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Aviation maintenance computerized management information systems : perspective for the future

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THESIS

AVIATION MAINTENANCE COMPUTERIZED MANAGEMENT INFORMATION SYSTEMS: PERSPECTIVE FOR THE FUTURE

by

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June 1984

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by

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ABSTRACT

The Naval Aviation Logistics Command Management Information System (NALCOMIS) is the next generation solution to the information assimilation gap faced by Naval Aviation maintenance managers. This thesis examines the scope of the problem at the Organizational and Intermediate levels of maintenance, and the intended effect of NALCOMIS and three peripheral information systems. The underlying concepts of the four systems investigated are used to explore Artificial Intelligence (AI) as the logical augmentation or follow-on to the NALCOMIS program. Recommendations regarding the implementation of AI and expert systems are made.

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I. INTRODUCTION

Logistics management within the military has established itself as a vital ingredient in the productive use of physical and informational flows. The need to address the transfer of technology into logistics applications and the need to pursue an integrated logistics information system within the Naval Aviation community established the foundation for this thesis. The authors believe the true test of military management excellence is in the ability to maintain armed forces and equipment, in sufficient quantity and state of readiness, to successfully respond to any real threat or contingency. But Naval Aviation management's ability to provide readiness is being inhibited by an inundation of information. Accurate and timely information processing has become a central issue. The proliferation of individualized maintenance/supply information systems currently attempting to manage necessary information is expanding. The need to integrate future logistical information system development is considered paramount to the community's success in achieving and maintaining aircraft readiness.

The Naval Aviation Logistics Command Management Information System (NALCOMIS) is the major program under development to meet the need for accurate and timely information processing. With NALCOMIS striving to close the management and information assimilation gap, special attention must be paid to the rapidly expanding technological capabilities that have been realized during its evolution.

With proper policy and technical direction and insight into what technology can provide in the management of information, the question becomes "What follows NALCOMIS?" This thesis attempts to examine management information systems, how they apply to Naval Aviation maintenance, and what should be expected of follow-on systems. As viewed by the authors, the next logical steps are an application of expert systems followed by artificial intelligence.

The implementation of such concepts will be neither expedient, inexpensive, nor simple, but are necessary if aviation maintenance is to surmount the plethora of information and its requirements for that information.

II. WHY MIS?

It has been more than two decades since organizations the size of the U.S. Navy ventured into the world of computers and began to embrace the information age. The nation's rapid technological growth has transformed the country from one able to survive on long hours of physical effort into a country dependent upon knowledge and information. The constantly growing and changing field of information technology is having a significant impact on the role of managers at all levels of organizational structure [Ref. 1]. Experts in the field of information systems are calling this age the "post-industrial period" or "information revolution." Regardless of the name that eventually identifies this period in our nation's history, recognizing information to be an extremely valuable resource is essential.

Today fifty-five percent of the nation's work force is involved with the information industry and by the year 2000, an estimated eighty percent will be information workers [Ref. 2]. The proliferation of computers and the ever-increasing complexity of modern weapon systems have made the need for accurate and timely information a requisite to survival.

Managers have always used information in the performance of their tasks, and to aid them in the decision-making process, functionally integrated information systems evolved. As the nation moves deeper into the information age, naval aviation has found itself operating in a "glut" of data that often hinders effective communication. The very nature of naval operations does not lend itself to a smooth flow of information. The United States has relied heavily on naval forces to show the flag in areas of potential conflict and, in the interest of international stability, to maintain a general maritime presence throughout the world on a continuing basis. Considering this constraint alone, it becomes readily apparent why effective communication of information is vital to the successful accomplishment, in either the micro or macro sense, of naval aviation's mission.

The constantly growing and changing field of information technology has significantly impacted management's involvement in the formulation of decisions. As the size and scope of naval aviation increases, general knowledge has been forced to give way to specialization. Today's managers, like those of tomorrow, are being required to use and understand systems-oriented procedures to try to satisfy the escalating demand for information. With a nation that is embracing the notion that it is better to work smarter, not to work harder, management techniques are shifting from reactive to proactive involvement with computers. Always questioning what is currently being done with an eye toward a better way, the only limiting factor on what computers can do is the imagination of the people creating them.

Fundamentally important to any concept of management information systems (MIS) is the caveat that the information system is a management tool and not the panacea to all of a manager's informational needs. MIS of the past only provided data and did not allow a manager to test the consequences of a potential decision or support the unstructured and non-routine problem. Internal collection, analysis, and dissemination of information is only part of the difficulty. The external pressures placed upon Navy management to provide real-time information up, down, inside, and outside the Government is overwhelming. To picture the environment that influences navy managers, consider the following simplified view (Figure 2-1) of competing influences that weigh heavily on managers and decision makers [Ref. 3].

The onslaught of technological advances has made the manual collection and retrieval of data inadequate to meet user requirements of timeliness and accuracy. Naval aviation's own maintenance/supply system is so large and complex that adequate analysis of data must be automated. However, with automation of the information resource, the system easily generates "data rich but information poor" communication. Edward D. Dwyer, a pioneer in the study of managing information very succintly states, "Information is management

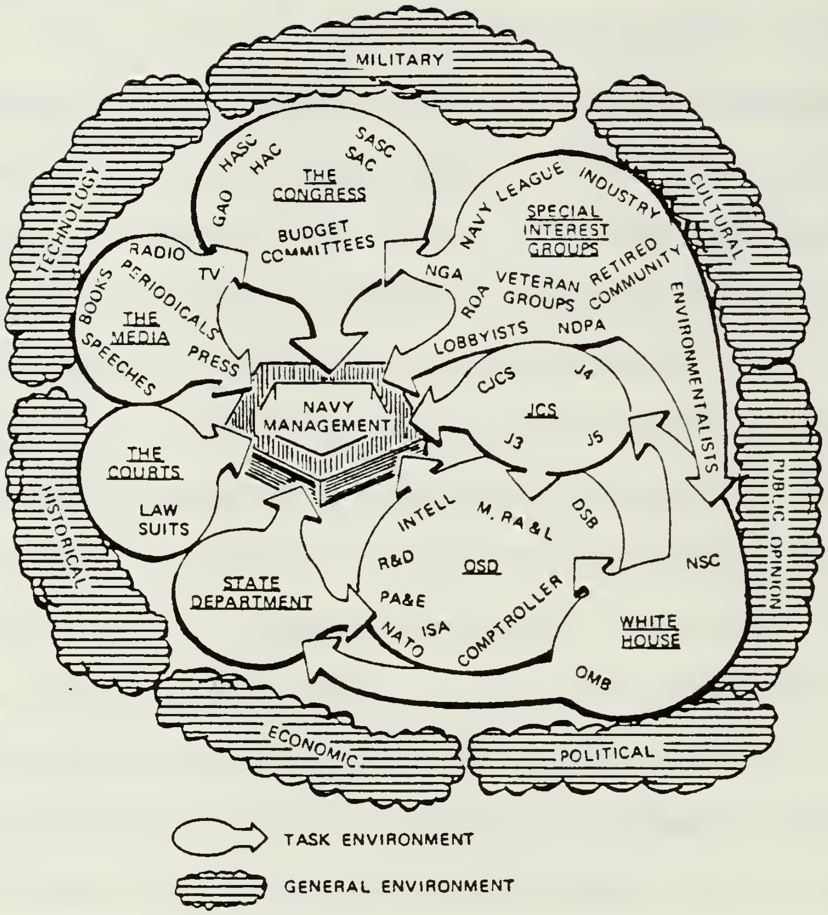


Figure 2-1

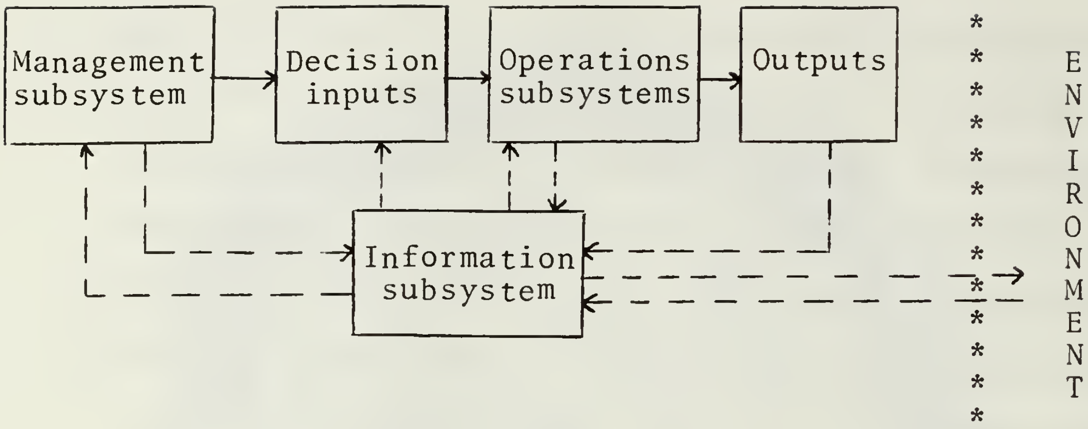
Competing Influences on Navy Management

information only to the extent to which the management needs or wants it; and it is significant to him only in terms of its relation to his accumulation of relevant knowledge and plans and to his personal responsibility." [Ref. 4] Thus, all too often, the relevant information has to be extracted from the mass of data available while it provides no support beyond simply supplying data.

Literature does not lend itself to one specific system or one definition for the MIS concept. The term MIS enjoys increasing usage, though there is no universal agreement on what MIS means. Even if MIS were defined according to managerial usage in the abstract, it would soon be apparent that a particular manager's usage of information would vary from that defined as the norm. The need for information also depends upon the background and proclivity of the individual decision maker. Thus, looking at the concept of MIS from the standpoint of managerial usage, the following definition is provided: "A management information system is one that supports managerial decision making by supplying relevant information when required." [Ref. 5]

In viewing naval aviation maintenance and material management as a total system, three subsystems emerge: operations, management, and information. Figure 2-2 displays vividly the key position information maintains in the total system concept [Ref. 6].

The information subsystem is necessarily highly integrated to allow access to the information resource by all departments, levels of management, and users. The computer becomes a vehicle for management to use, freeing themselves from the mundane or undue crisis management approach to decision making and allowing managers the opportunity to actually get out of the office and manage. An aphorism



Legend:

⟶ Flow of people, work, material, etc.

– – – Flow of data and information

Figure 2-2. Information Subsystem Flow

that really brings the point home is: "Don't confuse efficiency with effectiveness." The type of maintenance management naval aviation has to develop is effective, system-oriented management that uses high quality, timely information as a basis for decision making. With an increasing emphasis on speed and aircraft readiness, systems that focus on pushing paper have outlived their usefulness.

A carefully developed, well-planned information network can make virtually any organization more efficient, more cost effective and better able to manage its resources in the years to come. The issue of control of an organization's data is a serious matter. If various units within Naval Aviation maintenance try to maintain and control their own data bases, the compatibility of data as it flows upward through the chain of command becomes unmanageable. The current proliferation of microcomputers and the diversity of methods end users may select to manage their increasing informational needs cause great variability of input data. This variability and possible differing interpretations of that data can easily produce conflicting reports, while limiting management's ability to track the original data to a common source and reconcile differences.

The macro reality of the microcomputer is, that while it has modernized the age-old bookkeeping process [Ref. 7] and provided management with the opportunity to reduce time and effort while increasing the timeliness and accuracy of information, it has compounded the problems of control. Within Naval Aviation, the issue of agreement on the kind of information system to be developed and implemented within maintenance and logistic organizations has been determined. The Naval Aviation Logistics Command (NALC), recognizing the need to efficiently and effectively manage the Naval Aviation Maintenance Program (NAMP), chose a MIS for base level management of aviation maintenance and material, source data collection, and up-line reporting. NALC's choice is the Naval Aviation Logististics Command Management Information System (NALCOMIS). The primary purpose of NALCOMIS is to improve operational readiness of Navy and Marine Corps aviation units through improvements via automation of aircraft maintenance and supply management effectiveness.

Applying the premise that the purpose of a MIS is to decrease uncertainty in organizational decision making with a corresponding increase in resource employment, NALCOMIS is to provide local managers at the Organizational Maintenance Activity (OMA), the Intermediate Maintenance Activity (IMA), and the Supply Support Center (SSC) with a modern, responsive MIS. The NALCOMIS system addresses the urgent requirements to modernize and standardize the numerous information systems currently attempting to support Navy and Marine Corps aviation maintenance managers. The predominant problem NALCOMIS will meet head-on within the Naval Aviation Logistics community is that of too many aircraft not meeting the Chief of Naval Operations (CNO) minimum standards for mission capability (MC). Additionally, NALCOMIS is envisioned to be an important tool through which the Naval Air Systems Command (NAVAIR) can assist the Naval Supply Systems Command (NAVSUP) and the fleets to improve the MC rate [Ref. 8].

Implementation of NALCOMIS is currently planned for approximately ninety-eight afloat and ashore operational and support sites as well as approximately 400 squadrons within the Navy and Marine Corps. The project is sponsored by NAVAIRSYSCOM PMA-270 and is following the policy for all Department of Defense (DOD) acquisitions set forth in the

DOD Directive 5000.1. The preproduction prototype model of engineered designs has been constructed and is currently undergoing test and evaluation with Marine Air Group 14, MCAS Cherry Point, North Carolina.

To cover the interval between approval and fleet implementation of NALCOMIS, the Status, Inventory, and Data Management System (SIDMS) has been successfully installed and is being used in support of Intermediate Maintenance Activities (IMA's) afloat. SIDMS is a data retrieval system designed to provide IMA production control and service work centers with current and accurate information related to production control status, parts or equipment inventories, and personnel status. The system also provides the ability to automatically cross reference from part number to National Stock Number (NSN) as well as transmit DD Form 1348 requisitions between IMA and OMA levels. Although SIDMS is primarily a supply support system, it does provide management with on-line historical data, generally automates the requisition process, and monitors the flow of repairables. The value of this system as an interim measure has been well documented by the positive results achieved in operational parameters and enhanced performance [Ref. 9].

III. NATURE OF THE PROBLEM

In the early forties, the decision was made to produce an aircraft which traveled faster than the speed of sound. There were two possible approaches: one was to improve specific parts of the piston engine; the other to investigate the fundamental properties of motion and flight and develop a new engine. The result: a jet engine that changed the future of aviation. Much like the challenge faced by aviation in the forties is the challenge to management of the eighties to obtain better information from computers. From the beginning, penetration by computers into organizations has affected management procedures and the way managers do their job. MIS is an extender of skills, not a mindless electronic artifact programmed to perform crude repetitive tasks. Computers today complement, support, and extend human intelligence in problem solving. They have the capability to store, retrieve, and learn far larger amounts of data than can be handled by the conscious human mind. The challenge facing the aviation maintenance community today is how to cope with the growing need for more effective and efficient management of resources. The requirement to increase overall productivity in a resource-constrained environment has placed emphasis on all aspects of the system/product life cycle, and the management of information has assumed a major role.

A. NAVAL AVIATION MAINTENANCE PROGRAM

The Naval Aviation Maintenance Program (NAMP) encompasses all Navy and Marine Corps activities engaged in the operation, maintenance, repair, rework, production and support of aircraft. Levels of responsibility range from the daily aircraft upkeep maintenance performed at the Organizational (O) level to the major aircraft overhaul functions performed at the Depot (D) level. The Intermediate (I) level bridges the maintenance gap between the O and D levels by providing off-aircraft component repair, calibration and testing. This thesis is primarily concerned with operations at the O and I levels of maintenance. Appendix B provides a detailed explanation of the operations and responsibilities of the O and I levels.

B. VISUAL INFORMATION DISPLAY SYSTEM/MAINTENANCE ACTION FORM

The process of tracking and controlling the shift or daily work schedule is performed manually by Maintenance/ Production Control personnel. Two of the current control methods include the Visual Information Display System/ Maintenance Action Form (VIDS/MAF OPNAV Form 4790/60) and the VIDS board, plastic status boards, and grease pencils. Figures 3-1 and 3-2 show the NAMP's prescribed VIDS/MAF flow for the O and I levels. The redundancy of effort in information flow between Maintenance Control, Quality Assurance, and the affected work centers is strikingly evident. The

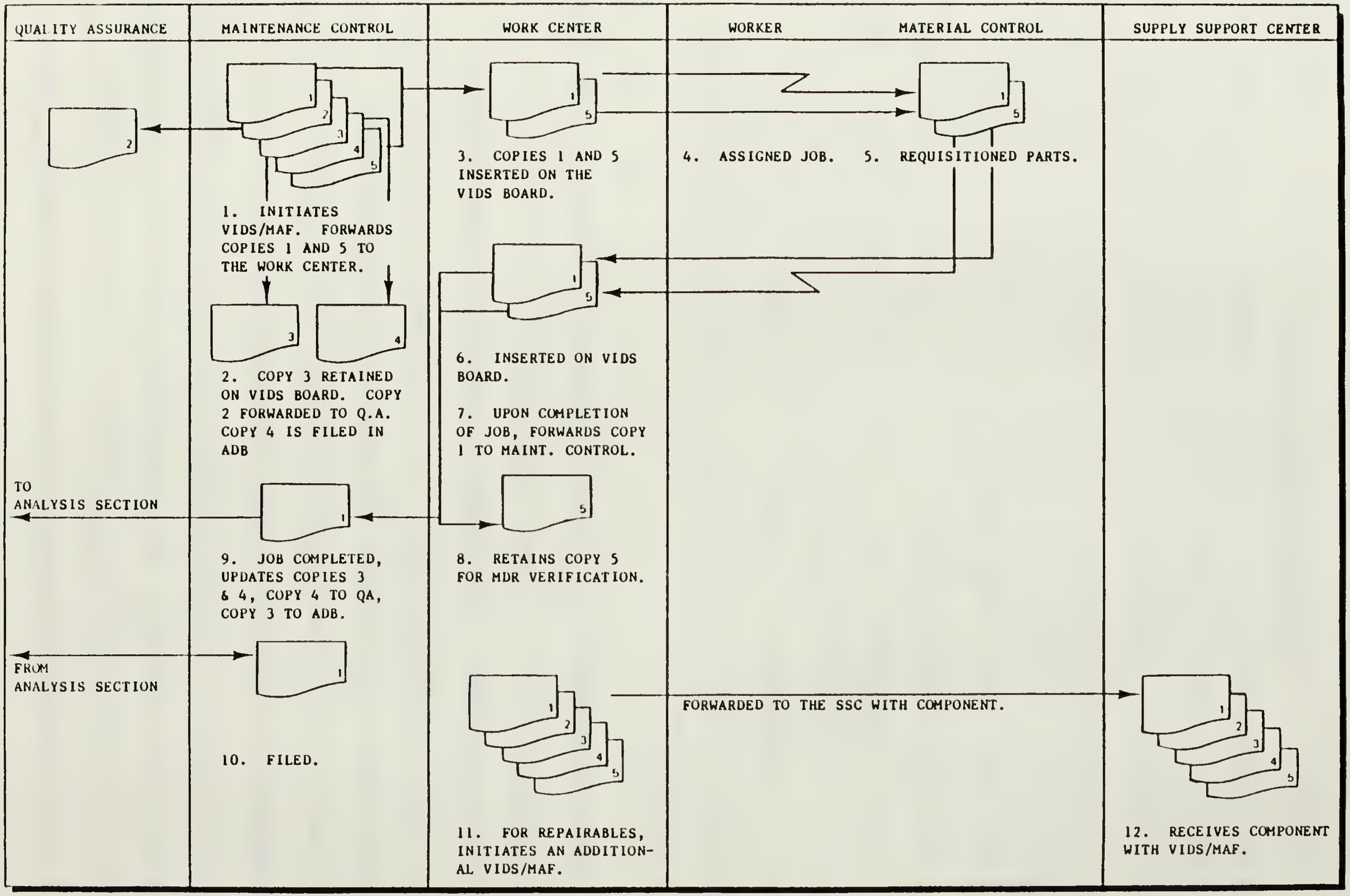


Figure 3-1 Organizational Maintenance VIDS/MAF Flow

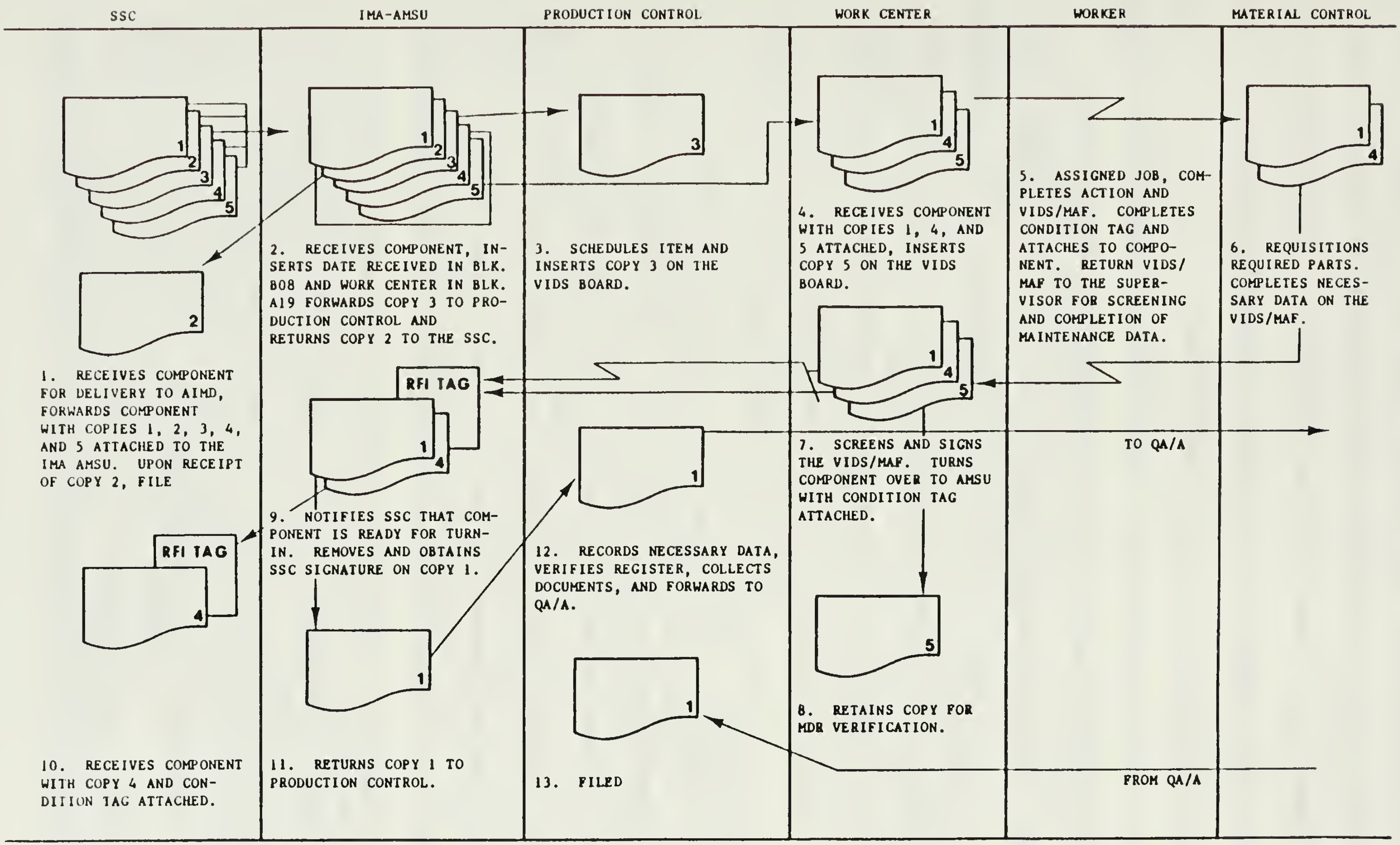


Figure 3-2 Off-Equipment VIDS/MAF Flow

VIDS boards are bulky, occupying space which is at a premium onboard afloat units and filing requirements for the five-part VIDS/MAF exacerbate storage problems. Additionally, information is easily lost as units or detachments deploy on mission assignments around the globe.

Clearly, the VIDS/MAF and associated information system as it is currently employed is not adequate for future management of increasingly complex aircraft and component repair. A real-time, fully integrated, automated information system linking the Maintenance/Production Control with all other work centers would have the potential to reduce the volume of paper products, reduce communication errors, improve data base accuracy and negate redundant activities currently causing a maintenance information dilemma.

The requirement to get the right information to the right people at the right time has to be systematically approached. It is essential that all facets of an information system be addressed as a fully integrated plan. Faced with new technologies, increasing systems complexity, limited resources and reduced operating budgets, today's managers must heed past lessons learned in development, allocation and management of the information resource.

C. GAO IDENTIFIED MIS DISCREPANCIES

In 1979, the Government Accounting Office (GAO) identified a myriad of problems encountered by the Navy in its efforts to implement computerized information systems. Through a brief review and understanding of past errors, future implementation efforts may be reduced in complexity, and the outcomes made more likely to succeed. The GAO report listed the following points as those which necessarily required improvement [Ref. 10]:

1. Insufficient programming staff: A lack of programmers, computer technicians and analysts can cripple the implementation of a system more quickly than any other insufficiency. A continuous evaluation effort by a staff dedicated to the system will eliminate, or substantially reduce, the likelihood of major malfunctions or inconsistencies. The myth of a "turn-key" operation remains just that. Computer systems require continuous maintenance of both the software and hardware aspects, especially if life cycle costs are to be held down. A dedicated staff throughout the useful life of the information system remains essential.

2. Needless duplication of MIS systems: Duplication of systems is defined in this instance as systems of various hardware/software configurations designed to perform the same basic functions. The proliferation of non-uniform, tailored computer systems is a successful method of enforcing competition among manufacturers and spreading the government dollars, but it is not necessarily efficient nor effective in attainment of information system goals. Because data base storage and retrieval requirements are functionally constant, there seems little reason to operate peculiar hardware and software throughout the various major commands.

3. Lack of hardware/software uniformity: Without standardization of hardware and software, information exchanges become difficult, if not impossible. Hardware exchanges are also less likely if commonality or compatibility does not exist. The uniformity question leads into additional costs to train personnel to maintain multiple systems, and reduces any one technician's ability to specialize without impacting the systems' operation, and that of the user command.

4. Lack of centralized control: Fragmented control and responsibility lead to a duplication of efforts and a

reduction in overall goal attainment at a reasonable cost. Central control is necessary to monitor system configuration, provide training, prepare and publish technical information, test all software, and act as a single point of contact for all users.

None of the previously mentioned points are radical or new, but each is well worth consideration. Rising costs, increased aircraft complexity, and ever-expanding data base requirements make proper, well thought-out information systems procurement and installation paramount to success.

The management process is one of decision making or choosing from alternatives. To be an effective tool to the maintenance manager, a computer system must support the manager by providing information that is assembled in a meaningful form and at the appropriate level. In the optimal sense, the MIS would provide precisely the required information, at the desired level of interest, at the right time [Ref. 11].

IV. FINDINGS

A. JASMMM CONCEPT

The implicit underlying concept for any maintenance/supply interface is the Joint Aviation Supply and Maintenance Material Management (JASMMM) program. JASMMM is designed to foster a spirit of cooperation and communication between the maintenance and supply organizations. Through JASMMM, the mission capability of Navy and Marine Corps aircraft is improved while meeting the NAMP objectives of maximum material readiness, safety, and optimum use of manpower, facilities, material and funds.

In the pursuit of an on-line, real-time, JASMMM oriented management tool, several systems that are either currently in use or undergoing development were researched. Each system is designed to reduce the level of detail required to manage time, and increase the overall efficiency and effectiveness of the maintenance operation. Each of these systems performs well but falls short of functioning as a total management tool. Each produces high quality results, and some very positive benefits in the areas of data base development and time savings are attained. The following is an encapsulation of the maintenance management information systems investigated.

B. NALCOMIS

The major information system undergoing testing and initial implementation is the Naval Aviation Logistics Command Management Information System (NALCOMIS). The system is initially designed for use by the afloat and ashore O and I levels and SSC's. Included in the NALCOMIS program is the objective to eliminate redundant information systems, and to implement MIS automation in the fleet in coordination with NALCOMIS. Appendix C lists the MIS designed for use, or actually used, in aviation maintenance material management excluding those MIS for which detailed procedures are provided in the OPNAVINST 4790.2B and word processing equipment applications. Of these systems, fourteen are considered interim to NALCOMIS, three will ultimately merge into NALCOMIS, and two will interface with the NALCOMIS system.
This categorization within the NALCOMIS program will continue to evolve, with the final MIS having ninety-eight NALCOMIS operational sites that are responsible for the effective and efficient management of approximately 5000 aircraft valued at over $23 billion, and a supply inventory valued at over $3.4 billion [Ref. 12].

To date, NALCOMIS development has been a twelve-year evolutionary process to replace or support the manual paperwork flow with an automated data processing system. A modular approach is being used in developing NALCOMIS programs.

Module 1 implementation limits the initial scope of coverage to support of O level, I level, and SSC functions afloat and ashore. The system will use Honeywell, Inc.'s Shipboard Nontactical Automatic Data Processing Program (SNAP) 1, phase 2, DPS-6 (AN/UYK-65) hardware and Common Business Oriented Language (COBOL) software.

NALCOMIS is intended to provide the majority of the Navy and Marine Corps aviation community with a standard automated information system that will assist managers in accomplishing aviation maintenance and supply support functions and result in increased aircraft mission capability, increased personnel effectiveness, and improved data reporting. The project is managed by NAVAIR (PMA-270), with the Naval Aviation Logistics Center designated the Lead Field Activity for Integrated Logistics Support of Module 1. An agreement for support between NAVAIR and NAVSUP dated 23 May 1978 designated the Fleet Material Support Office (FMSO), Mechanicsburg, Pennsylvania, as the Central Design Activity (CDA). Throughout this process both the Chief of Naval Operations (CNO) and the Deputy Under Secretary of the Navy for Financial Management have remained firmly committed to the development of NALCOMIS.

The purpose of NALCOMIS is to replace the manually and partially automated process of recording aircraft maintenance and workload data with a single, integrated, standard, automated, interactive, data-base system to provide real-time aviation logistics/material condition information to maintenance managers. Progress to date has been stormy with schedule slippages and controversy over how to best fill the existing real-time maintenance information void until full Module 1 implementation. A Naval Audit Service report (18 March 1982) estimated the implementation date to be Fiscal Year 1992 at the earliest.

Regardless of the stormy political climate that surrounds the NALCOMIS program, urgent requirements remain to make the concept of Module 1 a workable tool to assist aviation management in improving material conditions of readiness. The Navy currently has no single, integrated real-time, automated MIS to support the base level management of aviation maintenance and material, source data collection, intra-base data communication and up-line reporting functions. The NALCOMIS Module 1 system will provide a network to allow authorized users with a need-to-know, the ability to access required data, linking together the previously independent data base systems of the operational O, I, and SSC sites.

C. SIDMS

The Status, Inventory, Data Management System (SIDMS) is a shipboard system operating in an interim status until NALCOMIS implementation. The system operates on ruggedized Honeywell SNAP 1, phase 2 DPS-6 family (AN/UYK-65) hardware and COBOL based software. It is intended to displace proliferating, fleetwide shipboard non-standard systems and increase aircraft mission and full mission capability through the following objectives:

Primary: Improve expeditious repair (EXREP) and rotatable pool management while reducing supply response times.

Secondary: Improve personnel employment and material/equipment management while reducing component turnaround times.

SIDMS directly connects the afloat O level, I level and SSC operations. Printers and Video Display Terminals (VDT) are located in squadron Maintenance/Material Control, AIMD Production Control, AIMD work centers, Supply Response Section, Rotatable Pool, Program Management Branch and Awaiting Parts Unit.

The SIDMS software offers thirty-three user programs, sixty-six standard reports, and over one-hundred query operations. Some of the programs covered by SIDMS include:

-Aviation Consolidated Allowance List (AVCAL)

-Precision Measurement Equipment (PME)

-Support equipment management

-Rotatable pool management

-Technical Publication Library (TPL) files

-Individual Component Repair List (ICRL) files

-Test bench status

-Work center status

-Component status

- Supply stock information
- Requisition status
- Awaiting Parts (AWP) management
- Part number to stock number cross referencing
- Automated requisition forms.

SIDMS also produces management reports for use at all levels in assessment and documentation of material and personnel utilization and the production effort.

The SIDMS direct link between the squadron and the SSC is a long-awaited event for the O level maintenance manager. This interface allows for rapid processing of cannibalization requests, manpower reassignments due to parts availability, and a reduction in manual requisition processing. The Material Control personnel are also able to provide up-to-date information on requisition status to Maintenance Control without interfering with the SSC personnel. Supply requisition validations are greatly simplified through the direct interface and multiple methods of displaying all documents outstanding against a particular squadron or aircraft.

Because of the complexity and sheer volume of work performed at the AIMD, SIDMS has been geared to most directly serve the I level managers. This emphasis is observed in specific reports automatically generated by SIDMS such as the shift/daily production report. These reports provide the I level manager with near real-time summaries of the state of the production effort and enhance his ability to manage personnel and test branch assets. The availability of SIDMS has meant significant improvements in production and aircraft capability. As compared to non-SIDMS facilities, SIDMS has lead to a 17% improvement in average component turnaround time, an 11% increase in mission capability, and 29% increase in full mission capability [Ref. 13].

D. MRMS

The Mechanized Reparables Management System (MRMS) is a computerized maintenance and supply information system exclusively operating at the NAS Lemoore, California, Intermediate Maintenance Activity and onboard USS *Enterprise*. MRMS was designed to improve Production Control's ability to more effectively manage a yearly induction level of over 70,000 components. The system uses Wang Laboratories, Inc. hardware and the Beginner's All Purpose Symbolic Instruction Code (BASIC)-2 language structure.

MRMS goals include:

- Improved management decisions due to random/multiple access to information
- Real time information
- Interim selected reports
- Improved customer services
- Improved space utilization
- Improved efficiency through a shift of control to lower pay grades and the elimination of manual report writing and data compilation

- Elimination of duplication of effort
- Elimination of supply/maintenance head-to-head conflicts
- Allowing work centers and shops to concentrate on repair work
- Standardization of management information systems at the NAS
- Provision of single point of contact for all supported squadrons.

MRMS is intended to partially automate the paperwork functions of the Document Control Unit (DCU), Aviation Maintenance Screening Unit (AMSU), Awaiting Parts Unit (AWP), and Production Control (PC). Each of the work centers is equipped, as a minimum, with visual display terminals and all have printers except AMSU. Integration with the Air Station Supply Department is accomplished by a tape-to-tape method which eliminates true real-time information attainment. Should hardware become available, MRMS is expected to expand into the Rotatable Pool, Support Equipment, Precision Measuring Equipment, Power Plants, Armament and Airframes Divisions.

The most important features of MRMS include: full automation of the VIDS/MAF, automatic tracking of EXREP requirements, ease of use and tailored report generation. The automation of the VIDS/MAF entails all information being placed directly into the system via terminals with displays at Production Control (PC) and the affected work center.

This has led to the removal of the PC VIDS boards, and a subsequent release of much needed space. EXREP tracking has aided in smarter cannibalization management decisions through the identification of all likely candidates, thus allowing the manager to have a quicker, and possibly more thorough view of the available options. The MRMS software is written to allow quick understanding and use by personnel heretofore lacking in knowledge of the AIMD process or computer terminal use. This aspect is critical because of the AIMD's reliance upon temporarily assigned personnel from the supported squadrons to operate the terminals. The availability of tailored reports to the local level managers has enhanced their ability to decipher trends expeditiously and make better decisions regarding the production schedule and personnel/material asset use.

An important sidelight of the MRMS system has been the centralization and close coordination between the Production Control Officer and Component Control Officer. The close physical proximity of these key individuals has meant quick resolution of potential trouble areas and brought about a spirit of cooperation in the usually tense supply/maintenance interface. The final product tends to be smarter employment of available assets, improved production figures, and enhanced relationships between support facilities and departments.

E. VAMP

The Versatile Avionics Shop Test (VAST) Automated Management Program (VAMP) is one of the first Navy maintenance applications of automated prioritization assignment. VAMP is based on Honeywell SNAP 1, phase 2 DPS-6 hardware and COBOL language. The system is designed to prioritize VAST testable avionics components awaiting induction into the AIMD.

VAST is a computer-controlled test system used by the AIMD to process certain avionics components, or "black boxes." The system is made up of a group of independent, general purpose stimulus generators and measurement instruments called building blocks (BB's) that are necessary to automatically test highly sophisticated avionics equipment [Ref. 14].

VAST was designed to provide the following functions:

- Test different types of weapons system's components
- Test complex avionics equipment with greater speed and accuracy
- Provide flexibility to adapt to new weapons systems
- Realize long-term savings in resources
- Decrease the amount of set-up/tear-down time through the use of "batch processing."

To supplement the objectives of VAST, VAMP's objectives and functions are:

- Decrease turnaround repair time through better utilization of the Rotatable Pool

-Decrease required management manhours

-Decrease technician manhours on paperwork

-Provide more efficient tracking of components

-Increase VAST hardware utilization

-Collect real-time trend data

-Reduce 3M data errors.

Through arbitrarily determined weighting factors covering mission criticality of specific component, number of like components awaiting induction, test bench or building block status, supply requisition priority, and the probability of actually repairing the component, a final numerical value is assigned to the component. The component is then placed on a waiting list based on the final numerical value.

VAMP's use of weighting criteria and prioritization is an effective use of very basic management thought process techniques. The preset prioritization weightings allow the Production Control personnel time to manage other functions, such as test bench status, emergency induction requests, and the usual daily administrative workload. Additionally, VAMP automates the VIDS/MAF processing, which reduces documentation errors, and provides immediate status updates to Production Control.

As a management tool, VAMP currently provides the following:

-Prioritization of incoming work

- Automation of the documentation process
- Reduced documentation error rates
- Immediate test bench status
- Immediate component status and tracking
- Reduction of intensive management on daily workload assignments
- Enhanced utilization of test bench time.

Though a very narrow application, VAMP shows potential as a powerful management tool, and the hope for development as an "expert system" or artificial intelligence application. VAMP is currently in use at NAS North Island, California, for the S-3A Viking aircraft, and at NAS Miramar, California, for the F-14A Tomcat and E-2C Hawkeye aircraft.

V. THE FUTURE

A. THE CHALLENGE

Let there be no illusions; the next few years will be as crucial for America's defense program as they will be difficult. Meeting the challenges of the decade ahead calls for leadership to be constantly forward looking. The delicate balance of Western qualitative superiority currently cancels Soviet numerical superiority, but the West has higher personnel costs and therefore must spend proportionately less of its military budget on equipment. This necessitates that any inefficiencies or inadequacies of past systems development projects cannot be perpetuated. Managers of tomorrow must have the information they need to make effective decisions as well as the resources to maintain a technological edge sufficient to counter any Soviet threat. To date, most literature addressing maintenance information systems has done so from an information storage and retrieval standpoint. Because of the sheer volume of information maintained, storage and retrieval systems continue to gain in importance, but further steps in managing information resources must be taken. The finger-tip availability of vast quantities of information regarding aircraft status and configuration is not sufficient for future managers. Stand-alone microcomputers at the local level, as suggested by Hicks, will not fulfill the manager's basic need for a management tool [Ref. 15]. Faced with increasingly complex hardware systems and the reality of decreases in personnel, spare parts, and other resources,maintenance managers of the future will require additional assistance. This assistance could be in the form of computer-generated solutions, more commonly known as Artificial Intelligence (AI).

B. ARTIFICIAL INTELLIGENCE

AI has been defined as "the study and application of what is known about intelligence to the development of computer systems that model intelligent behavior" [Ref. 16]. Research and study in this area has been directed toward development of machines that can improve their own operations. The application of particular interest to aviation maintenance is the development of so called "expert systems." The expert system is designed to augment human expertise in diagnostics and training. Through the use of elaborately detailed logical rules, the expert system is capable of processing information in a strict order of deductive inference. The result is a pattern-match with the specified features of the task environment. Additionally, the expert system is capable of explaining its line of reasoning by displaying the rules used to reach a conclusion [Ref. 17]. Successful implementation of expert systems has taken place in the areas of medical diagnostics, computer system configuration troubleshooting and design, and business legal analysis.

The existence and expandability of machines which can "think" is inevitable. In the fall of 1983, the Air Force issued competitive contracts to seven U.S. airframe manufacturers for the design of an advanced tactical fighter which is intended to assure U.S. control of the air in the late 1990's. This "superfighter" and its Navy VFMX interceptor counterpart will have automatic systems or electronic copilots to handle flight, engine, weapons, countermeasures, communications, and navigation control. The systems will be programmable and allow the exchange of information between systems to provide backup in the event of failure. This autopilot of extraordinary machine intelligence and skill will relieve the pilot of many low-level tasks while keeping him abreast of his current situation and allowing him to become essentially a decision maker [Ref. 18].

C. BAYSHORE SCENARIO

The commitment to embrace new concepts and ideas will allow advanced technology every opportunity to develop. What follows is an adaptation of a scenario from Johnson [Ref. 19] and Dallman [Ref. 20] concerning the maintenance of an aircraft discrepancy. Note that this scenario could take place afloat or ashore and could be performed by personnel in any number of ratings.

Petty Officer Bayshore is an Aviation Electronics Technician onboard fighter squadron VFM-22, currently deployed in the Northern Pacific area. He begins his shift by reporting to the Avionics work center and connecting his portable computer to one of the desk-top workstations. Bayshore's work assignment appears on the workstation screen, "Aircraft 303 radar failure." The VIDS/MAF and BIT fault history, which were loaded into the system during the pilot's debrief, are displayed on the screen. Bayshore studies the information and requests historical data for the radar unit and for aircraft 303. As the data is retrieved, intelligent software in the system recognizes a pattern in the flight parameter data which matches a common radar system failure. The computer recommends a fault isolation procedure and lists the necessary technical instructions. Bayshore indicates to Maintenance Control that he is on his way to aircraft 303. He disconnects the portable computer from the work station and inserts the memory module containing the needed maintenance instructions, historical data, and diagnostic routines.

Bayshore carries the lightweight system to the flight deck, opens an access panel on the aircraft, and plugs the computer into the technician interface panel. (He recalls the Master Chief's story about the days when technicians actually had to get into the cockpit everytime they had to work on an aircraft. But that was when it took more than a half hour for aircraft daily inspections.)

He begins the fault isolation procedure by interrogating the avionics central computer. Bayshore's display draws a diagram of the current configuration of the self-repairing avionics network. He requests a comparison of the current and fully operational configurations. He notices that the radar and its data base interface have been operating in a rerouted configuration. Through the onboard panel, Bayshore indicates a system BIT test. The BIT report agrees with the pilot's discrepancy; a radar malfunction has occurred. However, when the computer analyzed the historical fault data, it discovered that 75 percent of the radar fault indications were caused by wiring problems and not faulty radar modules. He decides to test the wiring before removing a potentially good radar.

Bayshore activates the intelligent diagnostic aid which automatically downloads information about the current wiring configuration. Instructions appear on the screen showing where to locate the wire bundles which might cause a radar fault indication. Bayshore unplugs the portable computer from the aircraft and walks to the indicated access panel. He opens the panel, locates the bundle, and begins the fault isolation procedure. The intelligent software sequentially selects the optimum test points and displays graphic illustrations on how to conduct each test. (By now, the system knows that Bayshore always requests graphic instructions and displays then automatically. When he was new, Bayshore had to request the graphic data each time, until the system "learned" what to expect.) After ten minutes, Bayshore isolates the problem to a bent connector pin, and identifies the connector on his portable computer's graphic display.

Bayshore places a supply request for a replacement connector using his terminal and a direct interface with the supply computer via the flight deck radio communications network. The supply computer evaluates the requisition and responds with a status report. The part is in stock and will be brought to the aircraft in fifteen minutes. Automatic monitoring programs update Maintenance and Material Control on the aircraft status and part availability. By the time Bayshore removes the bad connector, the supply runner has delivered the replacement part. Bayshore replaces the connector and begins a final aircraft checkout. He calls up a display of aircraft 303's flight schedule for the next day. A heavy day of flying is planned. Bayshore asks for a comparison of the system capabilities needed for the upcoming missions. He is in luck; the system has not degraded to a point where it needs repair.

Now to check for projected system failures. Bayshore calls up the analysis of historical flight data which was performed back at the workstation. The analysis shows that an electrical system failure is likely to occur within the next ten flying hours. Bayshore checks out the indicated sub-systems and replaces a weak communication control panel before finishing the checkout.

With the job finished, Bayshore returns to the work center and plugs the portable computer into the workstation. By selecting a report option on the display, all the information, which was recorded as he worked, is automatically formatted and transmitted to Maintenance Control, Material Control, and Quality

Assurance. Bayshore does not need to spend time filling out numerous reporting forms as in the "old days." He again checks the work schedule and, finding himself free for the next twenty minutes, decides to run through a new flight control system training package. Maintenance Control is planning to install the new system next month, so Bayshore plays with the graphic simulation model of the system and remembers how boring and difficult the classroom training was before the new training system was installed.

Before signing off, he is reminded that he has one more skills test to complete in the maintenance activity simulation before he will be eligible for promotion. Bayshore asks for an analysis of his training profile to determine weak areas and then asks for absolute and relative maintenance performance standings. He is informed that he has had adequate simulated and actual practice in each area and that his fault detection and procedural task efficiency ratings have improved significantly. Furthermore, his standing in comparison to other E-5 avionics technicians has improved.

D. BAYSHORE SCENARIO ANALYSIS

The Bayshore scenario brings out many exciting prospects for future maintenance activities. Several points made in the scenario deserve highlighting. These include:

1. Failure pattern recognition: As aircraft sophistication increases, it becomes evident that basic technician training will be unable to adequately cover the myriad failure modes likely to be encountered in daily operations. Through accumulation of a substantial data base of failure history and application of decision logic, repair times should be reduced, cannibalization of aircraft components should be reduced, and ultimately aircraft readiness will increase. The data base information will also be vital to the Supply department in maintaining proper stock levels of spare parts.

2. Recognition of technician preferences and skill levels: By recognizing a technician's skill level in identifying, isolating and repairing a discrepancy, and preferences for certain technician information, the maintenance process time span is reduced. Also, through recognition of skill levels or abilities, the computer

can guide technicians through areas of personal weakness without significantly delaying the maintenance effort.

3. Pinpointing of optimal test points: A substantial data base with continuous updating will ensure that the technician is armed with all the available knowledge to quickly and efficiently isolate and repair a discrepancy. Due to the complexity and sheer volume of electrical wiring encountered in aircraft, accurate test point isolation is especially important. The same holds true for redundant systems or those with multiple interfaces which may show unusual failure patterns.

4. Automatic retrieval of technical materials: This facet will ensure the technician has the necessary information and diagrams to fulfill an assigned task. Further, the information will be easily referenced without the usual problems of paper materials blowing down the flight deck or flight line. Technical manual updating will also be improved since the information is loaded at a central point instead of within individual work centers.

5. Direct interface with the supply computer: One of the more time-consuming aspects of aviation maintenance is that of requiring a technician to requisition replacement parts. Through direct interface with the supply computer, real-time information is achieved which can assist both the technician and maintenance manager in assessing the situation. Time critical decisions can be made in a more educated manner through the availability of real-time information. Additionally, the computer will automatically reference each aircraft's current configuration to assure the parts delivered have all the necessary internal modifications. Each part will be tracked by individual serial number to ensure the inclusion of all internal changes, and provide an audit trail of maintenance actions.

6. Automatic report/form generation: One of the most critical activities associated with acquiring information is also the most often defeated. The validity of data is only as good as the input; therefore, automating the input can serve only to enhance the possibility of the data base being valid. Automation and transfer also assure all interested parties receive the information in a timely and accurate manner. Upline reporting is also greatly simplified through automatic updating and compilation.

7. Interface with maintenance training: Training has long been a problem because of scheduling difficulties and time requirements. An individual's ability to access training aids can serve as an impetus to conduct self-study during available hours while retaining the technician on-station for the next assignment.

8. Career counseling and advancement enhancement: The availability of an individual's qualifications for advancement and relative ranking can serve as valuable tools for a career counselor in assessing goals during critical junctures in a career path, especially at reenlistment times.

Obviously, the Bayshore scenario will not become a reality in the very near term. But, because computer technology has a tendency to expand in quantum leaps, the ideas embraced in the scenario need to be dealt with now. No management can afford to be satisfied with its past information system methods. Supporting initiatives to take advantage of this exciting new technology and to explore the field of AI will help ensure that maintenance managers meet the future in a complementary fashion. History is filled with cases of procrastination leading to years of crisis management in the wake of advancing technology. Navy management has a superb opportunity to meet the future on its own terms--if the initiative is taken now.

The Air Force Human Resources Laboratory (AFHRL) has compiled statistics which emphasize the importance of AI adoption into the maintenance sphere. It is estimated that the use of AI in job performance aiding alone could reduce first term enlistment training costs fifty to eighty percent, reduce erroneous component removal, and decrease maintenance labor force requirements by fifteen percent. These estimates could bring about a $1.675 billion savings for the Air Force annually [Ref. 21]. If the AFHRL savings estimates are correct, the Navy too can expect to achieve proportionate reductions in training and parts removal costs.

Clearly, artificial intelligence has tremendous potential in all arenas of aviation maintenance, and its management. Though not a panacea, artificial intelligence offers managers their first glimpse of the light at the end of the crisis management tunnel. The benefits will not come without work, without a plan, and without current leadership spearheading the research to implement its beginning.

VI. RECOMMENDATIONS

The Department of Defense has made the readiness of military forces its highest priority, while simultaneously making a major commitment to strengthen those forces through modernization. Modernization will provide for a force increase, lowering the average age of systems in use, and an incorporation of more efficient technology to give the qualitative edge that is needed. These future operational concepts and generation of weapons will require efficient logistics systems to deliver quickly, wherever needed, the required spare parts and repair capabilities [Ref. 22].

Today's logistics systems appear to be a generation behind weapons technology. The generating and storing of technical data to replace the manual, paper logistics documents and errors associated with manual operations is being attempted, but time and a lack of acceptance of computer capabilities seem to be working against management.

For almost four decades, the coming "information age" has been heralded with advances in computer technology, but the results in the design and development of information systems vary widely in usefulness and purpose. The value of information is a complex and subtle concept generating a myriad of literature and thought. However, as formal information systems become more prevalent, increased emphasis has to be placed on general design concepts and methodologies if the information systems are to aid decision making and problem solving within particular contexts and environments.

It is apparent that the design of an information system should be heavily influenced by potential users' information needs and before any future equipment selection decisions are made, it is imperative that an organization's information processing activities be fully understood. Accepting that NALCOMIS is the next generation solution to the maintenance management information assimilation gap, it is time to seriously consider what direction follow-on or augmenting systems will take.

One of Naval Aviation's major objectives must be the placement of management tools and support aids that will allow for a more useable and easily accessible management information and support structure. The concept of artificial intelligence, often defined as the science of enabling computers to reason, make judgments, and even learn, is actually concerned with building machines that mimic such behaviors, even if their internal operations do not actually correspond to the activities of the human mind. Research in this field is continuing to develop new and more powerful programming tools to deal with these concepts [Ref. 24].

As artificial intelligence approaches a realistically feasible stage, several issues regarding its implementation should be addressed. No matter how information systems have been previously put into effect, AI must be adopted in a pragmatic fashion. Certain rules must be adhered to if the system implementation is to be successful. These essential principles include incrementalism, central review and procedural review. A brief discussion of each principle follows.

1. Incremental Implementation

The consecutive addition or implementation of computer software is advocated in numerous management and computer texts. Through incrementalism, software can be developed, tested and implemented into the system with marginal impact upon the end users. This approach reduces management anxiety over potential production slowdowns caused by unfamiliar programs, or perceived career threats or reductions in control and authority. Any change must provide a very minimal effect upon the users and must not be perceived as ill-conceived or lacking in purpose.

Another important benefit gained through the incremental approach is the smooth interface made possible between all user levels concerned. This becomes a key issue if problems are encountered during the testing or implementation phase. Early identification of difficulties can mean quick rectification and minimum impact upon all users. This reduces the potential for "finger-pointing" when areas of control and command boundaries overlap or are in conflict.

2. Central Review/Authorization

Through time responsive, centralized review and control of all changes, commonality and goal attainment will be achieved. The existence of non-uniform systems in the fleet environment within a specific major command is counter-productive. As previously mentioned, non-uniform systems lead to increases in operations and maintenance costs, and decreased information exchange ability.

3. Real-time Interface

An absolute must in any future management application for end users is real-time interfacing. Information is a perishable resource; therefore, any delay between major command computers such as Supply and Aviation Maintenance can mean the loss of combat readiness, and valuable production time and capability. Commercial airlines, such as United Airlines, have found direct, real-time computer links between the supply and maintenance functions vital to keeping the competitive edge. In the case of commercial ventures, the competitive edge is measured in monetary terms; for the military, the edge is in readiness.

4. Billet/Responsibility/Procedural Changes

As with any new system, changes in billet descriptions and procedures are inevitable. It is incumbent upon managers to be flexible in their assessment of alterations, and tailor their operation to the new information system. Managers must avoid the common pitfalls which easily defeat a new system. A lack of education, unfamiliarity with the system goals, or perception of the system as a threat is not tolerable.

Changes in the Maintenance Administration and Material Control Division operations are likely. A change in manpower structure and billet descriptions are quite probable, especially in the Maintenance Administrationman (AZ) rating. General James P. Mullins, USAF, succinctly draws a vivid parallel that represents the environmental changes going on around today's military. He states:

> There are some disturbing similarities between the dinosaur of yesterday and the Air Force of today. Like those great reptiles, we've been characterized for some time now by great strength and relative invulnerability. We've derived our power from technology. Yet like the dinosaur, we are beginning to find it difficult to deal with the new realities of life around us--realities created by the very technology that gave us our strength in the first place. Indeed, like the dinosaur, we find ourselves roaming stubbornly down the well-worn path of outdated mind-sets, oblivious to the changes in our environment and serious consequences that are likely to result [Ref. 25].

Though it may be a matter of time before AI can begin incorporation into the NALCOMIS program, the challenge is to plan for this eventuality now.

JASMMM	Joint Aviation Supply and Maintenance Material Management
JCN	Job Control Number
JCS	Joint Chiefs of Staff
LRCA	Local Repair Cycle Assets
MATCO	Material Control Officer
MC	Mission Capable
MCO	Maintenance Control Officer
MIS	Management Information System
MMCO	Maintenance/Material Control Officer
MO	Maintenance Officer
MRMS	Mechanized Repairables Management System
NALC	Naval Aviation Logistics Command
NALCOMIS	Naval Aviation Logistics Command Management Information System
NAMP	Naval Aviation Maintenance Program
NAS	Naval Air Station
NAVAIR	Naval Air Systems Command
NAVSUP	Naval Supply Systems Command
NSC	National Security Council
NSN	National Stock Number
OMA	Organizational Maintenance Activity
OMB	Office of Management and Budget
OSD	Office of the Secretary of Defense
PC	Production Control
PEB	Pre-Expended Bin
PME	Precision Measuring Equipment
PRI	Priority Code
QA	Quality Assurance
QA/A	Quality Assurance/Analysis
R&D	Research and Development
SAC	Senate Appropriations Committee
SASC	Senated Armed Services Committee
SCIR	Subsystem Capability Impact Report

SE	Support Equipment
SIDMS	Status, Inventory, Data Management System
SNAP	Shipboard Non-tactical ADP Program
SRS	Supply Response Section
SSC	Supply Support Center
TPL	Technical Publication Library
VAMP	VAST Automated Management Program
VAST	Versatile Avionics Shop Test
VDT	Video Display Terminal
VIDS/MAF	Visual Information Display System/Maintenance Action Form
WCS	Work Center Supervisor
3M	Maintenance and Material Management System

APPENDIX B

NAMP ORGANIZATION OF ORGANIZATIONAL AND INTERMEDIATE LEVELS OF MAINTENANCE

The Naval Aviation Maintenance Program (NAMP) "encompasses all Navy and Marine Corps activities concerned with the operation, maintenance, rework, repair, production and support of aircraft." [Ref. 26]

> The objective of the NAMP is to achieve the readiness and safety standards established by the Chief of Naval Operations (CNO), with optimum utilization of manpower, facilities, material, and funds. This is to be accomplished through policy guidance, technical direction, management, and administration of all programs affecting activities responsible for aviation maintenance, including associated materials and equipment. It encompasses the repair of aeronautical equipment and material at the level of maintenance which will ensure optimum use of resources, the protection of weapon systems from corrosive elements through the prosecution of an active corrosion control program, and the application of a systematic planned maintenance program. It also includes the collection, analysis, and use of pertinent data in order to effectively improve material readiness and safety, while simultaneously increasing the efficient and economical management of human, monetary, and material resources.

To achieve the NAMP objectives, the maintenance structure is composed of three major levels: Organizational, Intermediate and Depot. Of the three levels, the Organizational and Intermediate levels will be of primary concern to this thesis. What follows is a brief functional description of these two levels of maintenance, the supporting supply activities, and documentation flow peculiar to each level.

Organizational level of maintenance: This is composed of "those upkeep maintenance functions normally performed by an operating unit on a day-to-day basis in support of its own operation." [Ref. 26] The functions include aircraft inspections, servicing, handling, corrective and preventative maintenance, incorporation of technical directives, and necessary record keeping and reports. Figure B-1 relates the position of the Maintenance Department within a typical squadron organization. Figure B-2 depicts a typical Navy Organizational Level Maintenance Department organization and Figure B-3 depicts the Marine Corps equivalent.

Maintenance Officer (MO): As Department Head, the MO is responsible to the squadron's Commanding Officer for all operations within the Maintenance Department. Responsibilities of the MO include:

- Administration of the department in accordance with the NAMP
- Employment of sound management practices in the handling of personnel, facilities and material
- Defining and assigning responsibilities, functions, and operations in accordance with existing instructions
- Continuous analysis of the department's mission and timely planning of requirements to meet future needs
- Ensuring full and effective employment of assigned personnel
- Providing data analysis summaries to the Commanding Officer and other superiors in the chain of command.

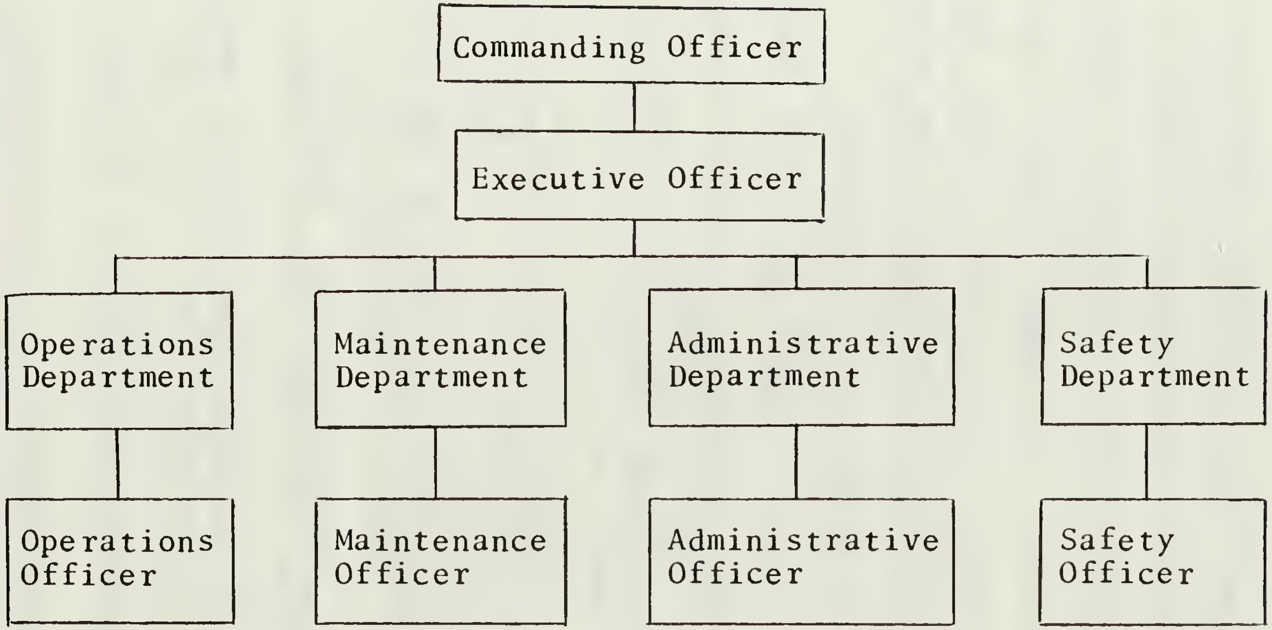
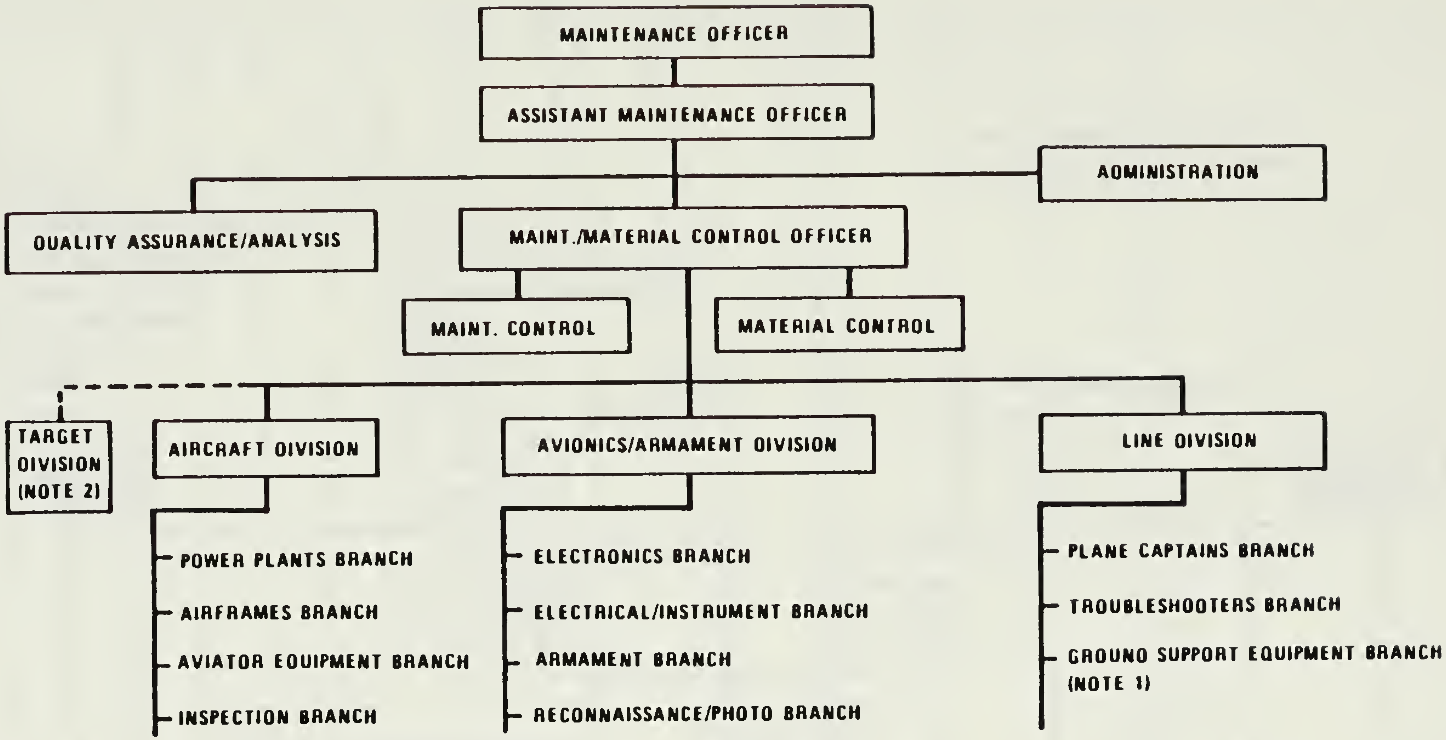


Figure B-1 Typical Aviation Squadron Organization Chart



NOTE 1: When responsibilities relative to operation and maintenance of Ground Support Equipment are extensive, the Commanding Officer will establish a Ground Support Equipment Branch under the Line Division to coordinate and/or carry out organizational maintenance functions on assigned support equipment.

NOTE 2: When responsibilities relative to the operations and maintenance of aerial or surface targets are extensive, the Commanding Officer will establish a Target Division.

Figure B-2 Navy Organizational Level Maintenance Department Organization

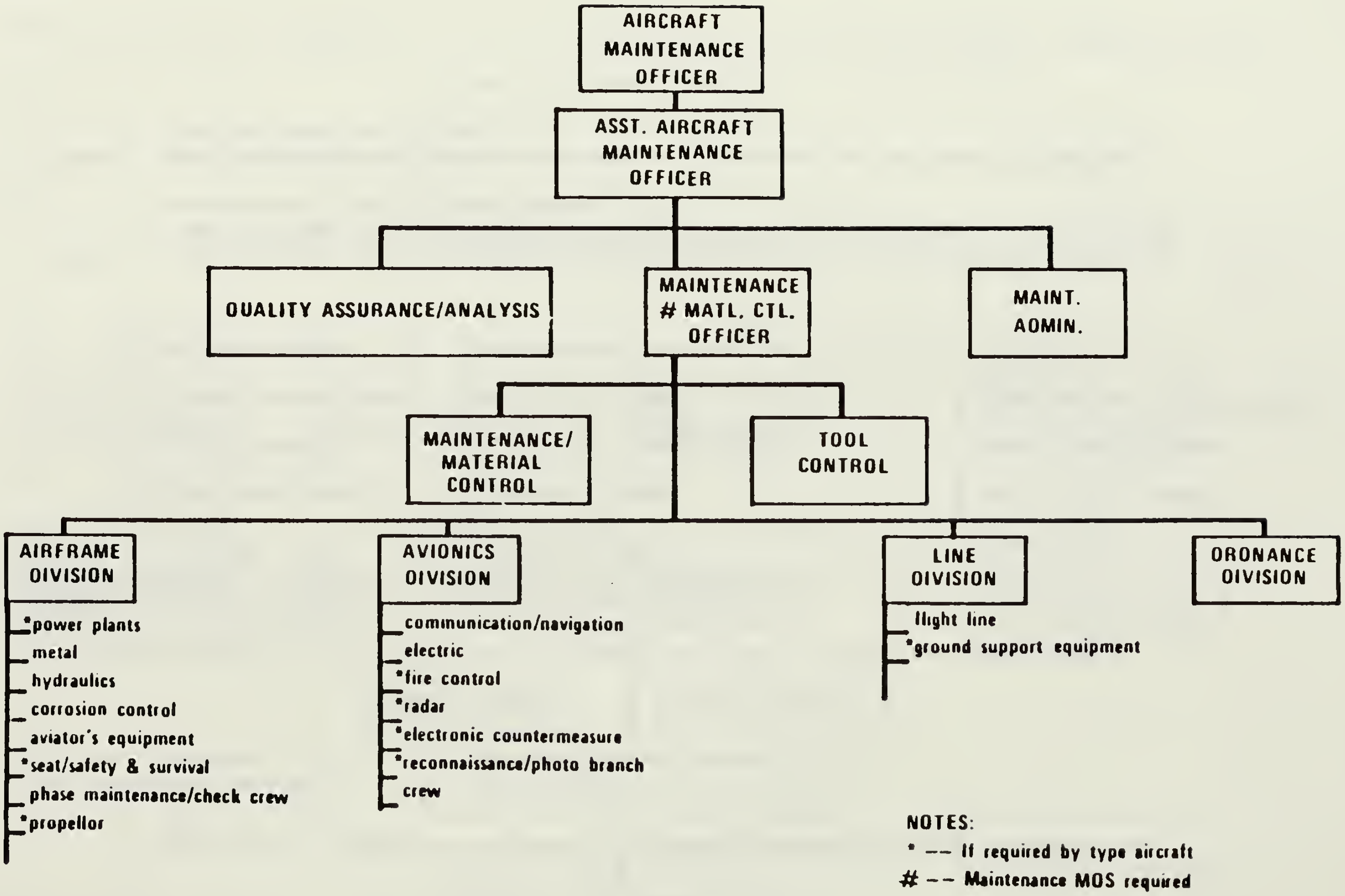


Figure B-3 Marine Corps Organizational Level Maintenance Department Organization

Maintenance/Material Control Officer (MMCO): The MMCO "is responsible to the MO for the overall productive effort and material support of the department/division." [Ref. 27] These responsibilities include:

-Coordinating/monitoring the department workload

-Maintaining liaison with the supporting activities and the local Supply activity to ensure squadron requirements are known and satisfied

-Controlling daily work load and assignment of work priorities

-Ensuring that the full capability of the department is utilized in the support of the department work load

-Maintaining aircraft log and associated equipment records, including weight and balance data, and inventory records

-Reviewing monthly Maintenance Data System (MDS) reports to ensure effective utilization of personnel, equipment and facilities.

-Planning material requirements to support the department work load

-Keeping the MO advised of the overall workload and material condition as it affects the department.

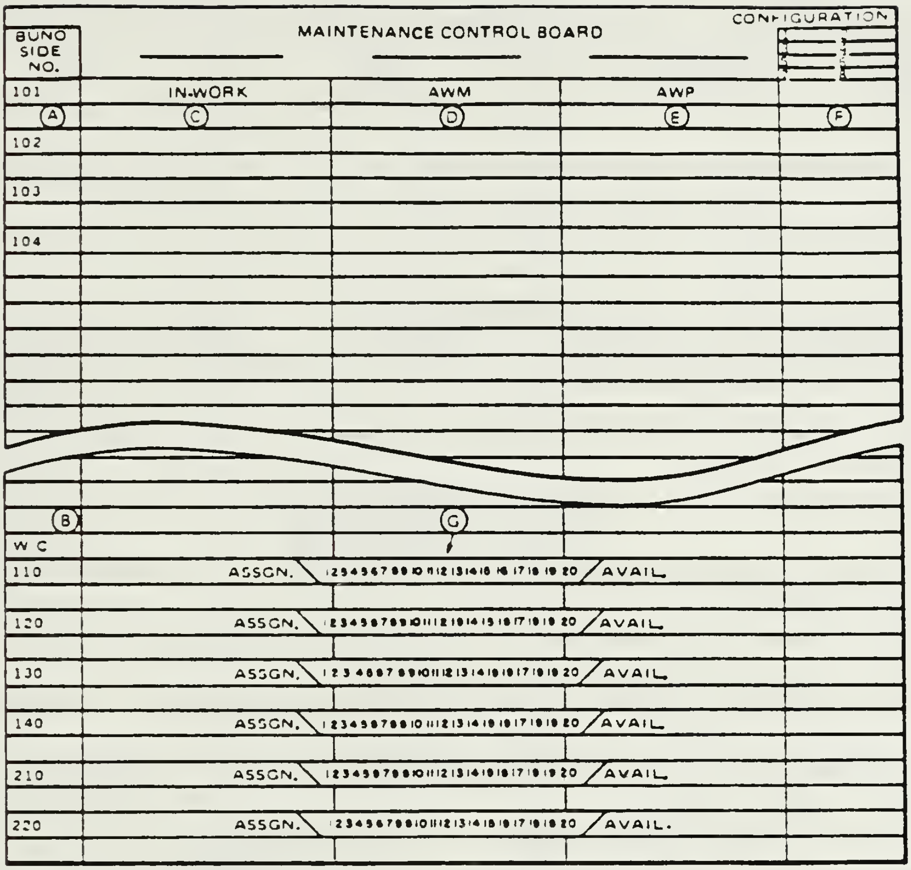
Maintenance Control Officer (MCO): The MCO is responsible to the MMCO for the operation of the Maintenance Control division. Maintenance Control is the central point through which all information passes concerning aircraft status, operational commitments, work load requirements, and personnel assets. The MCO's current primary management tool for controlling the maintenance effort is the Visual Information Display System (VIDS) located in Maintenance Control. Plastic status boards and grease pencils are also used to track other required maintenance actions. Information included on the status board may involve: hours remaining prior to inspections, oil sample intervals and mandatory component removals. The board is manually updated by the Maintenance Administrationmen (AZ) after each flight completion.

VIDS:

> The VIDS is a management tool that provides a graphic display of vital, up-to-date information on a continuing basis. The system correlates all aircraft status information and assigns a relative importance to each item.
>
> VIDS display boards consist of enlarged cardex type pockets for the visual display of weapon system status. Each pocket is overlapped by the one above so that approximately a three-eighths inch strip is visible at the bottom of the pockets

Figures B-4 and B-5 show typical Maintenance Control VIDS board layouts. Central to the operation of the VIDS board is the Visual Information Display System/Maintenance Action Form (VIDS/MAF, OPNAV Form 4790.60).

VIDS/MAF: This form is used to document all on-equipment maintenance actions, removal and subsequent processing of repairable components to the Intermediate level, compliance with technical directives and other assorted maintenance related actions. Figure B-6 depicts the VIDS/MAF. The VIDS/MAF flow is shown in Figure 3-1, and a complete description of its use is detailed in Volume 2 of the OPNAVINST 4790.2 series.



BOARD LAYOUT: CURRENT DISCREPANCY STATUS OISPLAY METHOO.

(A) BUNO/SIDE NO. – SPACE USEO TO OISPLAY THE AIRCRAFT ENGINE COMPONENT TIME CARD(S) ANO INFORMATION CONTAINED THEREON.

(B) WORK CENTER – SPACE USED TO DISPLAY WORK CENTER DESIGNATIONS.

(C) GRADUATED SPACE FOR DISPLAYING OUTSTANDING OISCREPANCY REGISTERS IN AN IN-WORK STATUS. COLUMN WILL BE TITLED IN-WORK.

(D) GRADUATED SPACE FOR OISPLAYING OUTSTANDING DISCREPANCY REGISTERS THAT ARE IN A AWAITING MAINTENANCE STATUS. COLUMN WILL BE TITLED AWM.

(E) GRADUATED SPACE FOR DISPLAYING OUTSTANDING REGISTERS THAT ARE IN AN AWAITING PARTS STATUS. COLUMN WILL BE TITLED AWP.

(F) CONFIGURATION – SPACE USED TO DISPLAY CONFIGURATION OF SPECIFIC AIRCRAFT. COLOREO SLIOING TABS ARE USEO TO INOICATE CONFIGURATION STATUS IN ACCOROANCE WITH THE CONFIGURATION KEY ON THE HEADER. SPACE IS PROVIOEO FOR 8 ITEMS BUT CAN BE SUBDIVIDED TO PROVIDE 16 CONFIGURATIONS.

(G) MANPOWER INDICATOR – SPACE USED TO INDICATE NUMBER OF LABOR COOE 500 PERSONNEL AVAILABLE WITHIN EACH WORK CENTER AND THE NUMBER CURRENTLY ASSIGNED.

Figure B-4 Organizational Maintenance Control Board

SIDE NO. W/C	IN WORK	AWM	AWP
201			
110			
120			
130			
210			
220			
230			
310			
302			
110			
120			
130			
210			
220			
230			
310			
303			
110			
120			

Figure B-5 Organizational Maintenance Control Board

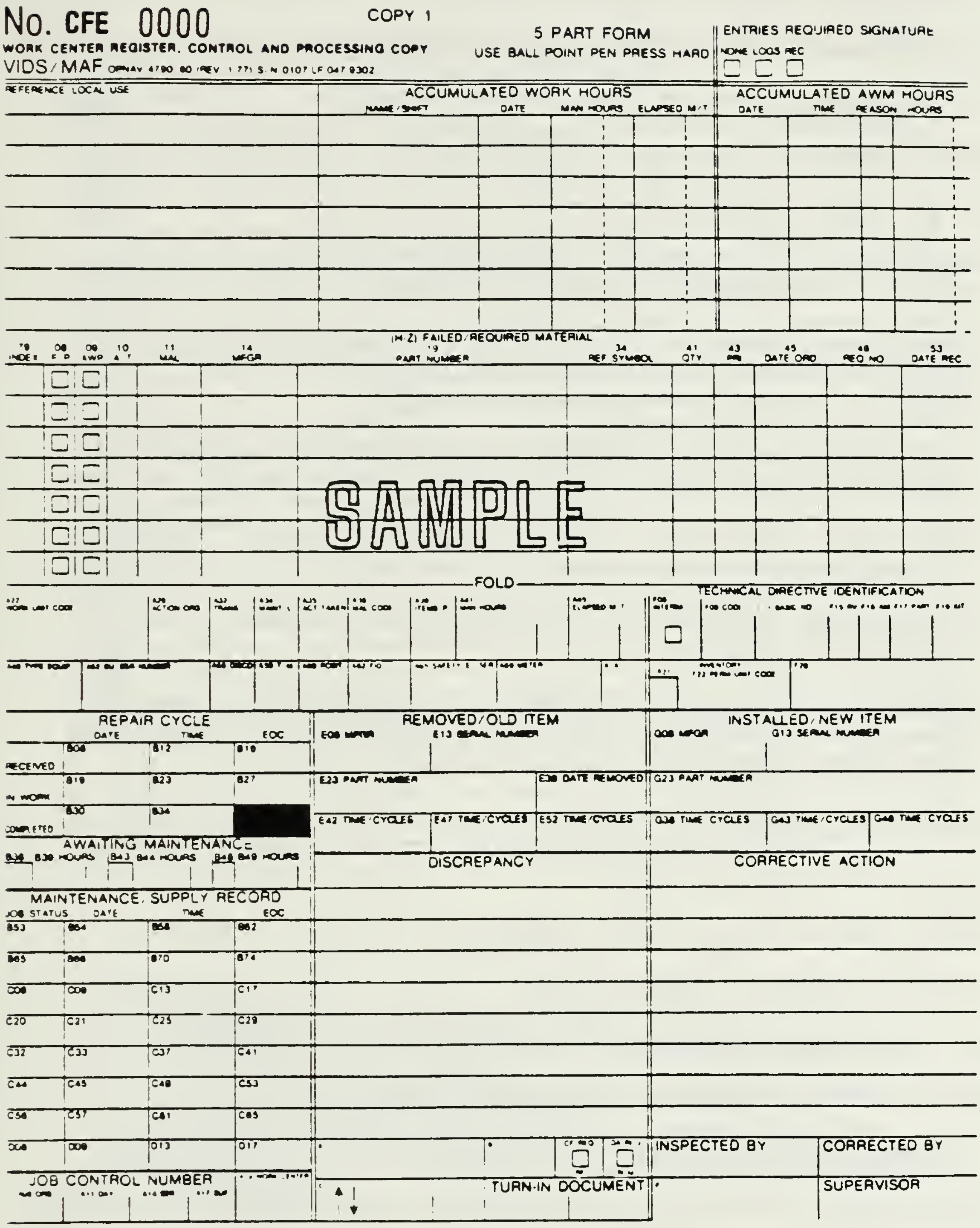

No. CFE 0000
COPY 1
WORK CENTER REGISTER, CONTROL AND PROCESSING COPY
VIDS/MAF OPNAV 4790 60 (REV. 1-77) S/N 0107-LF-047-9302
5 PART FORM
USE BALL POINT PEN PRESS HARD
ENTRIES REQUIRED SIGNATURE
NONE LOGS REC
REFERENCE LOCAL USE
ACCUMULATED WORK HOURS
NAME/SHIFT DATE MAN HOURS ELAPSED M/T
ACCUMULATED AWM HOURS
DATE TIME REASON HOURS
(H-Z) FAILED/REQUIRED MATERIAL
INDEX F P AWP A T MAL MFGR PART NUMBER REF SYMBOL QTY PRI DATE ORD REQ NO DATE REC
SAMPLE
FOLD
TECHNICAL DIRECTIVE IDENTIFICATION
REPAIR CYCLE
DATE TIME EOC
RECEIVED
IN WORK
COMPLETED
AWAITING MAINTENANCE
HOURS HOURS HOURS
MAINTENANCE/SUPPLY RECORD
JOB STATUS DATE TIME EOC
JOB CONTROL NUMBER
REMOVED/OLD ITEM
E23 PART NUMBER
E38 DATE REMOVED
E42 TIME/CYCLES
E47 TIME/CYCLES
E52 TIME/CYCLES
INSTALLED/NEW ITEM
G23 PART NUMBER
G38 TIME/CYCLES
G43 TIME/CYCLES
G48 TIME/CYCLES
DISCREPANCY
CORRECTIVE ACTION
TURN-IN DOCUMENT
INSPECTED BY
CORRECTED BY
SUPERVISOR

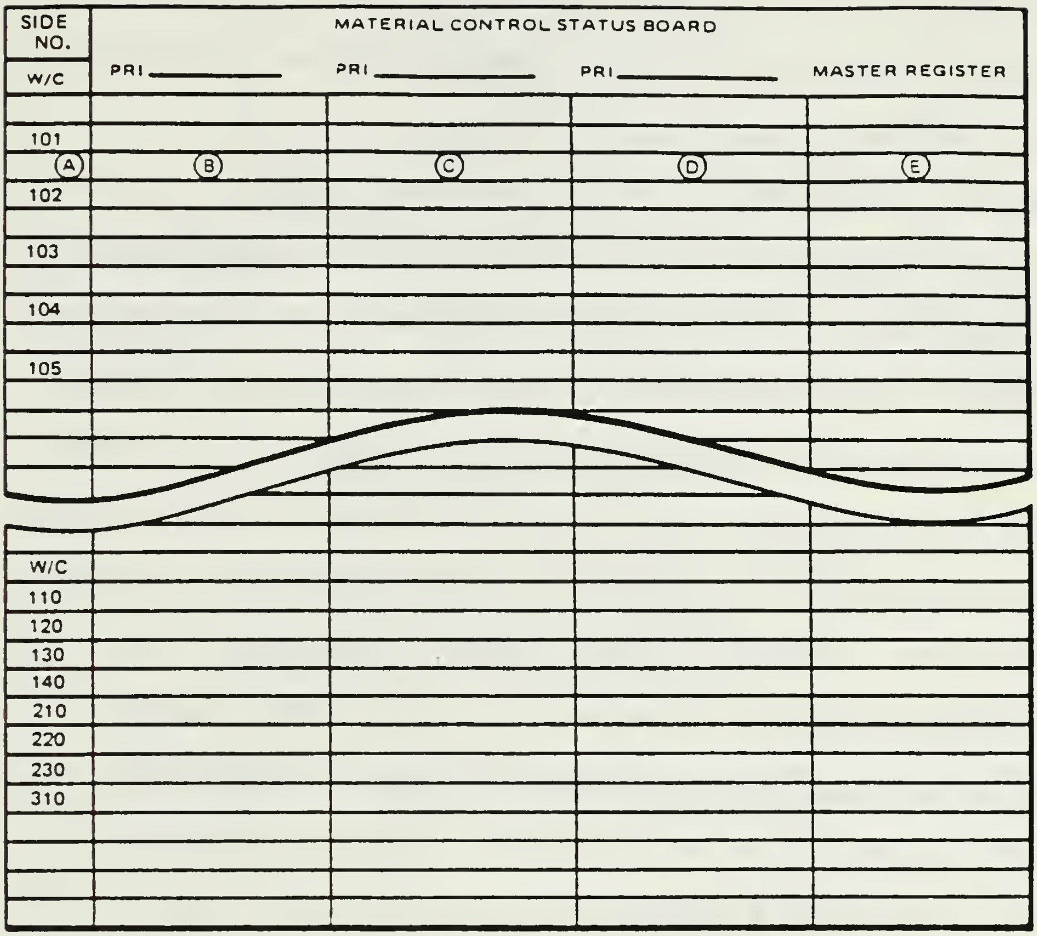
Figure B-6 VIDS/MAF

Material Control Officer (MATCO): The MATCO is responsible to the MMCO for the operation of the Material Control division. This division is the central point of contact for ordering, receipt, and delivery of aircraft parts, and material. The MATCO is also responsible for:

- Maintaining liaison with the supporting supply support center on maintenance material matters
- Furnishing technical advice and information to the supply activity on the identify and quality of supplies, spare parts, and material
- Keeping Maintenance Control advised of the overall supply situation and its effect on maintenance
- Performing memorandum and/or Operating Target (OPTAR) funding, accounting, charting, and budgeting of costs
- Maintaining adequate accountability of material and equipment on custody
- Maintaining inventory control of authorized allowances of material listed in the Individual Material Readiness List (IMRL) and authorized allowance lists.

The Material Control division Aviation Storekeepers (AK) utilize VIDS boards (Figure B-7) to control and track outstanding requisitions, and components due for turn-in to the Supply Support Center (SSC). Every component or part placed on order is tracked throughout the requisition process by means of unique requisition numbers.

Production Divisions: The production divisions carry out the actual aircraft and equipment maintenance as assigned by Maintenance Control. The production effort is divided into three divisions: Aircraft, Avionics/Armament, and Line.



BOARD LAYOUT:
(A) SIDE NO./WC– SPACE USED TO DISPLAY AIRCRAFT SIDE NUMBERS AND WORK CENTER NUMBERS.
(B) PRI–SPACE USED TO DISPLAY OUTSTANDING MATERIAL REQUISITIONS ORDERED AGAINST THE ACTIVITY'S HIGHEST PRIORITY.
(C) PRI–SPACE USED TO DISPLAY OUTSTANDING MATERIAL REQUISITIONS ORDERED AGAINST THE ACTIVITY'S SECOND HIGHEST PRIORITY.
(D) PRI–SPACE USED TO DISPLAY OUTSTANDING MATERIAL REQUISITIONS ORDERED ROUTINE PRIORITY.
(E) MASTER REGISTER–SPACE USED TO DISPLAY OUTSTANDING MATERIAL REQUISITIONS BY DOCUMENT NUMBER.

Figure B-7 Material Control VIDS Board

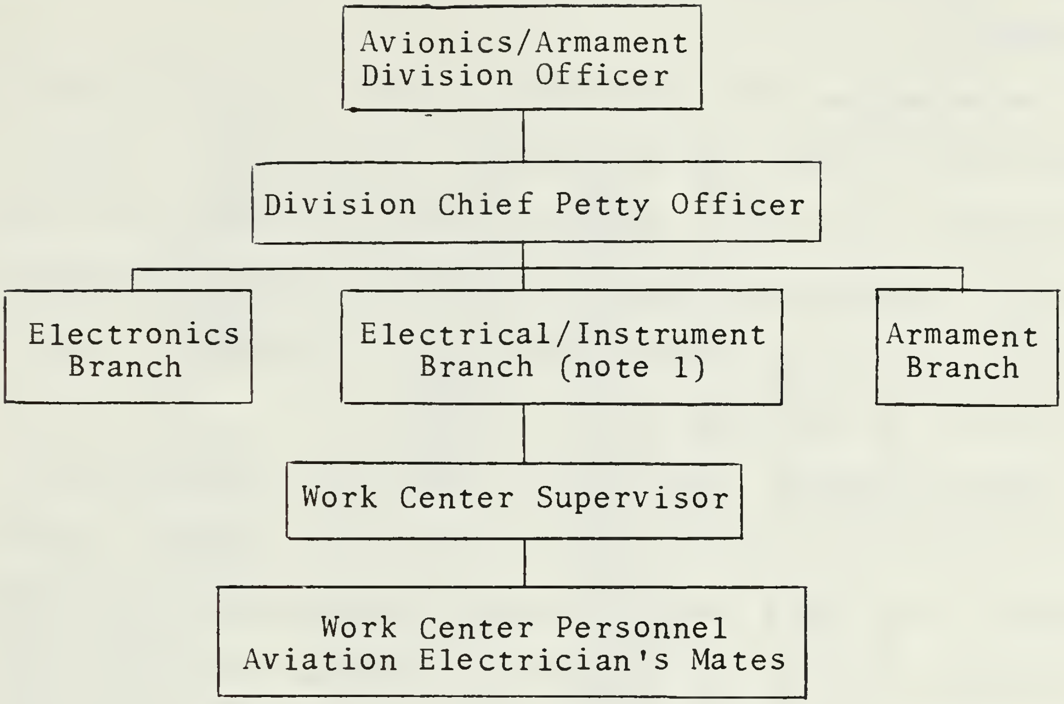
Each division includes branches or work centers whose constituents are of the same specialty field but may vary in technical experience or pay grade. Figure B-8 shows a typical division organizational chart.

The Division Officer is responsible to the MO for the overall management of the division, but the Work Center Supervisor (WCS) bears the brunt of the daily work center management. This includes effective employment of all assigned personnel, ensuring the Maintenance Data System documentation reflects true aircraft status, ensuring all special programs (e.g., took control, training, hydraulic contamination, foreign object damage) are adhered to, and maintaining continuous communication with Maintenance Control concerning work assignments and aircraft status. As in Maintenance Control, the WCS maintains VIDS boards to visually display and manage the assigned work load to the available workers.

<u>Intermediate Level of Maintenance</u>: This is composed of:

> That upkeep maintenance which is the responsibility of, and is performed by, designated maintenance activities in support of using organizations. Its phases normally consist of calibration; off-equipment repair or replacement; repair or replacement of damaged or unserviceable parts, components or assemblies; the manufacture of certain non-available parts; the accomplishment of certain periodic inspections; and providing technical assistance to using organizations. [Ref. 28]

The prime distinction between the O and I levels of maintenance is that I level technicians test, repair and



note 1: In larger squadrons, each Branch may have a Branch Officer and Branch Chief Petty Officer assigned.

Figure B-8 Typical Aviation Maintenance Division Organizational Chart

(Electrical/Instrument Branch Detailed)

calibrate components previously removed by O level maintenance personnel.

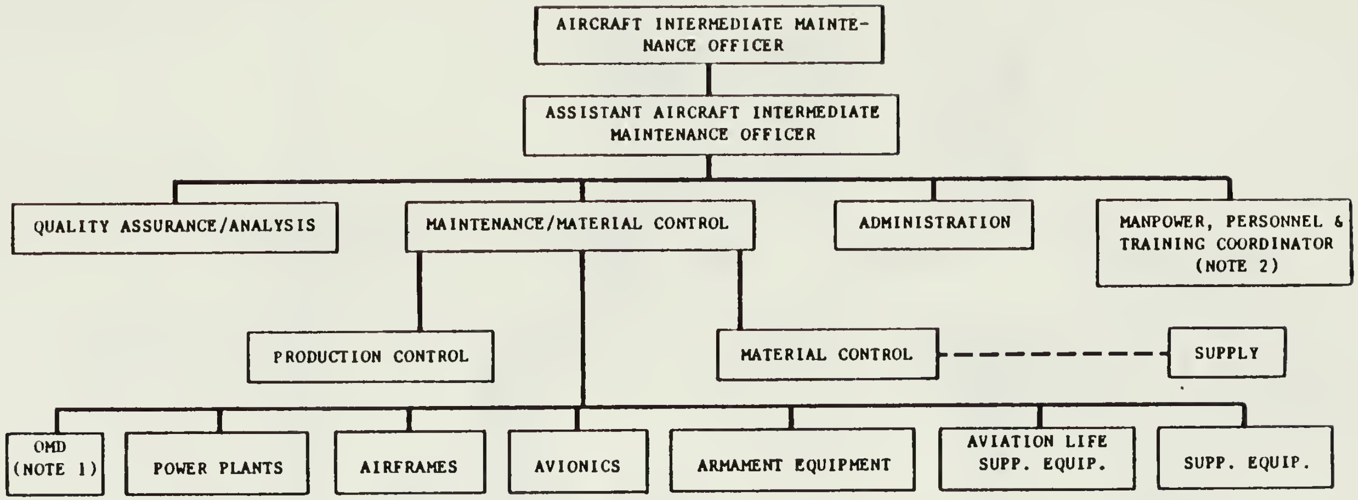
The management and organization chart for the I level is very close to those for the O level. Figures B-9 through B-11 depict the I level organizations afloat and ashore for the Navy and Marine Corps. The daily work load management is again controlled through the flow of VIDS/MAF's (Figure 3-2) and the use of the VIDS board (Figure B-12).

Supply Support: The distinct difference between the O and I levels is in their relationship to the supply support function. At the I level, material requirements are handled by the SSC (for the Navy) or Group Aviation Supply Support Center (GASSC) for the Marine Corps. These two organizations are shown in Figures B-13 and B-14. Due to the volume of material handled, each is a far more complicated operation than its O level Material Control counterpart.

The SSC is divided into two sections: Supply Response Section (SRS) and Component Control Section (CCS).

Supply Response Section: The SRS serves as the point of contact for satisfying maintenance material requirements. In general, the SRS is responsible for receipt and delivery of material to specified O and I level delivery points.

Component Control Section: The CCS is responsible for repairables management by accounting for all repairables stored in Local Repair Cycle Asset (LCRA) storage areas, all

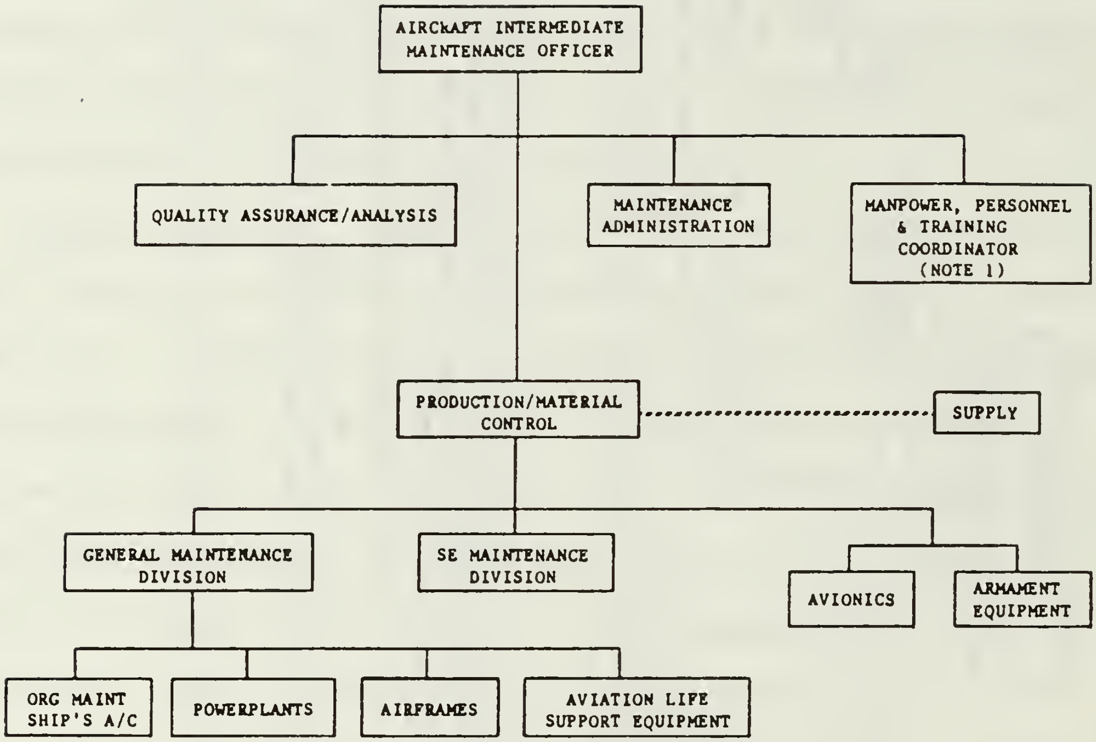


BREAKDOWNS BEYOND THE BASIC DIVISIONS ARE NOT ILLUSTRATED BECAUSE OF THE GREAT VARIETY OF BRANCHES POSSIBLE. ACTIVITIES WILL BE REQUIRED TO ESTABLISH THE NECESSARY BRANCHES IN ACCORDANCE WITH THEIR INDIVIDUAL REQUIREMENTS. APPENDIX "F" (STANDARD WORK CENTER CODES WILL BE USED AS A GUIDE TO ESTABLISH BRANCHES/WORK CENTERS WITHIN THE RESPECTIVE DIVISIONS. BRANCHES SHOULD BE ESTABLISHED ONLY WHEN MORE THAN ONE WORK CENTER IS INVOLVED, I.E., JET ENGINE BRANCH WITH WORK CENTERS FOR J-79 ENGINE AND J-52 ENGINE.

NOTE 1: WHEN SPECIFIC AUTHORITY HAS BEEN GRANTED TO COMBINE THE OMD AND IMA, AN ORGANIZATIONAL MAINTENANCE DIVISION WILL BE ESTABLISHED.

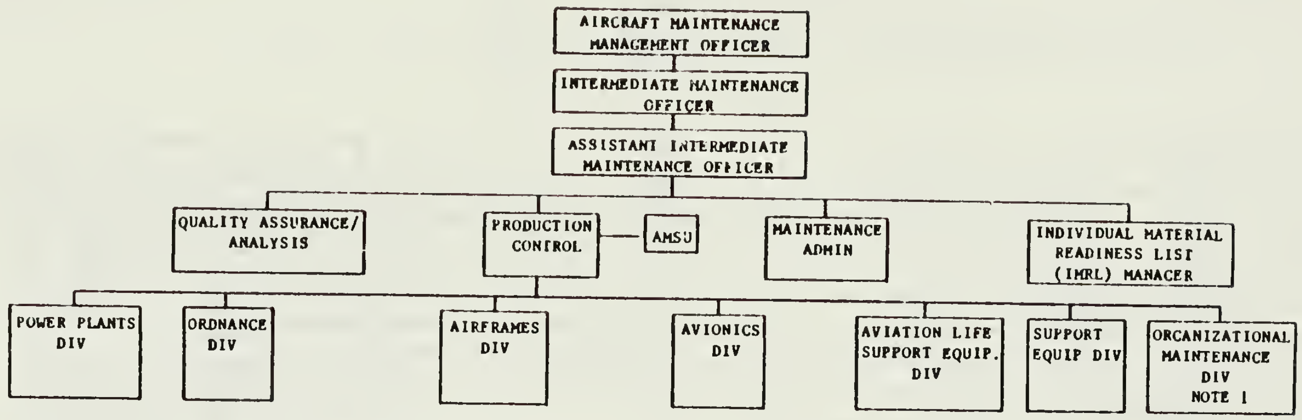
NOTE 2: FOR AIMDs NOT LARGE ENOUGH TO RATE THE E-9 BILLET ASSOCIATED WITH THIS FUNCTION, AND IN THOSE CASES WHERE FULL E-9 AND E-8 MANNING IS NOT AVAILABLE, THIS SEPARATE ORGANIZATIONAL POSITION IS NOT REQUIRED.

Figure B-9 Intermediate Level Maintenance Department Organization (Ashore)



NOTE 1: AUTHORIZED FOR CVs ONLY

Figure B-10 Intermediate Level Maintenance Department Organization (Afloat)



BREAKDOWNS BEYOND THE BASIC DIVISIONS ARE NOT ILLUSTRATED BECAUSE OF THE GREAT VARIETY OF BRANCHES POSSIBLE. ACTIVITIES WILL BE REQUIRED TO ESTABLISH THE NECESSARY BRANCHES IN ACCORDANCE WITH THEIR INDIVIDUAL REQUIREMENTS, APPENDIX "F" (STANDARD WORK CENTER CODES) WILL BE USED AS A GUIDE TO ESTABLISH BRANCHES/WORK CENTERS WITHIN THE RESPECTIVE DIVISIONS. BRANCHES SHOULD BE ESTABLISHED ONLY WHEN MORE THAN ONE WORK CENTER IS INVOLVED, I.E., JET ENGINE BRANCH WITH WORK CENTERS FOR F-402 ENGINES AND J-52 ENGINE.

NOTE 1: WHEN OPERATING AIRCRAFT ARE ASSIGNED TO THE IMA, AN ORGANIZATIONAL MAINTENANCE DIVISION WILL BE ESTABLISHED.

Figure B-11 Intermediate Level Maintenance Department Organization (USMC)

(1) W/C & EQUIP.	(2) GSE	(3) QTY	(4) LRCA LIMITS HI	LOW	(5) PRI	(6) AWM	(7) IN WORK	(8) AWP	(9) COMPLETED
610									
6217100									
62172									
6528100									
620									
7343100									
7351100									
640									
76240									
76290									
76310									

Figure B-12 VIDS Board Layout (Intermediate Level)

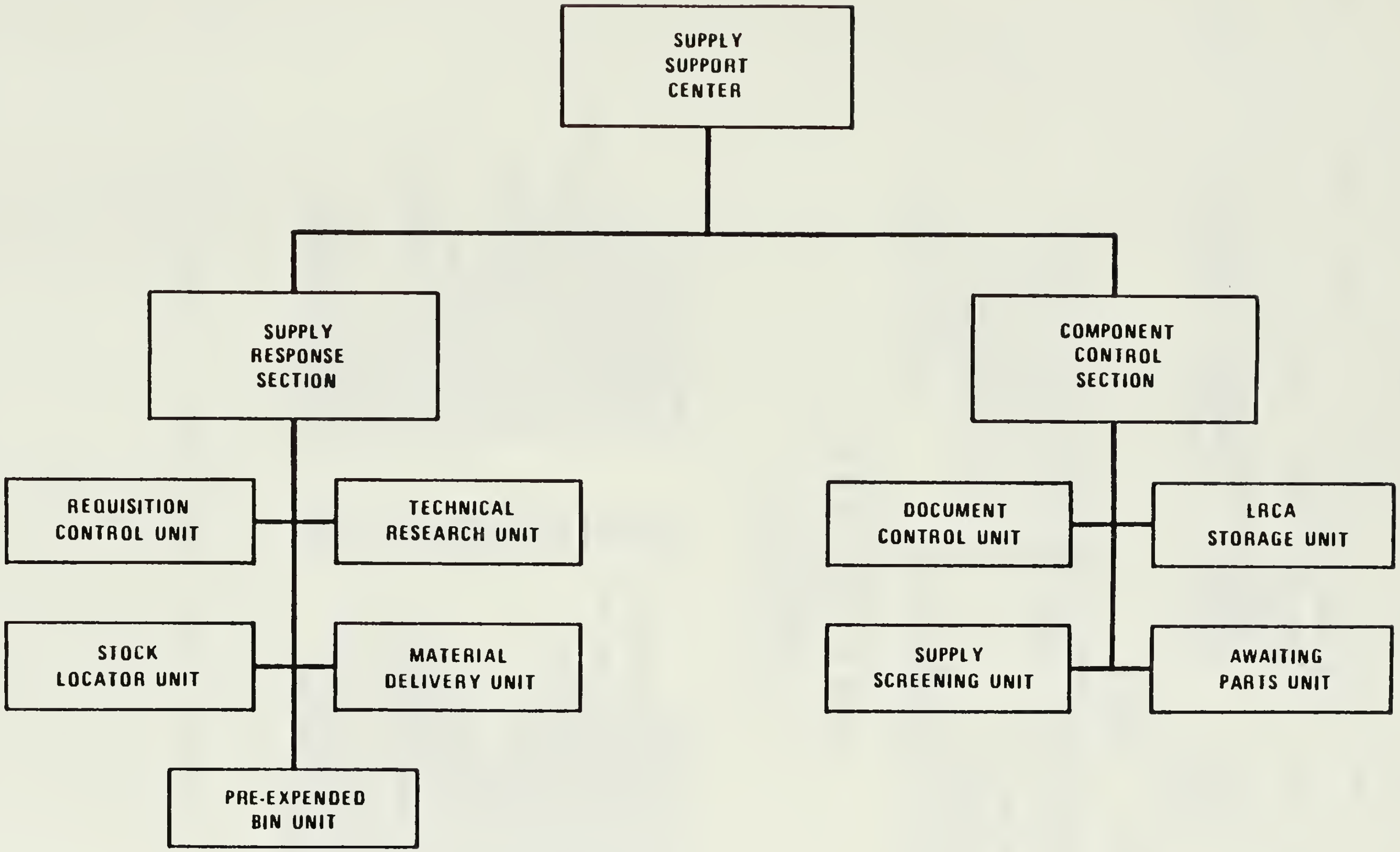
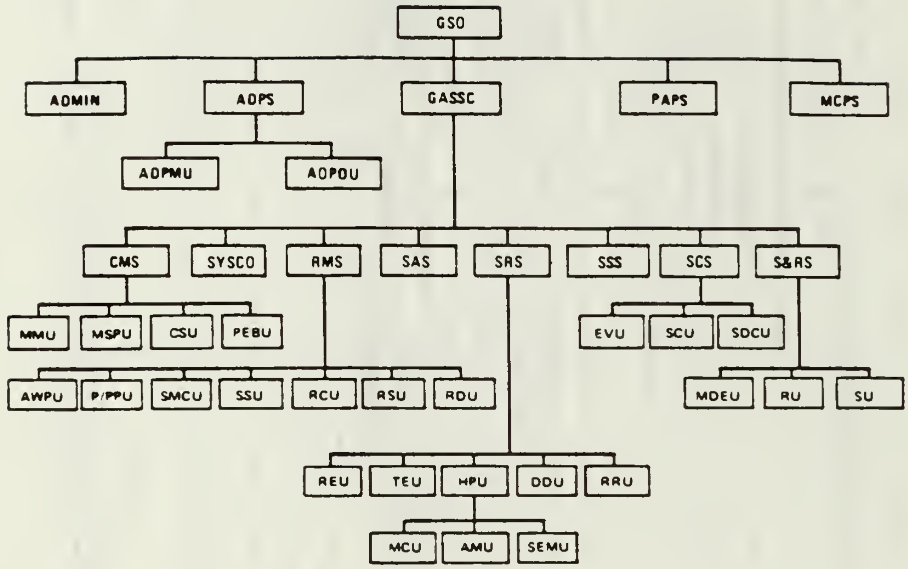


Figure B-13 Typical Supply Support Center Organization

GROUP SUPPLY DEPT.



GSO	GROUP SUPPLY OFFICER	CSU	CONSUMABLE STOCKING UNIT
ADMIN	ADMINISTRATIVE SECTION	PEBU	PRE EXPENDED BIN UNIT
GASSC	GROUP AVIATION SUPPLY SUPPORT CENTER	SSU	SUPPLY SCREENING UNIT
SYSCO	SYSTEM COORDINATOR	RCU	REPAIRABLE CONTROL UNIT
ADPS	AUTOMATED DATA PROCESSING SECTION	RMS	REPAIRABLE MATERIAL SECTION
SSS	SQUADRON SUPPORT SECTION	P/PPU	PACKING, PRESERVATION & PACKAGING UNIT
MCPS	MARINE CORPS PROPERTY SECTION	SMCU	SPECIAL MATERIAL CONTROL UNIT
SAS	SUPPLY ACCOUNTING SECTION	SCS	STOCK CONTROL SECTION
SRS	SUPPLY RESPONSE SECTION	RRU	REQUISITION RECONCILIATION UNIT
HPU	HIGH PRIORITY UNIT	SDCU	SUPPLY DATA COMMUNICATION UNIT
TEU	TECHNICAL EDIT UNIT	EVU	EDIT VERIFICATION UNIT
REU	REQUISITION EXPEDITER UNIT	SCU	STOCK CONTROL UNIT
AMU	AIRCRAFT MONITORING UNIT	DDU	DOCUMENT DISTRIBUTION UNIT
MCU	MAINTENANCE COORDINATOR UNIT	S&RS	SHIPPING & RECEIVING SECTION
SEMU	SUPPORT EQUIPMENT MONITORING UNIT	MDEU	MATERIAL DELIVERY EXPEDITING UNIT
CMS	CONSUMABLE MATERIAL SECTION	RU	RECEIVING UNIT
MMU	MINI MART UNIT	SU	SHIPPING UNIT
MSPU	MAINTENANCE SUPPORT PACKAGE UNIT	RSU	REPAIRABLE STORAGE UNIT
RDU	REPAIRABLE DELIVERY UNIT	PAPS	PLANS AND PROGRAMS SECTION
ADPMU	AUTOMATED DATA PROCESSING MAINTENANCE UNIT	ADPOU	AUTOMATED DATA PROCESSING OPERATING UNIT

Figure B-14 Group Supply Department Organization repairables in the I level repair cycle, and all repairables being processed for shipment to designated overhaul points. These areas are separate from the Rotatable Pool operation.

A detailed discussion of the SSC and its operation can be found in the OPNAVINST 4790.2 series.

APPENDIX C

PERIPHERAL SYSTEMS AFFECTING NALCOMIS

Interim systems to NALCOMIS:

AMMRL	Aircraft Maintenance Material Readiness List
ATSS	Aviation Training Support System
CAMS	Comprehensive Asset Management System
CGS	Computer Generated 3M Summary
ECS	Equipment Control System
FAMMS	Fixed Allowance Management and Monitoring System
MRMS	Mechanized Repairable Management System
PLS	Portable Logistics Support System
RCAS	Resources Configuration and Scheduling
RTSS	Reserve Training Support System
SAMS	Shipboard Aviation Management System
SESS	Support Equipment Standardization System
SIDMS II	Status, Inventory, Data Management System

Systems to merge with NALCOMIS:

CRS	Capability Reporting System
NAVFLIRS	Navy Flight Record System
VAMP	VAST Automated Management Program

Systems to interface with NALCOMIS:

NALDA	Naval Aviation Logistics Data System
SERMIS	Support Equipment Resources Management System

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