

USMC Aviation maintenance: Keeping Pace With I-Level Maintenance

CSC 2000

SUBJECT AREA Logistics

EXECUTIVE SUMMARY

Title: USMC Aviation Maintenance: Keeping Pace with I-Level Maintenance

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Thesis: A changed international scene, budgetary difficulties, force structure imbalances, and new operational concepts demand innovative solutions that will ensure support to the warfighter is not diminished.

Discussion: These realities and the implementation of newer aircraft owning advanced technologies and maintaining our existing aircraft present an opportunity to evaluate our current MALS organization. Currently, USMC aircraft are maintained with a three-level maintenance concept. As new aircraft with increased capabilities and reliability enter service and computer technology becomes further integrated with maintenance procedures, Marine Aviation is left with little choice but to consider changing its 20th century philosophy of maintaining aircraft which support new technologies in a 21st century environment.

The MV-22 Osprey and Joint Strike Fighter are the focal point for defining how future maintenance should be done, and who will perform the required maintenance. One of the keys to providing a better way of performing maintenance lies in the strategy of providing the right responses, the right parts, the right people, and the right skills in order to ready the aircraft for the next mission. To understand how we can better support and maintain existing aircraft and future aircraft, we must look outside our present-day organic maintenance support “box” to capitalize on more efficient and more effective ways of conducting maintenance.

It is clear to me our current MALS organization has considerable room for improvement. Reducing the number of levels of maintenance in addition to outsourcing maintenance will increase maintenance effectiveness and efficiency while simultaneously reducing the current logistics footprint and associated infrastructure costs.

Conclusion(s) or Recommendation(s): To maximize our full potential to maintain 21st century aircraft, MALS needs to restructure its organization to better support the organizational level capabilities. This can be accomplished through the transfer of I-level maintenance functions to the O-level, the D-level, and/or the outsourcing of maintenance functions to government/civilian industry. These changes will promote a more responsive, capable, and efficient aircraft maintenance concept.

Report Documentation Page

*Form Approved
OMB No. 0704-0188*

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1. REPORT DATE 2000		2. REPORT TYPE		3. DATES COVERED 00-00-2000 to 00-00-2000	
4. TITLE AND SUBTITLE USMC Aviation Maintenance: Keeping Pace With I-Level Maintenance				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) United States Marine Corps, Command and Staff College, Marine Corps University, 2076 South Street, Marine Corps Combat Dev Command, Quantico, VA, 22134-5068				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

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Chapter 1

Aircraft Maintenance in a Changing World

This era will be one of accelerating technological change. Critical advances will have enormous impact on all military forces. Successful adaptation of new and improved technologies may provide great increases in specific capabilities. Conversely, failure to understand and adapt could lead today's militaries into premature obsolescence and greatly increase the risks that such forces will be incapable of effective operations against forces with high technology.

–Joint Vision 2010¹

Post Cold War Reality

Over the last decade, the world has entered a new era of interdependence and opportunity. No longer is the US faced with national survival, as was the case in 40-plus years of nuclear standoff with the Soviet Union. In many ways, however, the world is far more complex than during the years of the Cold War. Bipolar alliances have given way to a world where regional interests dominate. On the international scene, terrorism and the threat of nuclear, biological, and chemical weapons proliferation, along with renewed national, ethnic, and religious rivalries are on the rise. Confronted with a more complex and diverse set of threats, US defense spending is stalled and there is a smaller military force structure to fight the enemy as new operational concepts are just beginning to take shape.

¹ Joint Chiefs of Staff. *Joint Vision 2010*. (Washington, D.C.)

These realities—a **changed international setting, budgetary difficulties, force structure imbalances, and new operational concepts** as documented in both *The Report of the Quadrennial Defense Review (QDR) 1997* and *Strategic Assessment 1998*—**demand innovative solutions that will ensure support to the warfighter is not diminished.**²

One area that innovation can be applied to is USMC aviation maintenance. Keeping USMC aircraft mission capable and maximizing their potential to meet future operational demands is fundamental to aircraft maintenance. The insertions of new technologies incorporated into both existing and newer aircraft bring increased reliability of aircraft systems and components, therefore resulting in reduced maintenance man-hours to flight hours. For example, non-metal composite materials reduce the number of parts, fasteners, and rivets, thus, fewer structural materials to remove and replace. Advanced diagnostics architecture applies diagnostic technologies that achieve 100 percent fault coverage eliminating the requirement for technicians to diagnose and troubleshoot aircraft systems. Scheduled maintenance requirements are minimized, thereby, fewer technicians and less parts are needed. Moreover, direct vendor delivery reduces inventory, warehouse storage space, and personnel. Together, these advances suggest a change to the current way of conducting aircraft maintenance.

² Both *QDR* and *Strategic Assessment* describe the changing international scene: spread of dangerous technologies (weapons of mass destruction), the reach of terrorism and crime, security of economic resources (oil), ethnic instability/internal conflict of failed or failing states; budgetary difficulties: funding for military modernization is insufficient with procurement budget stalled near the \$40 billion level (*QDR* procurement goal is \$60 billion by fiscal year 2001); force structure “tooth-to-tail” imbalances (footnote 3); new operational concepts: Dominant Maneuver, Precision Engagement, Full-Dimensional Protection and Focused Logistics.

Tooth-to-Tail Trail

As America seeks to reap the benefits of winning the Cold War, the nation is faced with tough decisions regarding the degree of defense needed in the new world. Service force structures have rapidly deteriorated and defense spending drastically slashed (Figure 1).

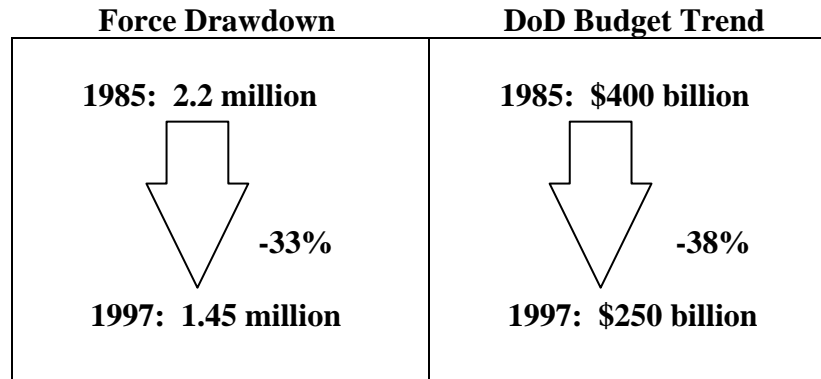


Figure 1.³ Tooth-to-Tail Trend

These cuts, felt by all the services, created imbalances. Among these imbalances is the disproportionate growth in the tooth-to-tail ratio since the end of the Cold War.⁴ The tooth-to-tail issue was considered such a major concern that Defense Secretary William Cohen established a commission chartered with the responsibility of finding ways to correct the problem. The commission was charged with finding

...ways to save money in the defense *tail* portion of the budget . . . while shifting those savings to the *tooth*—warfighting segment. That ratio, nearly a 50-50

³ Department of Defense, *Report of the Quadrennial Defense Review*, May 1997, 20.

⁴ Spending on defense falls into two broad categories: dollars that go toward combat capability and dollars that go toward supporting combat personnel. The percentage of spending on military combat capability relative to support is commonly known as the tooth-to-tail ratio. “Tooth” (combat power) is personnel, systems and support in the hands of operational combat forces. The “tail” (support structure) is everything else, ranging from data processing, accounting and housing to transportation, health care, education and surplus property disposal. For more information on the “tooth-to-tail” issue see *Report of the Quadrennial Defense Review*, May 1997.

balance at the end of the Cold War, has moved so that nearly 70 percent of the defense budget now goes toward support elements.⁵

Declining budgets, coupled with the need to reduce the support/warfighter ratio, make changes in the support structure and support concepts an absolute necessity. Change, although inevitable because of budget considerations, will not be easy considering the military's many years of experience with largely organic support capabilities and the successes enjoyed with this approach. "While organizational change has become commonplace in modern society, most organizations tend to change as little as they must, rather than as much as they should."⁶ From the huge depot repair capabilities to the organizational maintenance level, organic support has been the primary means for meeting Marine Corps aviation mission requirements. Today's support

. . . activities were largely established and organized during the Cold War when [the] DoD had to depend predominately on organic support. Such support was driven by the possibility of an extended conflict with a rival superpower and a less sophisticated private, commercial infrastructure.⁷

"To complicate budget and force structure imperatives, future wars are expected to be mostly regional or limited conflicts that are often unpredictable in nature."⁸ "These conflicts are often described as *come as you are wars*, meaning there will be little lead time for mobilization or surge of production capability."⁹ *Joint Vision 2010* clearly states

⁵ Weibel, Jack, "Cohen Exhorts Privatization Panel," *Air Force Times*, 27 Oct 97, 4.

⁶ Kanter, R.M., B.A. Stein, and T.D. Jick. *The Challenge of Organizational Change: How Companies Experience It and Leaders Guide It*. New York NY: The Free Press, 1992.

⁷ "Improving the Combat Edge Through Outsourcing," Vol. 11, No. 30, 97, 1. Downloaded from www.defenselink.mil/speeches/1996/s19960301-report.html 14 Dec 1999.

⁸ Prepared statement of Colleen Preston, Deputy Undersecretary of Defense for Acquisition Reform, to the House Government Reform and Oversight Committee, "DoD Must Re-engineer Its Procurement System Now," 21 Feb 1995. *Defense Issues*, Vol. 10, No. 24: Downloaded from www.defenselink.mil/speeches/index.html 14 Dec 1999.

⁹ "Improving the Combat Edge Through Outsourcing," 1.

the vision “will be difficult to achieve within the budget realities that exist today and into the next century.”¹⁰ It also says we must make “hard choices to achieve the tradeoffs that will bring the best balance.”¹¹ Change is difficult by itself, but if brought along properly by understanding the impact of change before it occurs, acceptance of change can be optimized.

Emerging Operational Concepts

The challenge for our Marine Corps is to ensure that we can effectively shape and respond to future conflict. *Joint Vision 2010*'s operational concepts—Dominant Maneuver, Precision Engagement, Full-Dimensional Protection, and Focused Logistics—rely on contributions of land, sea, and air power. Dominant Maneuver allows for aircraft such as the MV-22 Osprey to assault from ships far out at sea immediately to the objective located far inland significantly farther and faster with greater payload than CH-46 helicopters. Precision Engagement enables aircraft such as the Joint Strike Fighter (JSF) the capability to generate the desired effect against the objective due to a more precise weapon delivery system. Full-Dimensional Protection such as improved individual protective gear enable forces freedom of action during maneuver and engagement. Focused Logistics allows for accurate tracking of supplies and facilitate a timelier sustainment of operations.

Today's Marine Corps is a more mobile force and we need to have the necessary weaponry to engage with the enemy. The operational concepts function as force

¹⁰ *Joint Vision 2010*, 13.

¹¹ *Joint Vision 2010*, 32.

multipliers to enhance our primary mission—**warfighting**. To achieve war-winning advantages, we must stay focused on the promise of these concepts. The combination of these concepts will provide an order of magnitude improvement in lethality that will bring to bear overwhelming firepower on the enemy, creating a dramatic shock effect and producing short-duration conflict. These four operational concepts are in motion as I write this paper. In particular, the development of USMC aircraft that are faster and smarter from utilizing advanced technologies is currently underway pursuant to the constraints of America's defense budget.

Maintaining Readiness with Future Technologies

The Chief of Naval Operations (CNO) has stated, "I don't ever want for you to think we are going to do more with less. We can do more with more or less with less."¹² On the surface, it would appear the CNO's message implies less capability, fewer people, less weaponry; however, the real message is to understand the reduced defense budget requires us to develop innovative policies, strategies, methods, and technologies that allow the Department of the Navy to maintain relevant and appropriate levels of readiness and combat capability at a reduced cost of operation and support.

Doing "less with less" then means eliminating, automating, and/or commercializing tasks and functions in order for active duty personnel to focus on their main mission—**fight and win** America's wars. It also means implementation of technologies to reduce

¹² This statement is in response to a question asked during a meeting between US military personnel and the CNO. "How do you [CNO] see quality of life affected by the reshaping we are undergoing and won't reshaping mean we will have to do more with less?" Quoted from "CNO answers questions from the Fleet, Winter 1998". Downloaded from <http://mediacen.navy.mil/pubs/cck/cck0498/CCK04-02.htm> 13 Mar 2000.

hands-on requirements, perform intuitive thinking tasks, as in neural networks, and conduct near real-time prognostic assessments of machinery to enhance reliability and safety. The key to winning the technology war today is to be the first to integrate. The first to integrate technology is the one who will maintain the superior force.

Change is in Order to Optimize 21st Century Aircraft Maintenance

To better support the warfighter from an aviation maintenance perspective, a change in the way we conduct aircraft maintenance is worth looking into. New technologies drive future military hardware configuration. Such is the case with smarter aircraft. As the Marine Corps moves forward to buy and support newer aircraft and maintain existing aircraft, emerging aircraft technology has elevated the importance of examining our current Marine Aviation Logistics Squadron (MALS) organization to support a 21st century way of conducting aircraft maintenance.

The implementation of the Marine Corps' latest aviation weapon platform, the MV-22 Osprey (May 1999), in conjunction with the transition to the Joint Strike Fighter (Year 2008), has introduced new technological advances. These advances will promote a more responsive, capable, and efficient aircraft maintenance concept. Such increases in maintenance effectiveness and efficiency are expected to lead directly to needed savings in manpower and infrastructure.

Reducing the number of levels that currently perform aviation maintenance (e.g., organizational level (O-level), intermediate level (I-level), depot level (D-level)), might be beneficial because it would be expected to increase maintenance effectiveness and efficiency while simultaneously reducing the current logistics footprint and associated

infrastructure costs. For example, the process of repairing parts, usually done by Marine technicians at the I-level, is eliminated due to delivery of parts from the vendor directly to the squadron. The processing of parts, usually done by supply Marines, is eliminated due to delivery of parts from the vendor directly to the squadron. In both situations, parts repair, parts inventory, and parts delivery is the responsibility of the vendor. The elimination of these two functions removes a layer from the overall logistics process. It also frees up Marines for other needs. Consequently, it increases maintenance and supply effectiveness and efficiency. Moreover, aircraft incorporating fewer parts require a smaller inventory of parts at supply warehouses and, therefore, reduces the logistic footprint at home and reduces the logistic footprint during deployment. Advanced technology, Rear Admiral Bennitt said, “will minimize maintenance requirements, reduce infrastructure, and lower manning levels due to the development of more reliable, repairable, and automated systems.”¹³

Given these trends, it is relatively easy and straight-forward to envision the introduction of a two-level maintenance (O and D) concept in lieu of the current three-level maintenance (O, I, and D) concept. This transition is most apparent with the entry of the MV-22 Osprey and the Joint Strike Fighter aircraft into Marine inventories; both aircraft will be less maintenance- and supply-intensive than our existing inventory of fixed-wing and rotary-wing aircraft, thereby effectively negating the requirement for I-level support. For instance, advancements in computer technology provide for the realistic application of sensors and processors required for a “self-monitoring” aircraft. A

¹³ RADM Brent M. Bennitt, “Making Joint Fleet Aviators,” *Naval Aviation News* 76, No.6 (Sept-Oct 1994). 1.

technician can download data directly from the aircraft. The data provides information the technician needs to assess the system's performance, make any adjustments, diagnose malfunctions, order parts, and make repairs. The data also interfaces electronically to the supply source so that the correct part can be identified, ordered, and provided, all without the need for error-prone manual input of data. Compared to the way maintenance is conducted today, newer aircraft technologies offer the convenience of less maintenance and less parts inventory.

The current three levels of maintenance concept has considerable room for improvement; to be successful as new technologies increase the efficiencies of our airframes, it must undergo a metamorphosis, of sorts, from three to two levels of maintenance. This paper will explore the necessity for this significant transition—a transition to two levels of maintenance worthy of the challenges facing 21st century Marine aviation. Before we can successfully make the transition, we must first know ourselves as we are; an understanding of current USMC aviation maintenance policy, maintenance structure, logistics support, and how advanced technologies support the concept of Operational Maneuver from the Sea, is in order.

Chapter 2

Current Way of Conducting Aircraft Maintenance

Evolution of Marine Aviation Maintenance

Today's military doctrine requires a focus on rapid deployment and forward projection, and the Marine Corps' Marine Air Ground Task Force (MAGTF) concept fully supports this doctrine. The MALS organization offers aviation units flexibility, mobility, and sustainment in support of the MAGTF combat ground forces. The organization provides a total support concept, which effectively employs aviation logistical support, fulfilling Marine Aviation's combat role on today's battlefield and in future conflicts. The MALS organization is capable of providing aviation logistical support to any current mix of aircraft, in garrison or combat.

The Marine Corps, during the early 1960's, adopted the Naval Aviation Maintenance Program (NAMP) and organized its aviation supporting units into the Headquarters and Maintenance Squadrons (H&MS). This structure was set up to improve aviation logistical support, thus enhancing aviation response to the ground forces. The organization enhanced aviation support by providing I-level maintenance for all aircraft and aircraft support equipment attached to a specific Marine Aircraft Group (MAG). The introduction of new weapon systems into the Marine Corps resulted in some MAG's configured to support similar type/model/series (T/M/S) of aircraft. The H&MS

organizational structure reflected an increased manning level required to provide the necessary I-level support from both the Intermediate Maintenance Activity (IMA) and Group Supply Department to a specific and predetermined quantity of T/M/S aircraft assigned to a MAG while in garrison.¹⁴

The unique operational command relationship under the H&MS idea later proved unable to meet the needs of the Marine Corps' changing combat roles. The H&MS structure did not provide a total Marine Corps organic aviation logistical support concept. This minimized the effectiveness of the support initially realized through the reorganization. Adding to the problem, standardized operational structure of the H&MS did not exist Marine Corps-wide. Some H&MS were operational squadrons with assigned aircraft, while other H&MS had no aircraft assigned and provided only IMA support to the air groups.

The H&MS, providing functional requirements as the maintenance activity, also functioned as an administrative department to both the Group Supply Department and Group Headquarters. The H&MS IMA Maintenance Officer worked directly for the H&MS Commanding Officer. He also served as a special staff officer to the Group Commanding Officer, as did the Avionics and Ordnance Officers. The Group Supply Officer, although administratively assigned to the H&MS, operationally reported directly to the MAG Commanding Officer. The H&MS organization did not provide a focal point for all logistical matters, but piece-milled logistical information about maintenance or supply issues to the MAG Commanding Officer. As a result, the operational and

¹⁴ Captain Edmund C. Mitchell, USMC, "MALS and the Marine Aviation Logistic Support Concept", *Marine Corps Gazette*, May 1990, 94-95.

command structure of the H&MS was not task organized for a total Marine Corps organic aviation logistical support concept.

The Marine Corps, in October 1988, again reorganized Marine aviation logistic support to optimize the total aviation support concept. This total support concept brought together all Marine Corps organic aviation logistics under one command--the MALS. Under this new concept, the MALS Commanding and Executive Officers are the senior aviation logisticians in the MAG. The MALS Commanding Officer is the MAG Commanding Officer's single point of contact for all aviation logistics matters. The Aviation Supply, Maintenance, Ordnance, and Avionics Officers are key staff members to the MALS Commander and provide the technical expertise for their related fields.

The MALS organizational structure enabled the squadron commander to effectively control and manage all aviation logistical functions within the MAG. It provided the MAG Commander a total support package. The MALS is now on equal footing as the organizational structure of other Marine squadrons. Specifically, the squadron is comprised of the Commanding Officer, the Executive Officer, an Administrative Department, an Operations Department, a Logistics Department, an Aviation Supply Department, and an Aviation Maintenance Department. The centralization of all functions rolled up into the MALS was a necessary transition to best support the attached squadrons and provide a single voice of communication between the MALS Commanding Officer and the MAG Commanding Officer.

The Marine Aviation Logistics Squadron Concept

How does the restructure of the aviation logistics concept improve support to the employment of Marine aircraft? A primary reason for this logistical enhancement under the MALS concept is the application of the Marine Aviation Logistics Squadron Program (MALSP). The MALSP combines several concepts to enable the MALS to rapidly task-organize logistic elements for employment in support of the MAGTF Aviation Combat Element (ACE). The MALSP composition includes the Maritime Pre-Positioning Ships program, Aviation Logistic Support Ship (T-AVB) program, Contingency Support Package (CSP), Common Contingency Support Package (CSSP), Peculiar Contingency Support Package (PSCP), Fly-in Support Package (FISP), and the Follow-on Support Package (FOSP).¹⁵ The MALSP concept has provided a method for the MALS to organize logistical support packages to provide optimum aviation logistic support while operating in garrison, the ability to task-organize, and the capability to support a war-fighting composite ACE.

New technology brings with it aircraft owning fewer parts. Fewer parts translate to a smaller logistics support package footprints. A smaller logistics footprint is an added benefit when the time comes to determine the “lift” necessary to move into a theater of operations.

¹⁵ By structuring aviation logistical support packages, MALSP concept provides replenishable sustainment packages of logistical elements (personnel, spares, support equipment, and mobile facilities) sized and tailored to meet the aviation logistics requirements of each ACE. These packages are used as building blocks to keep aircraft operational during every phase of an operation.

Naval Aviation Maintenance Program

The NAMP supports the Commandant of the Marine Corps (CMC) aviation readiness and safety objectives and provides for optimum use of manpower, facilities, material, and funds.¹⁶ Established in 1959, the Naval Aviation Maintenance Program has been periodically revised to incorporate improved methods and techniques such as the three levels of maintenance (O, I, and D) concept. The purpose of the Naval Aviation Maintenance Program is to issue the maintenance policies, procedures, and responsibilities for the conduct of the program at all levels of maintenance throughout naval aviation. It is the basic document and authority governing the management of all Navy and Marine Corps aviation maintenance.

The NAMP requires varying degrees of maintenance capability at different locations. This capability is described (in order of increasing capability) as O-level, I-level, or D-level maintenance. Since it is not practical to provide the full complement of maintenance capability at each location, support is established based on the following considerations:

- Mission requirements
- Economics of repair
- Transportation limitations
- Component reliability
- Workload agreements
- Facility requirements
- Frequency of tasks
- Special training required

¹⁶ "NAMP Maintenance Concepts," *OPNAVINST 4790.2G*, Vol. I, 7.1. 1 Feb 1998.

Aviation Maintenance Organizations

The three maintenance level functions are described below. Organizational level (O-level) aircraft maintenance activities must possess enough capability to launch and recover aircraft and sustain the preventive maintenance program. Generally, this means most units possess a full complement of equipment and supplies to perform all types of on-aircraft maintenance along with a modest amount of off-aircraft maintenance.¹⁷

O-level squadrons maintain their assigned number of aircraft with Marines trained in a specialized aviation skill.¹⁸ Maintenance personnel assigned to squadrons accomplish O-level maintenance for either fixed- or rotary-wing aircraft (Figure 2).

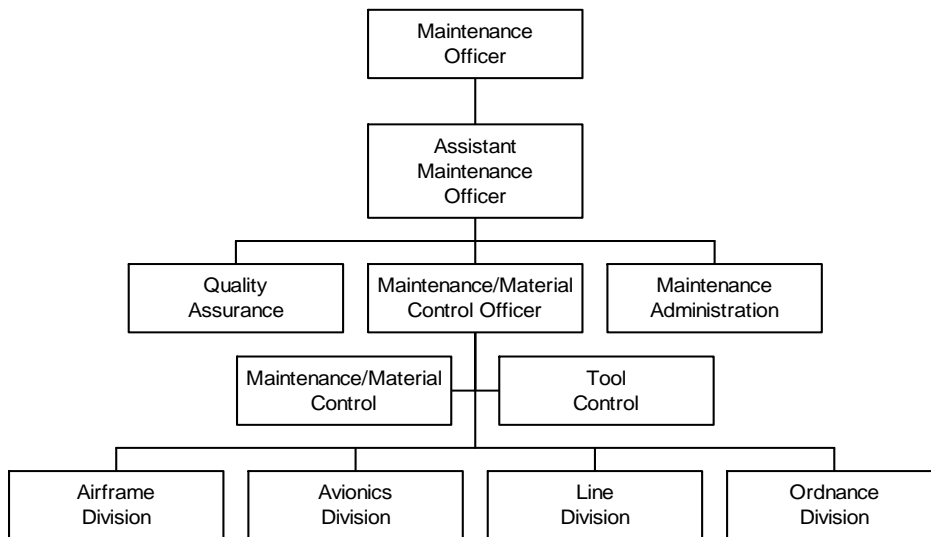


Figure 2. O-Level Maintenance Department Organization

¹⁷ Preflight and servicing of aircraft and their systems is normally accomplished on-aircraft. Support/repair of hydraulic actuators, servos, and accumulators, aircraft engines, and transmissions is normally accomplished off-aircraft.

O-level maintenance functions typically consist of:

1. Inspections.
2. Servicing.
3. Handling.
4. On-equipment corrective and preventive maintenance. (This includes on equipment repair, removal, and replacement of defective components.)
5. Incorporation of Technical Directives (TDs).
6. Record keeping and reports preparation.
7. Aeronautical equipment (AE) of aircraft and equipment under Reliability Centered Maintenance (RCM).

MALS organization provides Intermediate-level (I-level) maintenance and aviation supply support for aircraft and aeronautical equipment for supported O-level squadrons. Each MALS is organized to provide a core group of supervisory and support personnel that, when augmented by aircraft-specific maintenance personnel from O-level squadrons, provides an intermediate maintenance capability for either fixed- or rotary-wing aircraft (Figure 3).

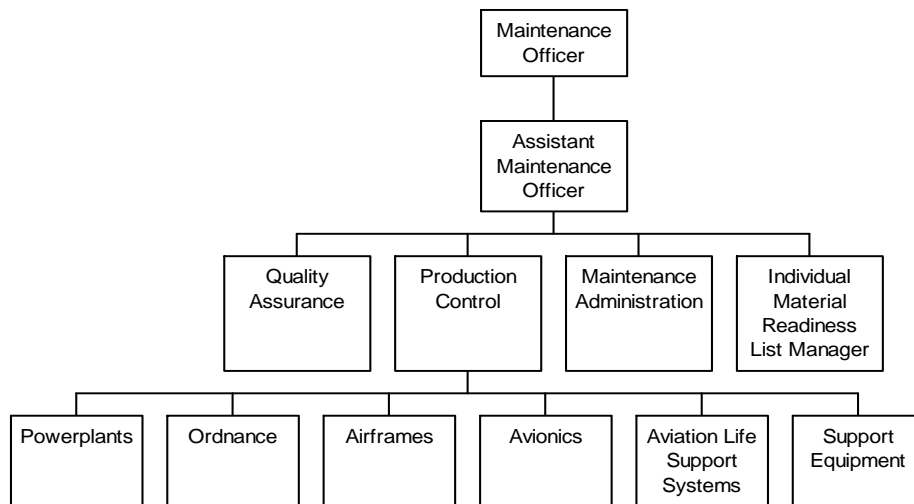


Figure 3. I-Level Maintenance Department Organization

MALS performs on- and off-equipment material support typically grouped as follows:

1. Performance of maintenance on aeronautical components and related support equipment (SE).
2. Processing aircraft components from stricken aircraft.

¹⁸ While there is similarity in the skills required to provide aircraft maintenance, the systems being supported are diverse.

3. Providing technical assistance to supported units.
4. Incorporation of TDs.
5. Manufacture of selected aeronautical components.
6. Performance of on-aircraft maintenance when required.
7. AE of aircraft and equipment under RCM.

Depot-level (D-level) maintenance is performed on material requiring major overhaul or rebuilding of parts, assemblies, subassemblies, and end items. It includes manufacturing parts, modifying, testing, inspecting, sampling, and reclaiming major weapons systems and end items. Primarily government civilian employees perform maintenance at naval industrial establishments. Depot maintenance supports O-level and I-level maintenance by providing engineering assistance and performing maintenance beyond organizational- and intermediate-level capabilities. Depot maintenance consists of:

1. Rework and repair of engines, components, and SE.
2. Incorporation of TDs.
3. Modification of aircraft, engines, and SE.
4. Manufacture or modification of parts or kits.
5. Technical and engineering assistance by field teams.
6. AE of aircraft and equipment under RCM.

Where Are We Today?

The MV-22 is the most recent addition to Marine aviation. It has more than twice the speed and lift capability of existing aircraft in the Marine inventory, and almost five times the range of the CH-46E (Figure 4). Just as in the CH-46 squadrons, each MV-22 squadron will operate and maintain twelve aircraft. The current plan begins the transition of the 2nd Marine Aircraft Wing, on the East Coast, with the Fleet Replacement Squadron,

CAPABILITIES	CH-46E	MV-22
FUEL (LBS)	2,400	9,600
RANGE (NM)	155	720
FLIGHT-TIME (HR)	1+25	3+00
PASSENGERS	18	24
TROOPS (COMBAT LOADED)	16	24
AVAILABLE PAYLOAD (LBS)	4,300	7,000 (VTOL)
MAX. AIRSPEED (KNOTS)	145	275
CRUISE AIRSPEED (KNOTS)	120	250
MAX. GROSS WEIGHT (LBS)	24,300	52,870 (VTOL)/60,500 (STO)

Figure 4.¹⁹ CH-46 and MV-22 General Capabilities Comparison

VMMT-204, followed by four HMM squadrons.²⁰ Once 2nd Marine Aircraft Wing has these five squadrons and 60 MV-22s, the focus will shift to the West Coast, where the 3rd Marine Aircraft Wing will transition four of its HMM squadrons. After 3rd Marine Aircraft Wing receives its first forty-eight MV-22s, delivery will then shift to the 1st Marine Aircraft Wing in Hawaii with the replacements of three HMH (CH-53D) squadrons. This same rotation between the three aircraft wings is followed again for a second round, this time completing the active tactical squadron stand-up plan. Finally, the 4th Marine Aircraft Wing will take delivery of forty-eight MV-22s to transition its four reserve squadrons. Throughout this process, the Fleet Replacement Squadron, VMMT-204 will receive an additional twenty-eight aircraft, while Marine Helicopter

¹⁹ Major Dean T. Siniff, USMC, *MV-22 Osprey Transition: Bridging the Gap in Medium Lift Assault Support*, MMS Thesis (Quantico, VA: United States Marine Corps Command and Staff College, AY: 1998-99), 7.

²⁰ Headquarters U.S. Marine Corps, APP, "MV-22 Procurement." Washington, DC, 23 October 1998.

Squadron One (HMX-1) will take delivery of eight MV-22s and eleven VV-22s (VIP models). As HMM squadrons transition to MV-22, these squadrons will transfer their CH-46s directly back to the fleet to cover current CH-46 inventory shortfalls. Although the number of CH-46 squadrons will be decreasing, these remaining squadrons will be brought up to their full programmed authorized allowance (PAA) of CH-46s. During June 1999, the 1st of 360 MV-22 aircraft was delivered to the Marine Corps to begin replacing the rapidly aging CH-46.

As the Marine Corps transitions to the MV-22, Naval Air Systems Command (NAVAIR) Assistant Program Manager for Logistics (APML) is evaluating Level of Repair Analysis (LORA) recommendations for various avionics repairs and various airframes/structures composite repairs on the MV-22.²¹ At present, the LORA Maintenance Decision Summary (MDS) has identified 65 of 485 repairs for organizational-level support, 99 repairs for intermediate-level support, 173 repairs for depot-level support, and 148 repairs discarded.

The MV-22 T406 Allison engine concept is organizational-level to Original Equipment Manufacturer (OEM) support. Engine test cells, engine repair, and associated maintenance are handed off to Allison if the engine/component repair is beyond

²¹ LORA is a computer model, that analyzes information such as mean-time-between-repair (MTBR), mission essential subsystem matrix (MESM) information e.g. systems that impact aircraft mission readiness, and component cost resulting in economic recommendations to either repair components at the O-, I-, D-level or discard the item. LtCol. D.J. Barr, USMC, AIR-3.1.2H, APML V-22, interview (Patuxent River Naval Air Station) by author, 16 Dec 1999.

organizational-level repair. The manufacturer is paid by the flight hour so there is an incentive for the manufacturer to keep the aircraft flying: “Power by the hour.”

The JSF is designed with cost-effective maintenance and supportability in mind. Advanced onboard diagnostics and testability will enable aircraft to provide analysis of its system health, both current and predicted. One of the objectives of the prognostics is to provide maintenance technicians with the projected lead-time to schedule appropriate maintenance. The Prognostics and Health Management (P&HM) system is designed to stimulate the autonomic logistics infrastructure with minimal human interaction.²² This means that while the aircraft is airborne, Prognostics and Health Management monitors the airplane’s heartbeat and, through Autonomic Logistics, the prognostics data is transferred to Maintenance Control prior to landing. Maintenance Control will have the necessary data to determine the priority of maintenance and/or repair, as well as have the parts available before the airplane returns to the flightline. The Marine Corps anticipates transition to the JSF in year 2008.

Need for Change

In the early 1990s, the Navy and Marine Corps presented a common vision for future naval operations in a series of white papers: *From the Sea*, and *Forward ... From the Sea*. This common vision concentrates naval power projection at the littoral as a conceptual

²² Prognostics and Health Management (P&HM) facilitate a condition-based support and maintenance scheme. P&HM, the capability of anticipating when a failure will occur, trigger’s the Autonomic Logistics system to schedule projected maintenance tasks. P&HM and Autonomic Logistics ensure quick return to service of the aircraft, data flow to maintenance, operations and logistics and data storage for subsequent analysis. Col. Russell J. Currer, USMC, Director, Autonomic Logistics, Joint Strike Fighter Program Office. Telephone interview by author, 2 Dec 1999.

outline delineating basic operational capabilities required for 21st century warfare. From these two papers the Marine Corps further developed the concept *Operational Maneuver from the Sea* (OMFTS). This overarching concept uses the sea as maneuver space at the operational level, allowing the Navy and Marine Corps team to gain a positional advantage over significant enemy weaknesses. Operational maneuver from the sea further requires moving forces directly from the ship to the objective. This requirement will challenge the Marine Corps' aviation capabilities.

Marine aviation in the OMFTS battlespace enables aircraft such as the Joint Strike Fighter to attack from over the horizon, by-pass enemy defenses, and strike where the enemy is weakest before the enemy can react. MV-22 aircraft fly from ship to the objective and back with no stops enroute carrying twice the capacity in half the time. By seabasing our aviation, naval forces take advantage of seabased logistical support facilities while reducing the requirement to establish and defend large aviation facilities ashore. The MV-22 and JSF will play significant roles as the Marine Corps prepares plans to meet these difficult challenges through “technology and new approaches in organization, doctrine, tactics and training.”²³

The MV-22 and JSF are the focal point for defining how future maintenance should be done, and who will perform the required maintenance. The underlying focus of both aircraft rests in maintainability and supportability. Both aircraft will be expected to perform in austere and expeditionary sites around the globe. The QDR embrace both aircraft as the type of weapons systems tailored for 21st century warfare. Defense

²³ Marine Corps Combat Development Command, Concepts Division, “United States Marine Corps Warfighting Concept for The 21st Century,” (Quantico, VA.1998), I-18.

strategists expect combat operations of the future to be more dispersed, requiring more flexible fighting formations. The MV-22 and Joint Strike Fighter epitomize this sort of tactical flexibility and are essential players for OMFTS execution. A maintenance system, which supports such operations, must be implemented. Designing the aircraft with state-of-the-art internal fault detection, isolation, and on-aircraft repair capability results in the actual aircraft becoming the test bench for diagnostic evaluation and on-site repair.

Looking back, our current MALS concept incorporates a building block approach from the various logistical support packages. Each support package is tailored to support any number and/or mix of aircraft and deploy to anyplace in the world. The NAMP promulgates Naval Aviation policy and therefore it governs procedure for the three levels of maintenance. Today, *Joint Vision 2010* concepts are taking shape on the horizon with the phased implementation of the MV-22 to Marine aviation. Compared to existing aircraft in our inventory, the MV-22 is designed with enhanced technologies that reduce maintenance manpower requirements and thus reduce the costs of operation as demonstrated from the LORA analysis. Anticipation of the Joint Strike Fighter to hit flightlines Marine Corps-wide brings with it robust advanced technologies to further support the requirement for fewer parts, less inventory, and fewer Marines to maintain the aircraft.

Changing technology is driving the future of aircraft maintenance. To understand how we can better support and maintain our current and future aircraft, we must look beyond our present-day organic maintenance support “box” and capitalize on more efficient and more effective ways of conducting maintenance.

Chapter 3

Marine Corps Aviation Maintenance For the Future

The Challenge of Maintaining Older Aircraft

Advances in technology, design tools, and manufacturing processes have significantly changed the manner in which aircraft are designed and built. One of the most significant challenges the Marine Corps faces is managing the costs associated with keeping an aging fleet of aircraft flying longer and longer while newer aircraft are implemented into the Marine Corps. Sustaining a fleet of aircraft that soon will average 30 years of age (both fixed- and rotary-wing aircraft) requires a commitment to balancing available resources to ensure we meet our most stringent operational taskings. Reducing costs becomes even harder with an aging fleet whose increasing operational & maintenance (O&M) costs are driven by parts obsolescence, fatigue, and consistent airframe and engine challenges.

The MV-22 implementation plan is described in Chapter 2. During MV-22 implementation into the Marine Corps, CH-46 aircraft remain operational until the MV-22 implementation is completed. Any avionic, engine, or structural upgrades are incorporated into the CH-46 as they occur to keep it current with the latest technologies. Operating both the MV-22 and CH-46 aircraft will enable the Marine Corps to continue

with its medium vertical lift capabilities without any shortfalls of operational taskings worldwide.

First introduced to the Marine Corps in June 1964, the last CH-46 helicopter rolled off the Boeing Corporation production line in 1971.²⁴ The last airframe extension program/modification should ensure the majority of the CH-46 fleet continues to operate until about the 2010 timeframe.²⁵ Marine aviation proponents recently (relatively speaking) challenged the aircraft industry to develop a medium lift replacement aircraft incorporating new technologies. The result of this challenge is the MV-22 Osprey.

Our current maintenance support system is reactive rather than proactive. Test capabilities, for example, Built-In-Test (BIT), Portable Maintenance Aids, and Automatic Test Equipment in present systems (AV-8, F/A-18 aircraft), indicate the existence of a fault but require front-line technicians to conduct a significant portion of the diagnostic analysis and subsequent maintenance activity to access the malfunctioning part(s) of the system. This type of maintenance system does little to anticipate demands for support material, personnel, or training. Because of these concerns, additional parts, support equipment, and personnel are required to maintain sufficient redundancy to achieve an acceptable mission capability rate. Moreover, this highly specialized maintenance concept also requires the deployment of larger than necessary amounts of spare parts, support equipment, and trained personnel into a theater of operations to support and maintain assigned Marine aircraft.

²⁴ Jane's World Aircraft, 1970-71., under "Aircraft: USA, Boeing Vertol,"

²⁵ Capt. David W. Coffman, USMC, "21st Century Medium Lift: The CH-46 in the 1998-2005 Timeframe," *Marine Corps Gazette*, May 1994, 42.

The USAF and 2-Level Maintenance

One of the keys to providing a better way of performing maintenance lies in the strategy of providing the right responses, the right parts, the right people, and the right skills in order to ready the aircraft for the next mission. During the last decade of the twentieth century, our sister service, the United States Air Force (USAF), exerted considerable effort in recognition of the advent of technological innovation to move the Air Force maintenance philosophy from three levels of maintenance to a two-level one.

Currently, USMC aircraft and weapon systems are avionics intensive and maintained with a 3-level maintenance philosophy. Much like the Marine maintenance concept, Air Force organizational-level maintenance performs aircraft servicing, minor repair of structures, and the removal and replacement of defective components. Air Force intermediate-level maintenance troubleshoots defective structural, electro-mechanical, or avionics components using extensive layers of personnel and support equipment. Depot-level maintenance shops consolidated at three major installations in the continental United States perform repairs or modifications beyond the organizational or intermediate level. Field teams can be deployed to the on-site location when it is not feasible to return the aircraft to the depot.

In 1992, the Air Force commissioned the Rand Corporation to conduct a study on the feasibility of converting from three levels of maintenance to two levels of maintenance.²⁶ The Rand Study rather obviously concluded that two-level maintenance would save

²⁶ Abell, J.B. and Shulman, H.L., *Evaluations of Alternative Maintenance Structures*, (Rand Corporation Rep No. R-4205-AF), Santa Monica, CA: Rand Corporation, 1992, 19.

resources and still meet all the Air Force's needs.

Air Force aircraft maintenance for most avionics and engines now utilizes two levels of maintenance versus the previous three levels of maintenance. Avionics and engine maintenance previously done by the intermediate level is now done either on the flight line or in depot repair shops. Under two-level maintenance, depot repair is tied directly to the Air Force flight-line and unit sortie generation capabilities. Readiness is maintained by improving pipeline processes, moving reparable to depot repair centers using high velocity parts movement, and state-of-the-art communications and computers for in-transit visibility and control of assets. Lastly, the two-level maintenance concept facilitates a reduction of the logistics footprint to a minimum level that will permit the warfighter to attain his or her mission in a satisfactory manner. A reduction of the logistics footprint is especially important in the early stages of a conflict when airlift assets are scarce and before a sea-lift bridge can be established.²⁷

The results of the RAND study is driving the Air Force to rely on contractor support, at least during the initial fielding phase of a system if not possibly for the entire life of the major weapon system. At Charleston Air Force Base in South Carolina, for example, O-, I-, and D-level maintenance gave way to two-level maintenance, dropping Intermediate-level maintenance, and McDonnell Douglas provides contractor support for all of the Air Force C-17 transport aircraft. Under two-level maintenance, aircraft are

²⁷ Dr. Jan P. Muczyk, "The Changing Nature of External Threats, Economic and Political Imperatives, and Seamless Logistics. Downloaded from www.airpower.maxwell.af.mil/airchronicles/apj/sum97/muczyk.doc 15 Mar 2000.

either maintained on the flightline for relatively uncomplicated and non-extensive repairs, or at the depots. “Where we came out with two-level maintenance we now have more reliable systems and we can save money by having fewer maintenance people on the bases and in the field,” Baily explained.²⁸

Outsourcing and Privatization for High-Technology Weapon Systems

In the past, DoD policy stipulated that the military services establish organic support for the logistical sustainment of new major weapon system end items as soon as possible after fielding. Specifically, DoD Directive 1130.2, *Management and Control of Engineering and Technical Services*, required the military to achieve self-sufficiency in maintaining and operating new systems as early as possible and limited the use of contractor field service to 12 months thereafter.²⁹

The purpose of this directive was to ensure the military services did not come to rely too heavily on the use of civilian technicians to support their systems.³⁰ Today, that directive is gone. Congressional language now requires that maintenance and repair for all new major weapon systems be under contractor support for at least 4 years.³¹

With the decline of manpower as a result of the military drawdown, the Marine Corps needs to consider privatizing its way of organic maintenance support through contracting out. In the past, maintenance functions required a military or organic

²⁸ Bailey, Rosanne, Col USAF. “Speed replaces size in Lean Logistics’ approach to inventories,” *Air Force News: Online*. Internet. 1 February 2000. Available: www.af.mil/news/Apr1996/n19960411_960336.html.

²⁹ Robert D. Kaiser and Richard M. Fabbro, *DoD Use of Civilian Technicians*, Washington DC: Logistics Management Institute, July 1990, iii

³⁰ Kaiser and Fabbro, July 1990, iii

³¹ “Outsourcing and Privatization,” 1998 Air Force Congressional Issue Papers Extract, undated.

capability because it was combatant in nature, and required potential deployment into harm's way. In light of the directive changing to 4 years of contractor support for a new weapon system, there exists the opportunity to privatize organic support.

The Air Force experience of privatization revealed two related outcomes of privatization. First, for those military members in a career field that is being privatized, there are fewer places they can be stationed. Often, the only place they can go is overseas or to a continental United States base which has significant deployment responsibilities. Second, privatization provides civilian job opportunities for skilled military technicians. When a military member approaches the end of his/her military obligation, he/she can be easily convinced to leave the military and accept private employment at higher pay. Often these airman work for contractors who support the military. The outcome, eventually, is the airman's skill will be eliminated due to privatization yet, he can take his talent and perform work on the same gear as a civilian and make more money. Everyone is a winner--airman, military and contractor.

Downsizing has made it a necessity that contractor personnel go to the deployed site to support their weapon systems and perform functions the same as military members. The greatest risk is that the contractor will not be there to perform or will leave when hostilities break out. As a result of downsizing, privatization, and modernization, there are no DoD resources available to fill potential voids. Legally, contractors cannot be compelled to go into harm's way, even when under contract, unless there is a formal declaration of war. The point is contractors do not have to stay, and the DoD needs to work to minimize the risk that fact entails. There is no doubt that the systems supported

and the functions being accomplished are prosecution of the battle. But, without contractor support, the unit the contractor supported may experience mission degradation.

From a cost standpoint for contractor support, the Air Force conducted a cost estimate study in 1995 to determine funding requirements for two-level maintenance of F-16 avionics. The cost savings of less manpower at the I-level and contractor support were predicted to exceed \$10 million annually. The current two-level maintenance concept of F-16 avionics was implemented and is testimony that interim contractor support in lieu of three levels of maintenance does save money.

Competitive Sourcing and Privatization (CS&P) is essential to meeting future support requirements. Outsourcing lowers costs, streamlines the labor force, and facilitates access to cutting-edge technologies. By partnering with industry, the Marine Corps can buy aircraft with much greater capabilities and realize force structure cost savings because of the fewer number of Marines required to turn wrenches through the use of outsourcing.

The DoD's experience with competitive sourcing and privatization seems to confirm savings are substantial when comparing organic support to contractor-provided support.

Cost comparisons conducted between 1978 and 1994 show savings of about \$1.5B a year. The military departments and defense agencies that took advantage of outsourcing via competition have reduced their annual operating costs by about 31 percent.³²

Interestingly, outsourcing and privatization are really not new concepts at all. Prior to World War II, the US military routinely relied upon the private sector for much of its

³² Department of Defense, Office of the Undersecretary of Defense for Public Affairs, News Release No. 185-96, Washington DC, 4 Apr 96.

support. Former Secretary of the Air Force, Sheila Widnall commented,

Lest you think this is a new phenomenon, let me take you back to the era before World War II when private support was standard. It was only during the Cold War when we realized the huge buildup of government operations that we came to think of government support as the norm. In a sense, we're going "back to the future."³³

A case in point is the Douglas Aircraft Company. During World War II, Douglas Aircraft set up a factory in North Africa for the dual purpose of conducting the final assembly of aircraft and performing aircraft maintenance and repair.

New technologies and business practices are changing the way the military procures, maintains, and supports its aircraft. As new aircraft with increased capabilities and reliability enter service and computer technology becomes further integrated with maintenance procedures, Marine aviation is left with little choice but to consider changing its 20th century philosophy of maintaining aircraft which support new technologies in a 21st century environment.

³³ Sheila E. Widnall, Secretary of the Air Force, "Privatization-A Challenge of the Future," Remarks at the Base and Civic Leader Dinner, McClellan AFB, California, 7 February 1996.

Chapter 4

Conclusion and Recommendations

Today, the average age of all USMC aircraft is almost 30 years and will continue to age over the next several years, even with the addition of new weapon systems like the MV-22 and the Joint Strike Fighter. Existing aircraft and systems were designed for three levels of maintenance. As the Marine Corps transitions to the MV-22, the CH-46 is to remain operational until MV-22 implementation is completed. The CH-46 operates on yesterday's technology while at the same time emerging technologies are incorporated to its avionic, engine, or structural components. These new technologies incorporated into existing aircraft and the implementation of newer aircraft suggests the possibility of contractor support, therefore, transitioning from three levels of maintenance to a two-level maintenance concept.

Maintenance and supply governs the tempo and power of operations. We have to think about the partnership of maintenance and supply (government and civilian vendors) because they are the enablers for sortie generation. *“As we select our forces and plan our operations, . . . we must understand how logistics can impact on our concepts of operation. . . . Commanders must base all their concepts of operations on what they know*

they can do logistically.”³⁴ We should remember that since the amount of logistics support available to any commander is limited, the commander who utilizes his limited resources most efficiently will have the greatest freedom of action and combat capability.³⁵

Real knowledge in this context is deep knowledge, not simply how long it takes a component to move from A to B, or the number of Marine maintainers to repair a component, but an understanding of the likely behavior and response of the logistics system in the face of the real demands, of real operations, as they develop and as they are executed. “At the tactical level . . . commanders and logisticians must plan and execute . . . aviation-peculiar logistical operations. These logistical operations must sustain the ACE as it provides support to the MAGTF anywhere in the world.”³⁶

Despite steady improvement in reliability and maintainability of aircraft systems, the aircraft of the foreseeable future will continue to generate failure rates resulting in difficult test and repair work. Nonetheless, newer aircraft will have fewer systems and fewer components to maintain at the I-level and that translates to less manpower and a smaller logistics footprint. This means the number of support forces near the battle may be reduced. Earlier the CNO stated doing “less with less.” Less troubleshooting and fewer repairs correlate to less manpower.

To maximize our full potential to maintain 21st century aircraft, MALS needs to restructure its organization to leverage technology to better support the organizational-

³⁴ Lieutenant General Alfred M. Gray, Jr., “Training the Fleet Marine Force,” *Marine Corps Gazette* (July 1987), p.15. General Gray was the 29th Commandant of the Marine Corps.

³⁵ Henry E. Eccles, *Command Logistics*, Newport, Rhode Island: Naval War College, 8 February 1956, xv.

³⁶ “Aviation Logistics,” *U.S. Marine Corps Aviation Operations, MCWP 3-2* (23 October 1998), 6-1.

level capabilities and, subsequently, achieve a smaller logistical footprint as part of the Aviation Combat Element of the Marine Air Ground Task Force. Marine aviation must look for opportunities to consolidate similar functions while eliminating duplicative efforts, even if they cross traditional boundaries. Lt Col Bolin suggested “that civilian and military logistics functions are fundamentally the same.”³⁷

Changes in avionics technology will allow replacement of more components at the squadron level and just-in-time delivery direct from vendors will reduce the size of the MALS supply department. Due to these changes, Marine aviation will be able to restructure the current three-level maintenance concept to a two-level maintenance philosophy. To completely implement two-level maintenance (O to D) is to cut away the I-level Marine and subsequently rely solely on contractor-supported maintenance. Care must be exercised in making competitive sourcing and privatization a reality or it may undermine America’s warfighting capabilities.

No weapon has ever won a war on its own and without support, clearly some integration is required. On the other hand, there exists a point beyond which integration, regardless of whether it was brought about by the strength of the opposition or by the inherent nature of technology itself will lead to diminishing returns.³⁸

Transitioning to a predominantly contractor-provided support force may seem a difficult departure from current maintenance practice, especially since the in-place organic workforce has traditionally provided quality and responsive support to the needs of the warfighter. On the other hand, we really do not want to transition to full contractor

³⁷ LtCol. Mark G. Bolin, USMC, *Reorganization of Marine Corps Aviation Associated Logistics*, Independent Research Paper (Quantico, VA: United States Marine Corps War College, AY: 1998-99), 4.

³⁸ Martin van Grevel, *Technology and War-From 2000 BC to Present*, London: Brassey’s, 1991, 312.

support because our mission expects our Marines to provide organic support for aircraft during wartime utilizing forward deployed squadrons.

A two-level maintenance concept will require the depot to assume some of the roles of the current MALS maintenance, such as tire and wheel build up and possibly powerplant module replacement and test. The next generation of aircraft (MV-22) powerplant support will go from the organizational level directly to the manufacturer for rebuild.

A reduction of on-hand spare parts due to on-aircraft monitoring and replacement before failure with just-in-time delivery of parts from the manufacturer, aviation supply can be much smaller than the current supply department of the MALS. “Doing away with excess inventory is a main target of “Just-in-Time” logistics, a civilian equivalent to the Commandant’s vision of Precision Logistics.”³⁹ Since the supply function will be reduced, we can integrate aviation supply with organizational-level maintenance. Integration with the organizational level will allow the supply department to retain some of its traditional functions of tracking, shipping, and receiving aircraft parts, but also permit it to maintain control of material functions the current supply department has oversight of, such as consumable parts (screws, bolts, washers), tools, support equipment, and hazardous materials (paint, solvents, adhesives, etc.).⁴⁰ Having the supply function of logistics support at the organizational-level of maintenance will increase awareness of the logistics team concept that is necessary for increased readiness.

³⁹ LtCol. Mark G. Bolin, 22.

⁴⁰ In his Independent Research Paper, LtCol Bolin commented that “the supply personnel should be moved from MALS and placed at the organizational level.” 13.

In reorganizing the MALS, there needs to be a reduction of occupational specialties to airframes, powerplants, avionics, and ordnance by type aircraft. Current MALS staffing require Marines with similar skills in their occupational field (e.g., avionics and airframes) to support the maintenance effort. Although the MV-22 LORA is incomplete, there is opportunity now to determine which intermediate-level maintenance skills can be transferred to the organizational level, merged with similar skills, or be discontinued. The MV-22 brings with it a smaller number of components for repair at the I-level, therefore should reflect a decrease of I-level structure. As a consequence, the arrival of newer aircraft incorporating advanced technologies “will result in the elimination of 200 or more Marine billets from the roles of each of the 10 MALS.”⁴¹

Technological advances in such areas as microcircuit repair and aircraft diagnostics will permit a transfer of more maintenance responsibility to the organizational level. Therefore, the MV-22 and JSF will promote aircraft maintenance that is more responsive, capable, and efficient. Such efficiency will lead directly to needed cost savings:

- Reliability – rarely breaks
- Maintainability – fixed easily
- Supportability – field technology
- Predictability – remove before failure
- Smaller footprint – speed & maneuverability
- Communication & Connectivity – information transfer (data)

By focusing in areas such as these, we will accomplish task reduction efforts leading to increased sortie generation. Detailed self-diagnosis systems allow technicians to rapidly identify defective components and aid in subsequent repair. Microcircuit maintenance

⁴¹ LtCol. Gilbert B. Diaz, USMC, “A Modest Proposal for the Future of Aviation Logistics,” *Marine Corps Gazette*, May 1998, 40.

allows the technician in the squadron to repair or replace a damaged component resulting in a significant reduction of intermediate-level maintenance needs. Further, it would reduce the need to maintain costly spare part inventories and expensive test equipment.

The goal is to have more capable and knowledgeable technicians that can perform a wide variety of tasks at the O-level. More capable and knowledgeable technicians have the ability to more effectively and efficiently perform aircraft maintenance. Additionally, technicians will have ready reference to all information through use of electronic publications on laptop-type computers replacing our current way of using paper publications.

The Marine Corps will continue to reduce the different types of aircraft in its inventory and replace them with smarter aircraft. These advanced aircraft will enter service with contractor support programs, along with advances in information technology that will enable greater efficiency from the Marines on the hangar deck. Making our Marines smarter and more capable will allow the Marine Corps to continue to do more with less. The changes proposed would allow Marine Aviation Logistic Squadrons to achieve greater economy and higher readiness that will increase the effectiveness of the Marine Air Ground Task Force.

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