoothest introduction of a weapons system. Such things as 'changes in policy' or 'procedures' go smoother and require only time--to change habits and get the word out to all levels."

"Impediments to change are caused by disunity among planners at the O-6 level--parochialism. But on the whole, changes progress rather easily in most cases."

"Impediments to change are caused by lack of:
- -Funding
- -Understanding of the Fleet's needs by the upper echelon decision makers."

"We tend to try and start new programs while requiring management to continue old processes at the same time. As a result, some of the bad habits continue and the new process never gets fully implemented."

"-Complexity of organization.
- -The requirement of getting a number of offices to concur when individual interests vary to some degree.
- -At times, human nature dictates a resistance to change, especially when we consider the 'not-invented-here' syndrome."

"Apart from personalities, the single major impediment to change is, in my view, our slow acceptance/development/implementation of automated MIS's; this is compounded today by the incredible number of ADP wickets to be hurdled."

"...The major impediments to change, are the changes themselves; their width, depth and volume to the point that the average sailor has to be repeatedly trained over to be advanced in rate."

"The biggest impediment to change within the aviation maintenance environment in my judgment, is the organizational hierarchy that is in place in Washington that you must deal with every day. When I say Washington, I am addressing Washington and all of its field activities. It is totally controlled,in my judgment,by civilians who in most cases have never been to sea and are not going to sea, do not understand the environment that we must operate in and are not willing to learn. I have heard the song you need them for continuity until I am sick at my stomach. Yes, you need the continuity, but if you do minimal personnel management, you can maintain continuity whether you are dealing with military or civilians. Until the 'blue suit'gets back in charge of his destiny in CNM and NAVAIR and all of the associated field activities, you will continue the blood bath as being the only road to change.... [upper levels] perform duplicated functions. You can find 1,000 people that can say 'No,' but you can never find that one responsible individual that can say 'Make it so.' Washington runs by committee and that is unfortunate."

Specific comments regarding the NAMP are as follows:

"There are faults in our system and improvement can be made. We have experienced and knowledgeable people in each echelon in the decision and/or management system. It is our responsibility to make the system work in each case or to change the system to one that is achievable. What we need is in the NAMP or complimenting instructions. We also know the chain of command to institute change. A recent Navy-wide survey indicates the NAMP 'as is' is an excellent document, providing all required information in the proper format and only needs 'fine tuning' to make it better. That is our present tasking and we need to support the request for inputs."

"The Naval Aviation Maintenance Program, as originally conceived and developed in 1968, was to have a Navy-wide standard policy and procedures document that could be utilized, in the broadest terms, to answer questions to problems in 95% of the cases appearing before the average maintenance officer on a day-to-day basis. Major maintenance programs and supporting elements of logistic support were to be blended into a document that headquarters personnel, fleet personnel and the shore establishment could equally utilize for guidance and management of those programs. Once the document was published in 1970 there were to be relatively few changes--a concept that seems to have fallen by the wayside. Later, during the mid-seventies it became painfully evident virtually every change was a complete overhaul of the document to the point that an intrinsic interest, by working maintenance people, could not be engendered for proper documentation procedures. Today, 10 years later, I see no trend toward decreasing the amount of changes on an annual basis. Users of the document could not have, until recently, cared less what was in the document. With the advent of NAMP PQS (AWS), this may change; however, they will have to turn in their wings each time a change is promulgated."

"The NAMP may be too large to ensure wide ranging updating and understanding. All directions are usually modified and changed."

"Although large strides have been made in 'ease of change' to [NAMP] we have a long way to go. Most people in the fleet feel it is almost too hard to originate and get a change to the NAMP implemented."

"[The] NAMP has been written in blood over the years. It is the best program in existence today. The NAMP has gone through many iterations to reach its present form and is constantly being revised and updated."

"The 4790 is a standardization manual. It's value relative to any of the five questions asked is only 'fair'. Most change needed is instituted by fleet activities and finally distributed or standardized by NAMP. Very little direct influence is seen by the NAMP which causes change."

"The NAMP appears to be such an impenetrable document that it inhibits change in every quarter."

"If I were in charge of the NAMP, I would restrict the gross weight of the document. I feel that if a board were picked to perform a hunt and kill task on the NAMP, they could eliminate 30% of the redundancy and specificity of telling today's maintenance officer how to do his job. As I talk to young 1520 maintenance officers they are chagrined at the lack of initiatives they can pursue and envision coming under the cookbook approach of the Air Force, where one's time is utterly consumed by avoiding deviations to step-by-step instructions."

"A significant improvement to the 4790.2 change process will accrue with NAMP automation, i.e. getting it on a word processor."

"Timeliness of changes is deplorable...12-18 months. Portions of the NAMP written by various individuals exhibit engineering background or technical background, etc. Let's put NAMP changes into a word processing system which will provide for homogeneity of content and assist maintenance workers in understanding the content. Timeliness could also be enhanced by transmitting change programs by CRT terminals."

"In the case of the NAMP, we need to speed up the part of the process from decision to actual implementation. That's being worked on. Other major changes require pure 'dog work'--complete staffing, getting our (your) stuff together and convincing the right people it's the smart and necessary thing to do. We've lost battles in the past for lack of the above plus follow up. There are too many people who can say no and too few who can say yes."

"The change process as I know it is a good one and becoming smoother as time goes by. I would leave it alone for 3 or 4 more years."

"The formal NAMP change process presently in use serves us well. It's better than anything we had or did in the past. It may seem a bit slow but that's not all bad--we make very few dumb decisions. However, we should always look to progress. Change and progress are not necessarily the same."

"Within Naval Aviation Maintenance no change to the present process is required. Change occurs to meet new needs--our system is flexible."

"There are too many things/programs in maintenance which require/need change but the NAMP is <u>not</u> one of them."

D. RESPONDENTS' VIEWS ON IMPROVING THE CHANGE PROCESS

The following list of suggestions to improve the change process, while not exhaustive, covers numerous areas which may possibly serve as a basis for formulating specific change recommendations. Some of these suggestions would require the efforts of many people to staff/implement, both in and out of the aviation maintenance community. Clearly, other suggestions may not be feasible for various reasons. Other change recommendations, however, might be implemented with relative ease. Senior level commentary and suggestions for improving the change process are as follows:

> "The change process has noticeably improved over the past 8 to 10 years. Encouragement of those who recognize problems and have some idea for resolution of the problems is our only real hope of getting to the heart of the issue. Expeditious processing of proposed changes with feedback to the originator might improve the process. I do have some question as to whether we can expect any significant improvement in the change process and certainly have no innovative ideas as to how it can be improved."

> "Appoint a standing board whose responsibility encompasses aviation maintenance in its entirety--responsible for reviewing the problems, the future, and coming up with action to take care of the problem--meet quarterly--members to be top level management and middle level (must be)."

> "Reduce review process. If TYCOMS agree and NAVAIR says O.K.--change it."

> "You can only change the current process by putting the military back in charge and having them exercise leadership of the first order, and not leadership by committee, but leadership--make the decisions. Secondly, you must streamline the organization by consolidation and significant reduction in the number of diverse contractors employed. Thirdly, you have to force integration of aviation supply into aviation maintenance. And fourthly, you must attack the fragmented programs which divert resources, energy and attention from the maintenance system."

> "-Develop human engineering into computer applications.
> -Thoroughly evaluate the need for a change prior to implementation...eliminate those changes that provide marginal return."

> "Aviation maintenance is more than 'kicking sailors around'. Too many of our maintenance officers seem to think that the louder (more intensely) an issue is presented, the more logical it is supposed to be. This approach has done great harm to many undertakings to bring about improvements in

aviation maintenance. The inability of many of the senior members of the aviation maintenance community to work successfully within the prevailing bureaucracy has stifled meaningful change. Anyone can float through a bureaucratic tour of duty without leaving a mark--many do; also, many fight the system rather than the problems; many try to change things overnight which doesn't happen; however, the prime element is being able to bring about meaningful change within the bureaucracy--it can be done with knowledge of how the system works, a complete knowledge of problems to be resolved and the patience to persist. A rebel without a cause is not needed."

"Aviation maintenance still has its primary emphasis at the depot level because the budget emphasizes depot dollars. Intermediate and organizational level maintenance activities are buried in other budget line items. For example, component repair receives major emphasis in the depot level budget, even though many more items are repaired at the I level. As long as senior managers let this continue, O&I levels will continue to suffer. I am encouraged with respect to personnel quality by seeing higher levels of formal education in the junior officers of the 1520 community. Hopefully, this will improve our professionalism."

"We must identify professional growth from entry level through middle to top management. Our present system does not foster this concept. We are always in too much of a hurry to take the time to properly indoctrinate, train and then to enable our personnel to develop skills, gain confidence and provide a fair return on our investment. We must provide time to practice our skills, to cope with new technology, to master our capabilities. We are slaves to change and new technology, frequently replacing systems that we did not optimize."

"-OPNAV and NAVAIR take the lead and drive the Type Commanders to standardize.
-In the real world--each Type Commander does 'his own thing' in aviation maintenance.
-Reduce the number of people/commands required to concur on changes."

"Better communications between program managers at the Systems Command level.

Earlier involvement of fleet personnel in planning stages of changes (requires more travel bucks than most fleet activities have now).

More flexibility to recommendations for change at Systems Command level when problems are identified (also takes bucks)."

"Open up the dialogue between Policy makers and the men in the field. Actively seek out new, young ideas and don't be afraid of conflict. Use conflict as a change agent, if necessary."

"A major step to effect change would be to completely identify all required elements or facets in the proposed change. Then make the proposal work--or if an element falls behind, stop the whole change until the delinquent element catches up. In this manner we may instill confidence in the individuals that will be required to make the change at all levels. Once a change is decided upon all echelons must implement and practice it."

"Cull out those with a 'stone-age' approach to management and remove the politics within the aviation maintenance community."

"Have NAVAIR and NAVSEA work closer together on ship/aircraft support problems."

"Recommend a 1520 Flag in OP 05 organization or designation of 1520 captain as spokesman--i.e. by position (OP 514 or AIR 580)."

"Provide adequate funding.
Decision makers must be thoroughly educated as to the Fleet's requirements."

"The senior 1520 should hold the top maintenance job (OP-514) or new flag billet in Washington D.C. Fundamental to this is a need for a progression of billets (commander and above) which lead to qualification for the top job."

"Make up a roving QA/New Idea/Problem team (commander, two lieutenants, AVCM, AFCM, AZCM) from both TYCOMS and have them 'roam' at the direction of CNAP 74 and CNAL 54 through both TYCOMS. Meet quarterly and also look/visit fleet activities from both fleets (i.e., CNAL team on PACFLT ship and vice versa). Don't make them an 'advisory team' with check list but a good idea/change team working directly/open door for 74/54. Make them a mix of young and old experienced people; make it sea duty but no more than 18 mo. so they don't get burned out; travel first class and be treated first class so experienced/professional maintenance experts will fight to get on the teams. Give them a budget with money in it; ensure one of the lieutenants is a supply officer; make a cardinal rule that the teams never be used as investigators. The payback would be predictably high for the investment."

"Need intelligent 1520 representation in several flag officer positions. Need more emphasis on readiness of current forces with this emphasis recognizing that this is not an overnight event but one which requires careful attention throughout the life of a piece of hardware--from conception to retirement."

"Recommend taking more rapid action on change suggestions from the fleet and establishing a feedback report system to the originator to let the individual know what is being done. NAVAIR has only recently started a feedback report system on Support, Maintenance and Recoverability (SM&R) code change requests. It only takes about 6 months to find out what's happening now vice the previous method of 2 to 3 years--or never."

"Sufficient bucks and bodies to fully support all elements of ILS package prior to fleet introduction."

"More knowledgeable decision makers in key positions [at higher levels]."

"Greater participation by fleet units in the process."

"Better passing of information aimed at the maintenance personnel. Articles in publications that are read by all. Better explanations as to how and why some of the changes are made."

"You should never take one element of logistics without considering all of the elements....The personnel, the facilities, the material, the maintenance, yes, all of them fit together. Logistics encompasses a lot, and maintenance is one of the logistics elements. I would wish you godspeed because somebody needs to look at the problem, but they need to do more than look at it, they need to implement something for a change. We keep developing and looking at the problem, but we never implement."

"I sometimes wonder if it is not better to stop doing a lot of these changes that we are doing and let the fleet catch up with them. We have so many changes that are flowing down upon our hill until we do not know which one to attack first. We need to let it stabilize, and we need to make certain our sailors are trained to understand what they have, and make those changes that are driven by sound leadership and sound management principles. We do not do that today, I can assure you. When you talk about [the problems of] logistics philosophies and the life-cycle costing and life-cycle management and all of the myriad terms that are flowing around--I hope your study will [highlight problem areas] that we can [present to] the highest levels....I have seen it addressed before, but I do not see much coming out of the other end of the pipe. I do not see change happening."

E. SUMMARY

A questionnaire (Appendix A) was designed to solicit Senior Aeronautical Maintenance Duty Officers' (Designator 1520; captains and commanders) views concerning the Naval Aviation Maintenance Change Process. The questionnaire requested responses in the following areas:

--the degree of technological, personnel, and organizational change which could be anticipated through the year 2000.

--evaluation of the current naval aviation maintenance environment (including NAMP) as it relates to: Planning for Change; Communication; Dealing with Resistance to Change; Implementation of Change.

--evaluation of areas which might be considered impediments to change.

--views concerning methods for improving the current change process.

Responses indicate a strong perception that technology will be driving a great deal of change in naval aviation maintenance through the year 2000. Perceptions regarding changes in personnel resources through the year 2000 reveal a predominant expectation that there will be moderate change in quality, with little to moderate change in quantity to the year 2000. Subjective comments point toward a concern for the fact that the quality of maintenance personnel will have to increase through recruitment and training in order to cope with more technologically sophisticated systems.

Concurrent concern is expressed with regard to an expectation of declining personnel assets.

Respondents perceive little change in organizational structure within naval aviation maintenance during the next 10 years, with moderate change occurring 10 to 20 years out. Subjective comments indicate that the baseline of three levels of maintenance is appropriate; however, budget constraints and a need for economies of scale could force consolidation. The high level of staff proliferation in existing organizational structures, is viewed as a barrier to organizational restructuring. Additionally, concern is expressed regarding a perceived need for closer matching of skills to maintenance billets.

Respondents' views of the current naval aviation environment, as it relates to various aspects of the change process, indicate that effectiveness in Planning for Change is perceived to be weak. Subjective comments regarding Planning for Change indicate a need for the following: long-range (strategic) planning within naval aviation maintenance; field participation in the planning process; greater attention to all elements of Integrated Logistics Support (ILS). Additionally, the bureaucracy, with its many sub-areas of conflicting responsibility is considered detrimental to effective planning.

Communication as it relates to the change process is considered good to fair (top-down) and fair to good (bottom-up). Subjective comments indicate concerns with respect to:

decisions being made with little fleet input; communications hampered by staff inefficiency; parochialism and ambiguity concerning ultimate responsibility; and the need for streamlining the communications system in order to improve the upward flow of new ideas.

Respondents evaluate effectiveness in Dealing with Resistance to Change as fair. A general perception is that resistance to change is less of a problem at the fleet level than at headquarters levels. To the degree that resistance to change exists in the fleet, it is perceived to be the result of a profusion of change in logistics and maintenance support systems. Respondents rate the process of change implementation as fair to good, and subjective comments do not reveal trends of concern.

Comments concerning respondents' perception of impediments to change within the naval aviation maintenance environment are divergent; however, some of the more frequently expressed concerns focus on the following subject areas: headquarters level bureaucracy and an abundance of overlapping organizational responsibilities; deficiencies in the utilization of MIS and ADP systems; emphasis on short-term solutions at the expense of long-term outcomes; budgetary constraints.

Subjective responses concerning the NAMP cover a wide range of comment, including the following views: the NAMP is an excellent, highly flexible document, well suited to change implementation; it is too large to keep updated and its size inhibits change; it is too specific and overly redundant; the NAMP change process is excessively elongated.

Recommendations and comments concerning improvement of the aviation maintenance change process appear to stress the following areas:

--improvement through "de civilianization" is needed, with greater control of the decision making process exercised by the military.

--greater attention to the precepts of ILS is required.

--better manipulation of the bureaucracy by insiders to ensure orderly change.

--greater degree of inter-headquarters cooperation (NAVAIR and NAVSEA).

--greater attention to inter-Type Commander standardization (AIRLANT and AIRPAC).

--increased involvement of fleet personnel in the change process.

--installation of 1520 flag representation in several flag officer positions.

V. SUMMARY AND CONCLUSIONS

A. SUMMARY

In fulfilling the Navy's mission, the large-deck carrier will most likely remain the prominent platform through the year 2000. Further development in V/STOL aircraft technology could facilitate greater dispersal of TACAIR, perhaps with a mix of large-deck CTOL carriers and smaller CVV's, supplemented with V/STOL aircraft aboard smaller combatants in an "air-capable" Navy concept. Further breakthroughs in aircraft design could make other combinations of force structure possible.

In addition to changes in force structure, technological change through the year 2000 will probably include: greater use of composite aircraft structures; lighter, smaller, higher thrust engines; highly miniaturized VHSIC avionics systems; greater use of fly-by-wire systems and BIT capabilities. In the area of personnel, future demographic trends may affect the Navy's ability to attract sufficient numbers of high quality personnel to cope with rapidly advancing technology.

In the near term, the Navy has been placing greater emphasis on the need for reliability and maintainability in an effort to improve weapons system readiness. It is envisioned that problems of readiness will persist for older systems that will remain a part of the inventory for years to come. As these systems are phased out, however, and as greater reliability and maintainability are designed into new systems, fewer, less highly trained maintenance personnel may be required. Maintenance support requirements posed by an air-capable Navy of the future will challenge logistics planners. This concept will require extensive modification of today's aircraft support capabilities.

Preparation for Change through Planning has recently been emphasized by CNO through establishment of the Long Range Planning Group (OP-00X) within OPNAV. This group serves in an advisory capacity to CNO concerning strategic planning matters.

Within naval aviation, the Deputy Chief of Naval Operations (Air Warfare) and the Commander, Naval Air Systems Command coordinate mid and long-range planning efforts through the Naval Aviation Plan. The Plan is made available to all elements of Naval Aviation in order that mid and long-range planning may be better coordinated.

Within naval aviation maintenance, NAMP planning and change requirements are the ultimate responsibility of OPNAV. Planning and change processes are effected in an evolutionary manner, through a two-tiered committee structure, with systematic viability reassessment handled as a function of the NAMP Working Committee.

It is useful, and sometimes necessary, to step outside an organization in order to analyze problems and strengths. It is equally useful, and perhaps even more necessary, to seek the opinions of those most closely associated with an organization. Aeronautical Maintenance Duty Officer's (Designator: 1520; captains and commanders) views concerning the Naval Aviation Maintenance Change Process were therefore solicited. Their expectations would indicate that technology will drive a great deal of change in naval aviation maintenance through the year 2000. In the area of personnel resources, the predominant expectation is that there will be moderate change in quality with little to moderate change in quantity over the next twenty years.

Senior level aircraft maintenance managers perceive little change in organizational structure over the same period; however, budget constraints and a need for organizational economies of scale may force consolidation. Staff proliferation is perceived as a barrier to organizational restructuring.

"Planning for change" is perceived by senior management to be generally weak, with a need for: long-range (strategic planning); increased participation in the planning process; greater attention to (ILS). Conflicting areas of responsibility that exist within the "bureaucracy" are considered detrimental to effective planning.

Concerns expressed with regard to communications center around the perception that decisions are being made with little fleet input and that communications are hampered by staff inefficiency. Additionally, parochialism, ambiguity concerning ultimate responsibility, and the need to streamline the communications system are expressed as areas of concern. "Resistance to change" is perceived to be less of a problem at the fleet level than at the headquarters level and change implementation at the fleet level is considered to be fair to good.

Comments regarding "impediments to change" within the naval aviation maintenance environment are divergent, and focus on expressions of concern for what are perceived to be: overlapping organizational responsibilities; deficiencies in MIS and ADP systems utilization; over-emphasis on short term solutions; and budgetary constraints.

The NAMP is considered by some to be an excellent, highly flexible document, well suited to "change implementation"; while others consider it to be too specific, overly redundant, and encumbered by an excessively long change process.

Comments concerning improvement of the aviation maintenance change process stress: improvement through "de-civilianization"; greater attention to ILS; better manipulation of the bureaucracy by insiders; greater degrees of inter-headquarters cooperation (NAVAIR and NAVSEA) and inter-Type Commander standardization (AIRLANT and AIRPAC); increased involvement of the fleet in the change process; and 1520 flag representation in several flag officer positions.

B. CONCLUSIONS

This thesis focuses on a variety of developments that are expected to be at the root of many changes likely to occur within naval aviation maintenance through the year 2000. The structure of sea based maintenance organizations could change dramatically should the air-capable Navy become reality. Technology will drive change in virtually every facet of aviation maintenance, including revolutionary concepts in aircraft structures, engines and avionics. Technology will increase the performance characteristics of weapons systems, controlling the complexities it creates through improved reliability and maintainability.

The naval aviation maintenance community has prepared well for change through the NAMP evolutionary change process, as well as through more recent organizational innovations such as the establishment of AIMSO. If the community is to become less reactionary as it struggles with the problems of rapid technological change, complex weapons systems, computers and data processing, increased training requirements, budget constraints, and differing priorities; it is imperative that it begin now to develop the psychology and the planning mechanisms that will place greater emphasis on long-range (strategic) planning. This must be done if changes occurring today are to be strategically evaluated before implementation decisions are made.

Although a positive, innovative, "can-do" spirit exists throughout the upper echelons of the naval aviation maintenance community, there is strong evidence of frustration at senior levels regarding a perceived need to streamline the "bureaucracy" to ensure both clarity of purpose and clarity of responsibility.

Very volatile expressions of concern are cited in this thesis regarding the perceived inability of present organizational structure (i.e. "the bureaucracy") to prepare for and adapt to change. These concerns are more widely held than those expressed regarding the community's ability to cope with advancing technology (albeit in a reactionary way) through the next 20 years. It is therefore subjectively concluded that the "bureaucracy", at least in its present form, is an encumbrance to effective preparation for change within naval aviation maintenance environment.

A parallel issue is the perceived need for "clarity-of-purpose" within the Aeronautical Maintenance Duty Officer community. Obviously, the quest for clarity-of-purpose is more likely to be successful to the extent that diverse approaches and philosophies are more unified, and views more broadly shared. Fundamental to the development of purpose are enlightened leadership and uninhibited, candid communications (up, down, and sideways throughout the community). Only when this is accomplished can the understanding that breeds common conviction and concerted action be nurtured.

Clarity of purpose and preparation for change demand central leadership, a leadership recognized at all levels, as the primary articulator of strategic objectives and community concerns, a leadership disciplined by experience in matching aims to the resources necessary to achieve them, a leadership unafraid of complexity and confident that complexity can be managed. Not until such a leadership position is institutionalized can the myriad concerns of senior level aircraft maintenance managers be cohesively addressed.

This thesis has highlighted a host of fertile areas for directed research. Further research might include the following areas as they relate to naval aviation maintenance: continued exploration of the naval aviation maintenance change processes; planning; organizational structure; and technology.

APPENDIX A
QUESTIONNAIRE:

THE NAVAL AVIATION MAINTENANCE CHANGE PROCESS

1. What degree of technological change do you expect in Naval Aviation Maintenance?

	Next 10 years	10 to 20 years
a. Significant change	( )	( )
b. Moderate change	( )	( )
c. Little change	( )	( )

Comments:

2. What degree of Personnel change do you think can be expected in Naval Aviation Maintenance?

Next 10 years

	Quality	Quantity
a. Significant change	( )	( )
b. Moderate change	( )	( )
c. Little change	( )	( )

10 to 20 years

	Quality	Quantity
a. Significant change	( )	( )
b. Moderate change	( )	( )
c. Little change	( )	( )

Comments:

3. In your view, what degree of change to organizational structure (both laterally and vertically) can be expected within Naval Aviation Maintenance?

	Next 10 years	10 to 20 years
a. Significant change	( )	( )
b. Moderate change	( )	( )
c. Little change	( )	( )

Comments:

4. How do you view the current Naval Aviation Maintenance environment (including NAMP) as it relates to the following facets of the change process:

Planning for Change	
outstanding	( )
excellent	( )
good	( )
fair	( )
poor	( )

Vertical Communication (Top - Down)	
outstanding	( )
excellent	( )
good	( )
fair	( )
poor	( )

Vertical Communication (Bottom - Up)	
outstanding	( )
excellent	( )
good	( )
fair	( )
poor	( )

Dealing with Resistance to Change	
outstanding	( )
excellent	( )
good	( )
fair	( )
poor	( )

Implementation of Change	
outstanding	( )
excellent	( )
good	( )
fair	( )
poor	( )

Comments:

5. What do you consider to be the impediments to change within the Naval Aviation Maintenance environment?

6. In your view, how can the current change process be improved?

Additional Comments:

Signature
(Not required)

CDR ( )
CAPT ( )
Years Aviation Maintenance experience ____

APPENDIX B

GLOSSARY/ACRONYM LIST

ACMO - Aircraft Maintenance Staffing Standard

ADP - Automatic Data Processing

AEW - Air Early Warning

AFCM - Master Chief Aircraft Maintenanceman

AIMSO - Aircraft Intermediate Maintenance Support Office

AIRLANT - Air Atlantic

AIRPAC - Air Pacific

AMP - Analytical Maintenance Program

ASD (S&L) - Assistant Secretary of Defense (Support and Logistics)

ASU - Aviation Support Unit

ASW - Anti-submarine Warfare

ATE - Automatic Test Equipment

AVCAL - Aviation Consolidated Allowance List

AVCM - Master Chief Avionics Technician

AVT - Auxiliary Aircraft Landing Training Ship

AWS - Aviation Warfare Specialist

AZCM - Master Chief Aviation Maintenance Administrationman

BIT - Built-in-Test

CINC - Commander-in-Chief

CNAVRES - Chief of Naval Reserve

CNO - Chief of Naval Operations

CPPG - CNO's Program Planning Guidance

CRT - Cathode Ray Tube

CTOL - Conventional Take-off and Landing

CV - Aircraft Carrier

CVN - Aircraft Carrier Nuclear

CVV - Aircraft Carrier Vertical/Short Take-off and Landing

DASH - Drone Anti-submarine Helicopter

DCNO - Deputy Chief of Naval Operations

DOD - Department of Defense

FLIR - Forward-looking Infrared Receiver

FUNCWING - Functional Wing

FYDP - Five Year Defense Plan

GSE - Ground Support Equipment

HUD - Heads-up Display

ILS - Integrated Logistics Support

IMA - Intermediate Maintenance Activity

LAMPS - Light Airborne Multi-purpose System

LPH - Landing Platform Helicopter

LSI - Large Scale Integrated

MDS - Maintenance Data System

MIS - Management Information System

MMP - Maintenance Monitor Panel

NABIT - Non-Avionics-Built-in-Test

NAEC - Naval Air Engineering Center

NALC - Naval Aviation Logistics Center

NALCOMIS - Naval Aviation Logistic Command Management Information System

NAMP - Naval Aviation Maintenance Program

NAP - Naval Aviation Plan

NAVAIR - Naval Air Systems Command

NAVMASSO - Navy Maintenance and Supply Systems Office

NAVMAT - Naval Material Command

NAVSEA - Naval Sea Systems Command

OPNAV - Office of the Chief of Naval Operations

PABST - Primarily Adhesively Bonded Structure

PPBS - Planning, Programming, and Budget System

POM - Program Objectives Memorandum

PQS - Personnel Qualification Standard

RAF - Royal Air Force

RCM - Reliability Centered Maintenance

RDT&E - Research, Development, Test and Evaluation

SBA - Sea Based Air

SCS - Sea Control Ship

SES - Surface Effect Ship

SHOROC - Shore Required Operational Capabilities

SIDMS - Status Inventory Data Management Supply Support System

SLEP - Service Life Extension Program

SRA - Shop Repairable Assembly

STOL - Short Take-off and Landing

STOVL - Short Take-off and Vertical Landing

TACAIR - Tactical Aircraft

TAD - Temporary Additional Duty

TARPS - Tactical Air Reconnaissance Pod

TYCOM - Type Commander

TYT - Turn around Time

UFC - Up Front Console

VHSIC - Very High Speed Integrated Circuit

VLSI - Very Large Scale Integrated

V/STOL - Vertical/Short Take-off and Landing

WRA - Weapon Replaceable Assemblies

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