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THESIS

AN ANALYSIS OF NAVAL AVIATION
CONFIGURATION STATUS ACCOUNTING

by

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and

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December 1983

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An Analysis of Naval Aviation Configuration Status Accounting

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ABSTRACT

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Naval Aviation configuration status accounting and its interface with the present and future prescribed and locally developed information systems is reviewed. It was determined that the lack of coordination, integration and standardization resulting from the proliferation of locally developed systems decreases logistic support and maintenance management effectiveness. It is recommended that the prescribed Naval Aviation configuration status accounting system and the proliferation of local systems be consolidated into a single integrated system. NALCOMIS, a program currently under development, has the potential to meet all user requirements with minor expansion to its current design.

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I. INTRODUCTION

A. BACKGROUND

Between 1950 and 1979 the number of aircraft purchased by the Department of Defense (DOD) decreased from 3,000 per year to approximately 300 per year [Ref. 1]. However, the complexity and unit cost of these aircraft increased greatly. As a result of a smaller, more expensive, very highly sophisticated aircraft inventory and major ongoing technical advances, aircraft life cycles are extended and capabilities upgraded through changes and modifications.

Changes to Naval aircraft are promulgated by the Naval Air Systems Command (NAVAIR) for specific aircraft type/model/series. The actual incorporation of the changes occurs at the organizational, intermediate and depot levels of maintenance. The incorporation process is an ongoing one, and the applicability of changes varies with aircraft model, series and bureau number. Modifications can affect the logistic support required for an aircraft to varying degrees. While some changes bring about only minor deviations to the maintenance and supply requirements, others can cause major revisions. Maintenance tasks, support equipment requirements, testing procedures, weight and balance and spare parts can all be affected by a single change. Although identical configuration of all similar type/model/series aircraft is a goal, differing capabilities

are often desired to meet operational commitments and/or are necessary to remain within financial constraints. Consequently a functional wing is composed of aircraft with varying configurations which subsequently have varying support requirements.

If the changes incorporated in an aircraft are properly documented and the aircraft's configuration is known, the logistic support of the aircraft can be planned and carried out. A major problem arises when the configuration of an aircraft is either unknown or incorrectly documented. In the former case, manhours must be expended to physically verify the changes that have been incorporated so that a support plan can be drawn up. In the latter case, a plan will be pursued but may be ineffective, as the correct spare parts will not be stocked, correct and sufficient support equipment will not be available and technicians will not possess the proper training to repair and service the aircraft.

This problem is further compounded in the Navy as a result of the deployment requirements of aviation units. Maintenance and supply facilities aboard an aircraft carrier are limited, necessitating careful planning and coordination of all support requirements. Under these circumstances incorrect and incomplete configuration documentation can thwart logistic support efforts to the point where aircraft are rendered incapable of safe flight or mission performance. Effective maintenance management is highly dependent on accurate and timely configuration status accounting. Consequently, configuration status

accounting systems are, out of necessity, an integral and active part of maintenance management systems during the use period.

B. STATEMENT OF THE PROBLEM

The Technical Directive Status Accounting System is the Navy system prescribed for tracking aircraft configuration. The personal experience of the authors at the squadron, functional wing and carrier air wing levels is that this system is unreliable and ineffective in providing valid and timely information on which to base logistic support decisions. Consequently, each functional wing or type commander currently employs locally initiated systems, ranging from luck to computer-aided management information systems, for monitoring and controlling aircraft configuration. The inability to integrate these various systems results in degraded logistic support and loss of continuity for deployed airwings which are composed of squadrons from several functional wings. In addition to aircraft configuration information often being incomplete and incorrect, the form, presentation and accessibility are frequently inconsistent across the airwing. This greatly decreases the ability of logistics managers to provide proper and effective support for a deployed airwing. It is the authors' belief that the Navy requires a common, comprehensive system for monitoring and controlling aircraft configuration status and accountability that can be used for all type/model/series of aircraft.

C. THESIS OBJECTIVES

The objectives of this thesis are as follows:

1. Review the concept of configuration management and its application in Naval aviation.

2. Review and evaluate the Navy Technical Directive Status Accounting System with regard to its effectiveness and deficiencies.

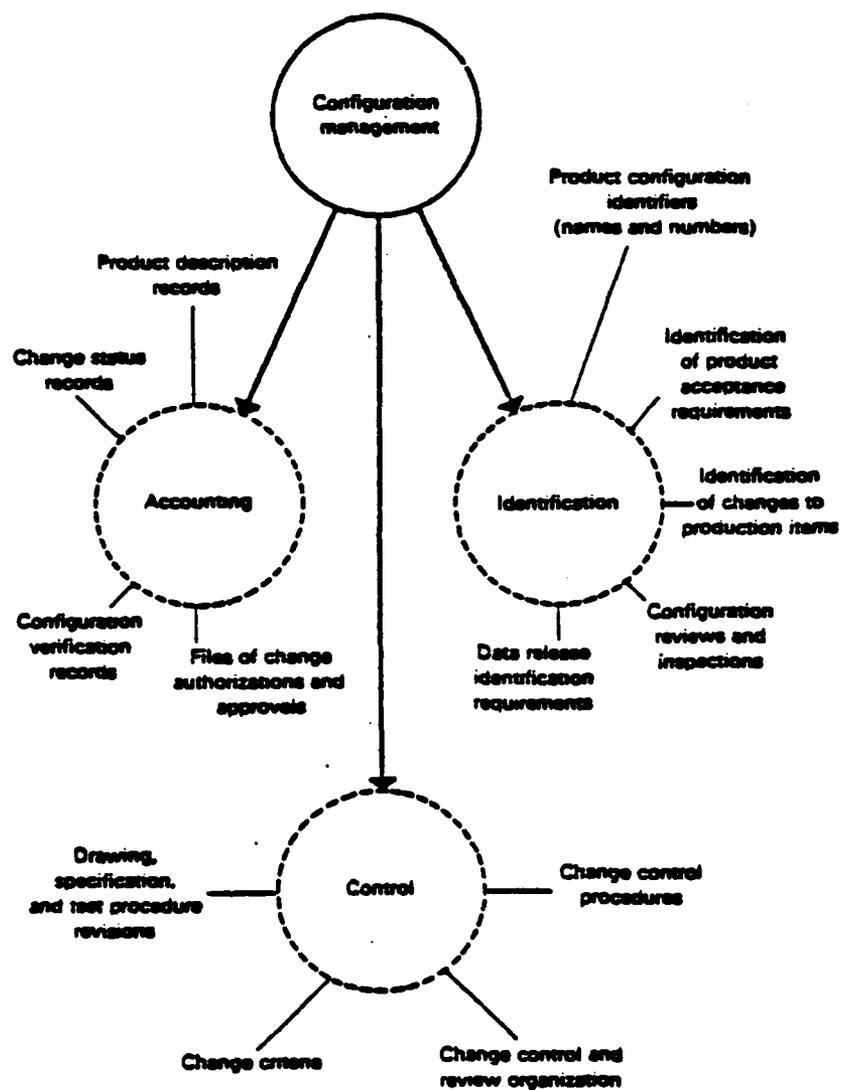
3. Review four major local systems which have been developed to mitigate the deficiencies of the Technical Directive Status Accounting System.

4. Provide recommendations for future direction of Naval aviation configuration status accounting programs.

D. THESIS SCOPE

Configuration management is a broad discipline that is divided into several different facets. Figure 1.1 shows the major facets--accounting, identification, control. Properly done, configuration management would be carried out throughout a system's life cycle from its conception through its design, production and use, until it is retired. The implementation and interaction of the above facets vary during the life cycle, but all are present in one form or another.

The scope of this thesis is limited in three respects. First, the concentration is on the accounting segment of configuration management and more specifically the area of configuration status accounting. Second, only that segment of the



CONFIGURATION MANAGEMENT INTERRELATIONSHIPS

FIGURE 1.1 (REF.4)

system life cycle in which the system is operated and maintained by the user is considered. The formulation, design, test and production portions are only briefly mentioned with regard to configuration status accounting. Third, the systems or equipment addressed are limited to the hardware under the cognizance of the Naval Air Systems Command.

E. METHOD OF RESEARCH

Research for this thesis was conducted through a review of configuration management literature, contact with numerous Navy squadrons, functional wings, type commanders and higher level staffs, and a visit to Commander Naval Air Force, U.S. Pacific Fleet. The literature review included published articles written by both military and private industry managers, technical papers delivered at symposia and conferences, Naval Audit Service and Comptroller General reports, and Department of Defense and Navy correspondence, directives, instructions and technical manuals. The various squadron, functional wing and type commander contacts provided information on how Naval aviation units are currently performing configuration status accounting. Managers at the Naval Air Systems Command and Naval Material Command provided insight to future changes to the current Navy configuration status accounting policy. In addition, the personal experience of both authors contributed in a large degree to the information presented.

F. THESIS STRUCTURE

1. Chapter One

This is a general introductory chapter which briefly presents the problem being considered and the thesis objectives.

2. Chapter Two

This chapter presents a general overview of configuration management including definitions and techniques. It also covers a brief description of the system life cycle and its relationship to configuration management.

3. Chapter Three

In this chapter, Department of Defense Directive 5010.19 concerning configuration management is reviewed as well as Naval Air Systems Command and Naval Material Command instructions. When reviewing Navy instructions, the subject is narrowed from configuration management as a whole to configuration status accounting specifically.

4. Chapter Four

A brief discussion of the importance of configuration status accounting and its interface with aircraft logistic support within the Naval Air Systems Command is presented.

5. Chapter Five

In Chapter Five the Technical Directive Status Accounting System, the prescribed system for accomplishing configuration status accounting within the Naval Air System Command, is reviewed.

6. Chapter Six

Some of the major deficiencies of the Technical Directive Status Accounting System reviewed in Chapter Five are discussed in this chapter. Four local systems independently developed at various levels throughout the Navy to alleviate those deficiencies are presented.

7. Chapter Seven

In this chapter an outline of the Naval Aviation Logistics Command Management Information System as it relates to configuration status accounting is presented. This system, which is in the prototype phase, has been designed to improve the management of aircraft maintenance including configuration management.

8. Chapter Eight

This concluding chapter presents the authors' views of where the Naval Air Systems Command stands today with regard to configuration status accounting. It also includes recommendations for action to be taken now and in the future.

II. CONFIGURATION MANAGEMENT OVERVIEW

A. INTRODUCTION

Configuration management is a relatively new discipline in military management when considered in a formal sense, although it has long been practiced informally by commercial companies [Ref. 2]. The advent of the missile/space race in the 1950's brought with it products that were characterized by a high incidence of change. These changes were accepted results of "the technical complexity, high reliability, extensive software, complex support, high subcontract rate and the essentially developmental nature of the industry" [Ref. 2]. The continued production, operation, and support of such products require documentation and strict control over their configuration. Thus it was necessary to develop a formal system to replace the informal methods then in use whereby the product's functions and equipment could be identified, controlled and documented throughout its life.

B. DEFINITION

The literature contains several definitions, both formal and informal, of configuration management. Some of these follow:

Configuration Management is a management science that provides a disciplined environment and administrative framework for the precise definition and control of product configuration throughout its life cycle [Ref. 2].

It [configuration management] defines the product, its components, and their interfaces. It restricts idle change,

and it requires precise records of the changes that are authorized [Ref. 3].

Configuration management is the art of organizing and controlling planning, design, development, and hardware operations by means of uniform configuration control, identification and accounting of a product [Ref. 4].

There are some important points in these definitions that deserve further comment. First of all, there is an emphasis on discipline, precision and organization. Fragmented, unsupported methods for managing configuration have been proven ineffective. Second, a degree of uniformity or a framework is stipulated. This is necessary to assure some sort of consistency of information and policy across industries. Third, the term "configuration" applies to the physical and functional characteristics of a product as well as to the information required to build and support it [Ref. 4]. This encompasses both hardware and software, design, build, test, operation and maintenance. Fourth, configuration management applies throughout a product's life.

C. SYSTEM LIFE CYCLE

All products or systems result from a perceived need, new technology or a replacement of products or systems that have become obsolete [Ref. 5]. They then progress through several phases which compose their life cycle as shown in Figure 2.1. Out of these phases emerges the product or system which will satisfy the need. As it progresses through development, its configuration is defined more precisely. In addition, changes

can occur. This process is essentially a progressive definition of a system's configuration and it is a key concept in configuration management [Ref. 4].

The first step in this progressive definition is to define the system in operational terms and determine the feasibility of pursuing its development. This occurs during the Concept Formulation Phase of its life cycle. No specific hardware is identified at this point, but rather the basic mission the system must perform is identified. The output of this phase are the operational requirements or characteristics for the system. During the next phase, which is the System Definition Phase, physical requirements are stipulated for the system. These are requirements and constraints such as size, weight, maintainability, etc. and are the inputs for the next phase, the Design Phase. It is during this phase that specific hardware is fitted to the requirements, and the result or output is a model of the system. The model is subjected to test and evaluation where changes may occur. The final output will result in the actual configuration that serves as the input for the Production and Installation Phases.

As can be seen in Figure 2.1, the following two phases, the Operations and Support Phase and the Modification and Retirement Phase, comprise the Use Period for the system. The system is transferred from the manufacturer (or producer) to the user where it performs its intended mission. Once the system enters the Use Period, configuration management is

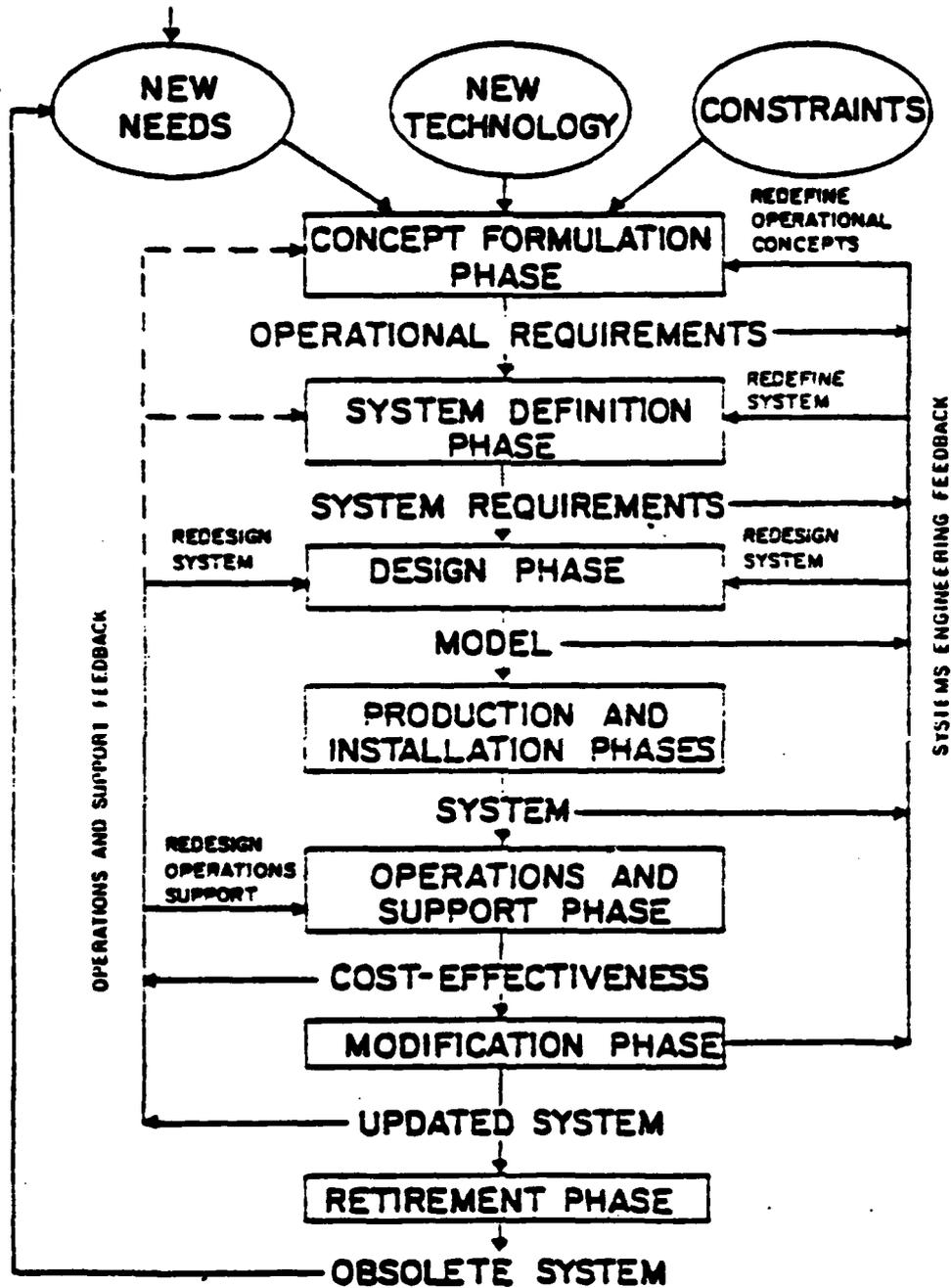


FIGURE 2.1 SYSTEM LIFE CYCLE (REF. 5)

essential and can become more complex. Changes may be required for the system to perform its originally intended function. In addition, changing needs or technology may modify its required function, making further modifications necessary at any point in its Use Period. Prior to the Use Period, any changes to the system's configuration are performed and documented by the manufacturer with the participation and concurrence of the user. However, after entering the Use Period, the user assumes primary responsibility for change incorporation, documentation and progressive definition of the configuration throughout this period to retirement.

In summary, the progressive definition concept of configuration management describes the process whereby, "...the configuration of a product is derived during development, determined during design, established during production, and maintained during operational support." [Ref. 4]

D. BASELINE MANAGEMENT

A system's configuration is monitored and controlled during progressive definition by means of a concept called "baseline management". A baseline is established by compiling technical documentation of the system at various points in its life cycle. This documentation describes the system in terms of its physical and functional characteristics at that point and must be agreed upon by both the customer and the contractor. The established baselines are major control points necessary for further

advancement through the system's life cycle. Deviations from an established baseline must be approved by both the customer and contractor and must be documented in a manner that facilitates ease of configuration identification at any point in time. [Ref. 6]

Baselines are established at a minimum of three and up to six points during the system life cycle. Samaras and Czerwinski identify three contractual and three recommended internal baselines, as depicted in Figure 2.2 [Ref. 4]. (Their Acquisition Phase is equivalent to the Acquisition Period in Figure 2.1). The contractual baselines are the Functional, Allocated and Product Baselines which are established at the end of the Conceptual, Definition and Design phases respectively. They further recommend that Design, Development and Production baselines be established at the indicated points within the Design Phase.

In the Functional Baseline, specifications that define the program requirements are established. It is in this baseline that the identified need which originated the requirement for the system is defined in performance and operational terms.

During the next phase, these objectives are allocated to their respective elements known as configuration items (CI) within the system. Further, the design requirements for the elements are identified. These elements and their performance specifications establish the Allocated Baseline.

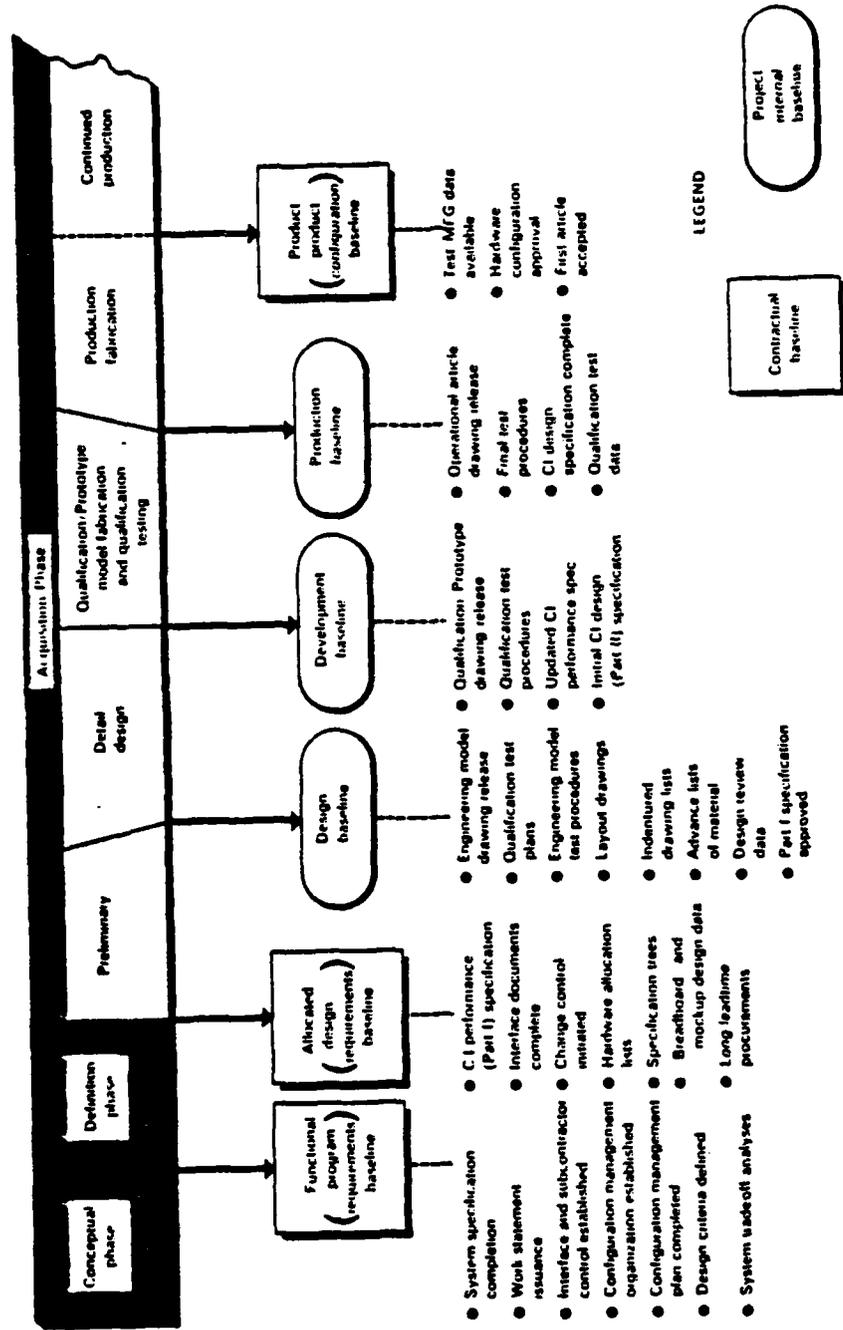


FIGURE 2.2 TYPICAL BASELINES (REF.4)

Various internal baselines may be established during the Design Phase, as shown in Figure 2.2. In terms of progressive definition, this is where the configuration of the system that will be delivered to the customer is increasingly defined as the design proceeds. The culmination of this phase produces the Product Baseline.

Strict control of configuration deviations from the Product Baseline is maintained with the customer approving all changes. This strict control assures that the customer receives a system that conforms totally with both the specifications in the Product Baseline and all approved and documented changes thereto.

When the system enters the Use Period, incorporation and documentation of changes to the Product Baseline become the responsibility of the customer. This thesis focuses on the documentation and status accounting of changes incorporated from the Use Period on. If efficient configuration management is to be successfully carried out, the Product Baseline with its documented changes must be maintained in a current status at all times. However, as the system leaves the controlled environment of the manufacturer and transitions to the operational environment, its configuration management can become more difficult and involved.

E. CONFIGURATION MANAGEMENT TECHNIQUES

Monitoring and directing baseline configuration requires a progressively stricter control process as each baseline is

established [Ref. 2]. Therefore, configuration management is comprised of various techniques for its systematic application throughout the system life cycle [Ref. 4].

1. Configuration Identification

Configuration identification, as the term implies, identifies the physical and functional characteristics of a system. It is comprised of the complete system documentation such as specifications, engineering drawings, data lists and other information required to completely define the system's configuration and any approved changes to it. The configuration identification is detailed to the degree that serial numbers of assemblies, subassemblies and parts are identified on the documentation. The purpose is to assure that the hardware and accompanying documentation coincide throughout the life cycle.

2. Configuration Control

A process which starts at the beginning of and continues throughout the life cycle, configuration control provides the management framework for proposing, evaluating, approving or disapproving and documenting changes to the system. Configuration control is limited in the early life cycle phases to the functional requirements (Functional Baseline), and the proposed configuration and specifications (Allocated Baseline). In the later phases it applies to the actual hardware and software which comprise the system (Product Baseline).

3. Configuration Verification

Incorporation of approved changes may or may not proceed as planned and/or documented. It is necessary, therefore, to compare or verify the approved documented baseline and incorporated changes with the actual hardware and software contained in the system. Inherent in this configuration verification process is the identification and subsequent correction of configuration discrepancies by either updating the system to conform with its approved configuration or approving its present configuration as is. In the latter case, the discrepancies and buyer's approval of those discrepancies are noted.

4. Configuration Accounting and Reporting

Configuration accounting and reporting provides the administrative framework for documenting a system's location, its component makeup by serial number and its current configuration. It establishes the system for recording and reporting the incorporation of approved changes. The process continues throughout the life of the system and "establishes records which enable proper logistic support to be established" [Ref. 4].

5. Configuration Audit and Review

Configuration audits are designed and conducted to determine if the functional and physical characteristics in the system's configuration identification match the system's actual physical and functional characteristics. These are formal

audits which are selectively performed on items and contribute to the establishment of the Product Baseline (especially on the first production article called First Article Configuration Identification or First Article Configuration Review).

III. CONFIGURATION MANAGEMENT STATUS ACCOUNTING WITHIN THE DEPARTMENT OF DEFENSE

A. DOD CONFIGURATION MANAGEMENT POLICY

According to the DOD, the purpose of configuration management is:

...to assist management in achieving and documenting, at a controlled total life-cycle cost, the required performance, realistic schedule, operational efficiency and readiness, integrated logistics support (ILS), configuration identification and interfaces of systems, system segments, equipment, components, sub-components, parts, firmware, computer programs, facilities, and other configuration items. [Ref. 7]

To achieve this stated purpose, Department of Defense Directive 5010.19 prescribes uniform policies for configuration management within the military services and agencies of the Department of Defense [Ref. 8]. This directive requires that:

1. The degree of configuration management applied to a given item be tailored consistent with the complexity, size, quantity, intended use, mission criticality and life-cycle phase of the item
2. Configuration management be applied to any item developed wholly or partially with government funding, immediately following approval for full-scale engineering development
3. Configuration management be applied to any item wholly developed with private funding and procured by the government upon procurement initiation

4. Configuration management be continued during the deployment/operation/support phases to the extent required for readiness support

DOD Directive 5010.19 further directs each DOD component head to designate for specific, individual items or categories of items, the technical organization or individual having authority and responsibility for configuration management during each life-cycle phase of the item being procured. The DOD component designated by the Secretary of Defense to have primary responsibility is additionally responsible for developing and documenting interservice joint agreements for configuration management when more than one service is involved in the acquisition or modification of an item.

B. CHIEF OF NAVAL MATERIAL CONFIGURATION MANAGEMENT STATUS ACCOUNTING

Within the U.S. Navy, the Naval Material Command (NAVMAT) has been designated by the Secretary of the Navy as the configuration office of primary responsibility. Chief of Naval Material Command Instruction (NAVMATINST) 4130.1A and its proposed revision NAVMATINST 4130.1B implement the configuration management policies of DOD Directive 5010.19. The stated configuration management objectives of NAVMATINST 4130.1A are to attain and maintain: [Ref. 7]

1. Effective DOD component and contractor planning to ensure that the fundamental elements of configuration management (configuration identification, control, status accounting

and audits) are appropriately implemented for each configuration item during each phase of its life-cycle

2. An optimum degree of design and development latitude coupled with the introduction of the fundamental elements of configuration management at the appropriate time, degree and depth

3. Visibility of development progress and compliance with design requirements during the acquisition process

4. Appropriate interfaces and coordination within the DOD and between DOD and industry

5. Maximum efficiency, timing, justification and visibility in the processing, control and implementation of configuration changes

6. Adequate and verified documentation and configuration status accounting records to satisfy configuration identification and overall program requirements

7. Desired life-cycle costs and the required level of operational readiness, supportability, interchangeability and interoperability through standardization and integrated logistic support considerations

8. Accurate and timely knowledge of the current configuration of the configuration item

NAVMATINST 4130.1B (Draft), if published as currently written, will require that configuration identification be broken down into three additional levels. These additional configuration levels will be implemented sequentially during the development

of the system and will form the bases for the Functional, Allocated and Product Baselines represented in Figure 3.1.

The first identification level proposed by NAVMATINST 4130.1B (Draft) is the Functional Configuration Identification which defines all essential quantitative and qualitative performance requirements, interface constraints, test and evaluation criteria, and integrated logistic support parameters [Ref. 7]. The Functional Configuration Identification is developed by the customer in conjunction with the contractor (if available) in what NAVMAT proposes to rename the Concept Exploration Phase of the system life cycle (The Concept Exploration Phase is equivalent to the Concept Formulation Phase in Figure 2.1). The Functional Configuration Identification is evaluated at a Functional Requirements Review to determine the adequacy of the functional requirements contained in it and to evaluate the contractor's approach and completeness. Upon the completion of the Functional Requirements Review, the preliminary Functional Configuration Identification is established, and it becomes the basis for the Functional Baseline. After its approval, the Functional Baseline is formally placed under government configuration control.

The Product Configuration Identification is the third level of the DOD configuration identification proposed by NAVMATINST 4130.1B (Draft). It "defines the CI in the form of product, material, and process specifications and references documentation" [Ref. 7]. It is reviewed during the Critical Design

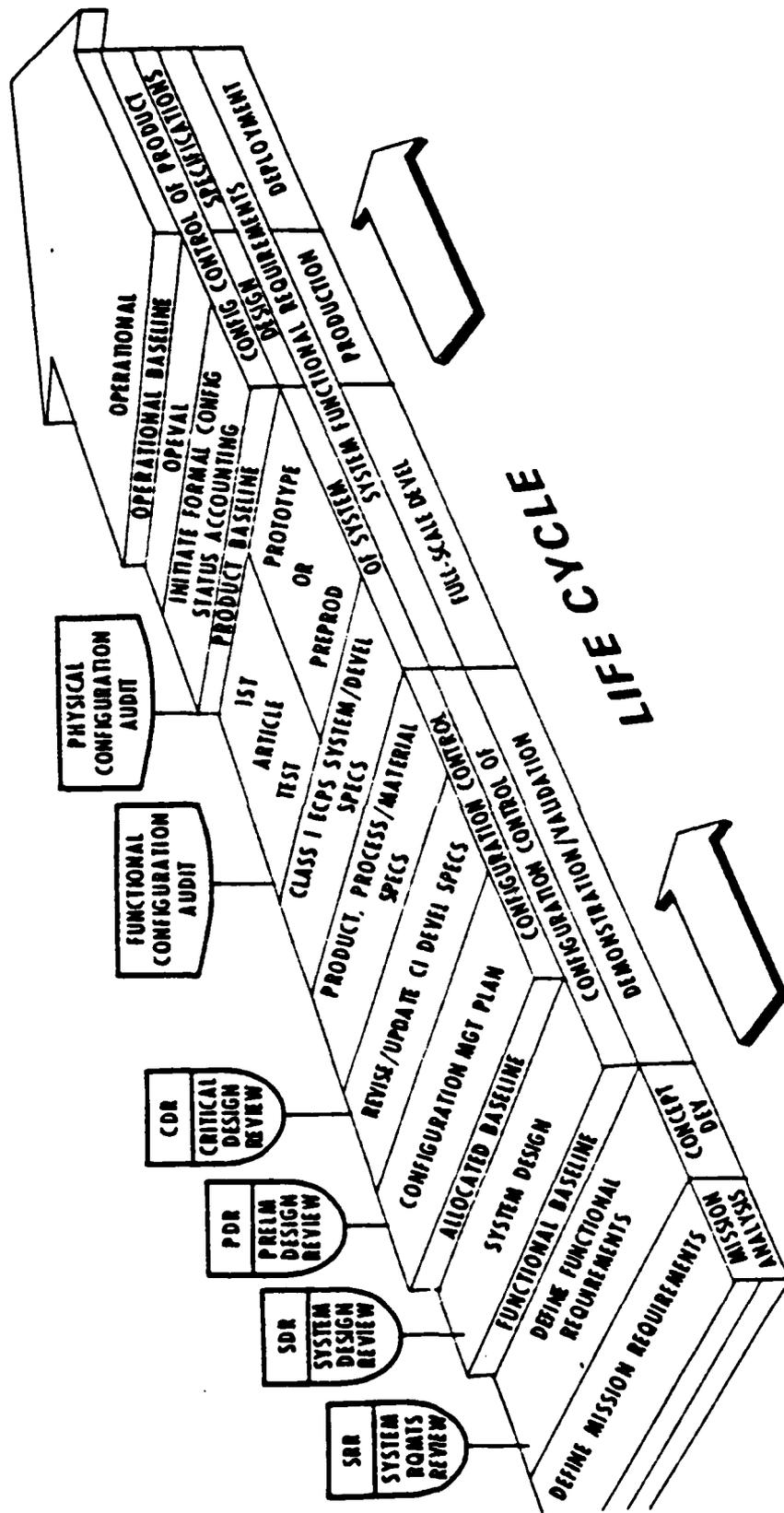


FIGURE 3.1 CONFIGURATION MANAGEMENT LIFE CYCLE (REF. 12)

Review which is held when the detailed design of the system has been completed but prior to its release for prototype manufacture and test. The Functional Configuration Identification and Allocated Configuration Identification are also updated at this review. After prototype manufacture, the Functional Configuration Identification, Allocated Configuration Identification and Product Configuration Identification are further evaluated in an Integrated Pretest Review and a Formal Qualification Review. The former determines whether the system is developed sufficiently to undergo test and evaluation, and the latter certifies that the CI meets the contract requirements. The Product Baseline is then established from the Product Configuration Identification.

NAVMATINST 4130.1A and NAVMATINST 4130.1B (Draft) provide specific guidance with regard to configuration status accounting for each phase of the configuration item's life cycle. During the Concept Development Phase, configuration status accounting is limited to the recording of all proposed changes to specified functional and physical characteristics. The depth of data to be recorded and the scope and complexity of the contractor's configuration status accounting system is tailored to correspond to the complexity of the configuration item. Additionally, all configuration status accounting data is included in the contractor's proposed Functional Configuration Identification.

During the Demonstration and Validation Phase configuration status accounting is established and maintained to record and provide traceability of all changes to the contractor's Functional Configuration Identification. Data recorded during this phase of the life-cycle is additionally included in the Allocated Configuration Identification and is to be of sufficient detail to aid in the technical review process. Technical reviews are used to determine if the configuration item development has achieved contract milestone requirements. Additionally, during this phase, both the plan of the office of primary responsibility and the contractor's plans are to include provisions for identifying, continuing and expanding the configuration status accounting system.

During the Full-scale Development Phase the configuration status accounting system identified in the contractor and office of primary responsibility configuration management plan is implemented. NAVMATINST 4130.1B (Draft) proposes that configuration management plans be revised during this phase to record and provide traceability of the status of all changes to the Product Configuration Identification as well as the Functional Configuration Identification and Allocated Configuration Identification. Additionally this instruction directs that the configuration status accounting system implemented during this phase be compatible with DOD standard configuration status accounting systems, planned technical reviews, configuration

audits, and the needs of management, acquisition, evaluation production and integrated logistic support. [Ref. 7]

During the Production Phase, the configuration status accounting system developed during the previous phases is further expanded and refined. The office of primary responsibility is tasked with adapting contractor configuration status accounting systems to the DOD service (i.e., Navy, Air Force, etc.) standard system for all configuration items not developed at government expense. Upon configuration item deployment, those activities responsible for acquisition, operation, test and evaluation are directed to utilize the system established by the respective DOD service to record and trace all changes to the configuration item.

Finally, during the Deployment Phase, the configuration status accounting system implemented during the Production Phase is utilized.

NAVMATINST 4130.1A directs the initiation and maintenance of a configuration record for each configuration item upon configuration baseline establishment. The configuration record when established consists of the current configuration item identification coupled with a history of all configuration changes. The record is maintained in a manner that provides management visibility of the configuration item. The reporting system utilized to maintain the configuration record consists of subsystems for data collection and data processing. Utilizing

designated reporting sources, quality assured data and standardized elements, the data collection system accumulates structured records for data processing. The data processing system is engineered to provide timely and current configuration status accounting information to user activities. Status accounting output data requirements such as report formats, level of detail, distribution and report frequency are to be of an adequate level to meet management needs.

C. NAVAL AIR SYSTEMS COMMAND CONFIGURATION MANAGEMENT STATUS ACCOUNTING

The Chief of Naval Material has assigned to the Naval Air Systems Command (NAVAIR) overall responsibility and delegated it the authority for management of the configuration of Naval Air weapon system material items. This responsibility and authority are further assigned and delegated to the Director of the Naval Air Systems Command Headquarters Configuration Management Office which is responsible for developing and maintaining policies and procedures governing the NAVAIR Configuration Management Program. These responsibilities include:
[Ref. 9]

1. Providing technical and administrative direction to properly identify, control and record the configuration and change implementation status of the physical and functional characteristics of aircraft, weapons, weapon systems and related equipment throughout their life cycle

2. Acting as the primary NAVAIR point of contact for coordinating configuration management matters and resolving associated problem areas

3. Developing, integrating and promulgating overall NAVAIR policies, criteria and procedures

4. Providing policy and administrative guidance to the Change Control Boards which review and approve or disapprove engineering change proposals

5. Providing authoritative direction and managerial assistance to functional groups and project managers in implementing configuration management

6. Counseling and advising contractors regarding configuration management policies, plans and procedures

7. Interfacing configuration management procedures with other DOD and Navy management disciplines (e.g. Naval Aviation Maintenance and Material Management System and Navy Integrated Logistics Support System)

8. Establishing and maintaining an overall system for processing and monitoring all configuration changes

9. Developing and maintaining an aviation configuration status accounting system to permit timely and accurate communication of necessary configuration data among acquisition, operational and support activities

10. Conducting continuous surveillance of configuration management to assure compliance and improve effectiveness

NAVAIR Instruction (NAVAIRINST) 4130.1A implements NAVMATINST 4130.1A and contains detailed guidance, policy and procedures governing Naval Aviation configuration management responsibilities assigned to the NAVAIR Headquarters Configuration Management Office. Specifically, in the area of configuration status accounting, NAVAIRINST 4130.1A identifies required configuration status accounting data, sources of data, configuration status accounting systems and flow of data. It additionally establishes guidelines for acquisition of status accounting data/records/reports applicable to NAVAIR, its contractors, field activities and inventory control points. It further provides general guidance for physically marking configuration items for visual identification, which is essential to traceability.

NAVAIRINST 4720.1C establishes policy, responsibility and procedures for management of modification materials procured by or for the Naval Air Systems Command. The procedures outlined in this instruction cover the assignment of kit identification numbers and shipping instructions, inventory management, allocation and reallocation, requisitioning, receipts and issues, storage, excesses and reclamation. The Naval Aviation Logistics Center has been assigned by NAVAIR as the manager for the NAVAIR Modification Program and as manager for modification installation support.

D. OTHER COMMAND ROLES IN CONFIGURATION MANAGEMENT STATUS ACCOUNTING

NAVMATINST 5401.2 assigns the Naval Supply Systems Command as a principal configuration management status accounting participating activity. The Naval Supply Systems Command is directed to provide responsive weapon systems file support for the Navy's configuration status accounting system, a focal point for liaison with other system commands, and policy and procedural support for the Navy's configuration status accounting system.

NAVMATINST 4130.5A establishes policies and assigns responsibilities for Naval aviation configuration status accounting to fleet commanders, type commanders, depot level maintenance activities and other commands having custody of operational and support configuration items. These policies and assigned responsibilities are outlined as follows:

1. Fleet Commanders

- a. Support and ensure that subordinate commands and activities support configuration status accounting
- b. Require a configuration manager at each level of command
- c. Ensure coordination between maintenance and supply functions

2. Type Commanders

- a. Implement and maintain a configuration status accounting system in the fleet

- b. Designate a configuration status accounting manager
- c. Ensure configuration change reporting is initiated by the installing activity and submitted by the activity having custody of the configuration item
- d. Sponsor configuration validations as required

3. Depot Maintenance Activities

- a. Report configuration changes accomplished during industrial maintenance
- b. Provide validation of configuration items
- c. Provide assistance to validation teams

4. Commands and Activities Having Custody of Operational and Support Configuration Items

- a. Report configuration changes by submitting Navy configuration change data
- b. Provide validation of configuration items
- c. Provide assistance to validation teams

IV. THE NEED FOR CONFIGURATION MANAGEMENT STATUS ACCOUNTING

A. IMPORTANCE OF CONFIGURATION MANAGEMENT STATUS ACCOUNTING

From the earliest beginnings of an organized military, weaponry has been modified to improve capability, reliability and maintainability. Documentation of these modifications, when accomplished, has been typically informal and non-standard. However, the increasing complexity of weapon systems, the large number of dissimilar items and the high unit cost of individual components has led to the development of advanced modification and documentation systems. Machine processing techniques have enabled management to generate report upon report in an attempt to determine the exact configuration of specific weapon systems at any given moment in time. Unfortunately, the majority of these advanced configuration status accounting modification and documentation systems lack accuracy, standardization and centralization.

The number of modifications to weapon systems is on the rise [Ref. 10]. In the Department of Defense, there is a trend toward longer life cycles for equipment and systems, with modernization being substituted for new procurement [Ref. 10]. This situation is exemplified by the aging and much modified B-52 bomber and F-4 fighter aircraft.

As a result of these longer life cycles, the armed services have experienced a large backlog of not incorporated modifications.

In 1973 it was estimated that the Army, Navy and Air Force had approximately \$304 million worth of kits on hand pending installation [Ref. 10]. This estimate did not include any modifications scheduled for completion in future years for which material had not yet been procured.

Further complicating the situation is the fact that, even with complex record keeping systems, the Navy is frequently unable to determine with accuracy which modifications have been accomplished and which have not [Ref. 10]. This leads to improperly identified assets, additional physical audits which result in wasted manhours, duplication of effort, excess costs and possible hazardous conditions.

The importance of configuration management status accounting does not end with monetary, manpower and safety costs. Additional capability reductions result from the significant time lag between identification of functional problems with a system and implementation of corrective action. This situation often results in emergency modifications to the system and hasty procurement of unproven fixes. Modifications that have not been fully tested frequently cause excess downtime due to incorporation difficulties and new deficiencies caused by the unproven modification. This type of situation contributes to improper documentation and status accounting.

One of the most significant cost areas surrounding configuration management status accounting concerns logistic support [Ref. 11]. Prior to a carrier-based deployment, Naval aviation

squadrons are drawn from different geographic locations and assembled onboard an assigned aircraft carrier. Once onboard, the carrier assumes full responsibility for the logistic support of all assigned aircraft. Since the selection of aircraft scheduled for deployment is determined by the functional wing at the squadron's home base, the supporting carrier depends on a configuration input provided by the functional wing and airwing commander. This input is utilized to outfit the ship with the correct assortment of repair parts, test benches, support equipment and trained personnel. Any configuration differences between the aircraft provided and the configuration data utilized by the ship directly results in decreased operational readiness, due to a lack of optimal onboard support.

The importance of configuration management in the Use Period of a weapon system's life cycle is heightened since during this time hardware is largely in the hands of the using agency. Because these military users are frequently far removed from the system developers in terms of time, facilities, personnel, communications and expertise, they are, out of necessity, frequently required to repair, modify and retrofit systems and components without outside assistance under conditions of urgency.

B. THE ROLE OF CONFIGURATION MANAGEMENT STATUS ACCOUNTING

Status accounting from an operational sense is probably the least understood part of configuration management [Ref. 12]. It is often perceived as a highly expensive, monotonous

group of reports utilized by management to track modifications. Actually, configuration management status accounting is part of a management process that uses these reports as a means to an end.

Effective configuration management status accounting requires that all changes be tracked from the time the idea for the change is officially proposed and recorded, through its investigation and evaluation, until such time as the change is disapproved or approved. If approved, it is further tracked through its incorporation into the weapon system. This includes tracking the incorporation of approved changes on the contractor's production line, in operational units and in spare units located within the logistic support system to ensure that all changes are accomplished as required.

Additionally, status accounting programs must track identification (serial) numbers and document numbers for each configuration item to ensure an adequate level of control. Programs, whether manual or computer based, need to monitor the development of new/revised manuals and support equipment necessary to support the change to the product baseline. In the case of retrofits, programs should track the development, delivery and location of modification kits and their associated incorporation instructions. Finally, configuration status accounting must include a routine to track the configuration of all units in the field.

The increasing emphasis on lengthening life cycles of equipment to preclude new procurement will necessitate more and more changes if systems are to remain current with state of the art technology and competitive with those potential enemies of the United States. Precise knowledge of equipment configuration obtained through effective status and accounting programs is vital to successfully achieving the required equipment performance, logistic support, system readiness and operational efficiency and effectiveness critical to warfare success.

V. CONFIGURATION MANAGEMENT STATUS ACCOUNTING IN NAVAIR

This chapter contains an overview of the Technical Directive Status Accounting (TDSA) System, the Naval Aviation Logistics Data Analysis (NALDA) System and the interface between the two systems. These systems are prescribed for recording and maintaining modifications to equipment in the NAVAIR inventory.

A. TECHNICAL DIRECTIVE STATUS ACCOUNTING (TDSA) SYSTEM

The TDSA System is designed to encompass all weapon systems, missiles, engines, trainers, support equipment, and repairable components under NAVAIR cognizance [Ref. 7]. To accommodate this diversity of configuration items, the status accounting system is divided into four subsystems. The subsystem approach provides an economical means of including the entire NAVAIR inventory in the configuration management program, while furnishing NAVAIR optional levels of data depth based on user requirements [Ref. 13]. The four configuration status accounting subsystems are: Advanced, Standard, Installed and Bulk. Table 5.1 provides a breakdown of the four subsystems and their specific applicability, accounting standards and identification methodology.

The Advanced Configuration Status Accounting subsystem is the most costly to operate since it provides configuration status of selected components and support equipment by serial

TABLE 5.1 NAVAIR CONFIGURATION STATUS ACCOUNTING SYSTEM
 [Ref. 12]

	<u>Applicable To:</u>	<u>Accounting:</u>
ADVANCED CSA SYSTEM	10% of Support Equipment 12% of Components	Standard CSA and Location (2nd Indenture)
STANDARD CSA SYSTEM	All Aircraft All Engines 10% of Support Equipment 10% of Components All Trainers	Unit Serial Number and Tech- nical Directive Status
INSTALLED CSA SYSTEM	10% of Components 10% of Airborne Armament 12 Aircraft Models 10% of Support Equipment	Mission/System Capability
BULK CSA SYSTEM	70% of Support Equipment 68% of Components 90% of Airborne Armament	FSN/Part Numbers & Manufacturer's Code

number and location. It has the potential to identify, for example, a specific squadron aircraft bureau number in which a specific serial number identified component is installed. As indicated in Table 5.1, the use of this subsystem is limited due to the significant resources required to support its operation.

The Standard Configuration Status Accounting Subsystem records the incorporated or not incorporated status and applicability of technical directives against specific bureau numbers or configuration item serial numbers. This subsystem provides the means to match listings of not incorporated technical directives against baseline records for each configuration item. This capability supplies management with the basic data necessary to manage technical directive change kits, technical directive incorporation workload scheduling and configuration item mission capability.

The Installed Configuration Status Accounting Subsystem provides configuration status accounting for selected systems within a weapon system. In this subsystem selected systems are coded by capability and compatibility for inventory and support requirement management purposes. Selection of systems for inclusion in the installed subsystem is based on the following criteria: [Ref. 7]

1. Mission and safety importance
2. Unusual support requirements due to complexity or spare part shortages

3. Potential for frequent updating
4. Number of different configurations possible on like model aircraft

The Bulk Configuration Status Accounting Subsystem provides configuration management for those configuration items not included in the previous subsystems. This system provides a summary of the incorporated/not incorporated status of each technical directive applicable to each item in the subsystem. Being the most economical to operate, this subsystem contains the majority of NAVAIR configuration items, as indicated in Table 5.1.

The Configuration Status Accounting System utilizes uniform record formats which consist of baseline listings, and standard configuration status accounting elements. Identification of status accounting elements and their related data items is contained in Military Standard 482A. Generally, baseline records are initially acquired through contract requirements for development and production products. Once acquired, configuration item baseline records are maintained at the Naval Air Technical Services Facility, Naval Aviation Logistic Center, NAVAIR Designated Overhaul Point, Cognizant Field Activity and at the Designated Field Activity.

Accountability of technical directives issued and incorporated was previously maintained through both the Technical Directives Master Data File by the Naval Air Technical Services Facility and the Configuration Status Accounting System by

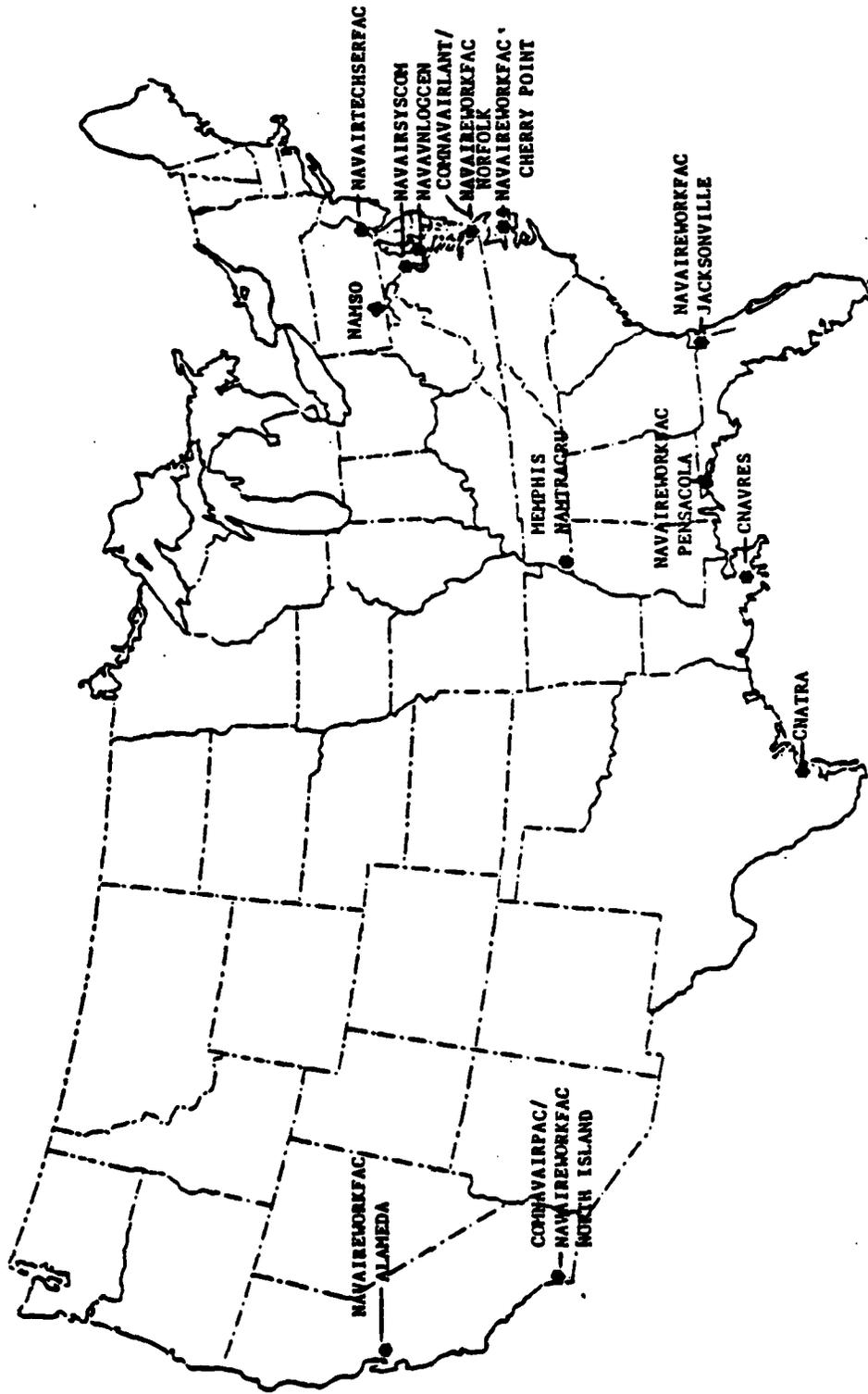
the Naval Air Systems Command. In an effort to reduce redundant efforts and duplicate data bases, and to provide more current and credible information, the Technical Directives Master Data File and Configuration Status Accounting System were combined into the Technical Directive Status Accounting (TDSA) System [Ref. 7]. The TDSA data base contains only data supported by formal documentation and can be changed only by issuance of amended or revised technical directives. Chief of Naval Operations Instruction 4790.2B establishes the policies, procedures and responsibilities for the Naval Aviation Maintenance Program. Data from the Maintenance Data Collection System of the NAMP is used in the TDSA system for recording technical directive compliance.

TDSA data bases contain data describing attributes of Naval Air Systems Command technical directives such as category, issue/rescission dates, applicable equipment, kits required, planned maintenance level, work unit code, applicable engineering change proposal, and configuration control board information. In addition to detailed records for each NAVAIR technical directive, TDSA data bases contain equipment records for all Naval aircraft and aircraft engines which describe the incorporation status of applicable technical directives. There is one TDSA data base for aircraft, one for engines, and one for components and support equipment. In addition, TDSA provides projected and actual manhour reporting, configuration status of configuration items, change kits,

material accounting, and summary reporting for overall technical directive management and budgeting. The system is operational on a centrally located computer which is accessible through the geographically dispersed terminal network illustrated in Figure 5.1.

The diverse type of equipment within NAVAIR's inventory requires different types and degrees of management reports for managing the modification program. To provide an effective yet economical method for furnishing this data, the reports listed in Table 5.2 have been tailored and standardized to provide desired information to meet user requirements. Each TDSA data base is structured on a Technical Directive/Applicability file, a Reference/Incorporated file and a History file. All three of these files are maintained and are accessible to all customers concerned with NAVAIR's modification programs as long as the equipment remains in NAVAIR's inventory.

The Technical Directive/Applicability file is established and maintained by the Naval Air Technical Service Facility on technical directives approved by NAVAIR. The Reference/Incorporated file is established and maintained by the Naval Aviation Logistics Center and the Naval Aviation Maintenance Training Group. These commands are responsible for ensuring that all technical directive changes reported are accurately reflected as incorporated. A history file is created and maintained by the Naval Aviation Logistic Center and contains all technical directives that have been rescinded or cancelled.



**FIGURE 6.1 TOSA NETWORK
(REF. 14)**

TABLE 5.2 TDSA USER REPORTS AVAILABLE [Ref. 14]

LST01	List of all TDs and their effectivity ranges
LST02	List of serial numbered items showing NINC TDs applicable to each
LST04	List of serial numbered items showing the INC TDs for each
LST04H	List of serial numbered items showing the INC TD history data for each
LST06	List of serial numbered items showing both the INC and NINC TDs for each
LST07	List by TD of the serial numbered item for which the TD is applicable indicating the INC or NINC status for each S/N
LST20	List of serial numbered items and selected information about each
LST201	Summary information on the INC and NINC TDs by serial number
LST301	Summary listing of TDs showing INC and NINC statistics for each
NA001	(TD Number Assignment Report): Provide a summary report of TDs, kits, and man-hours by type equipment code and series for aircraft and engines, and by TD code for components
NA002	(Aircraft Norm Report): TD calculated NINC manhour norms for a given number of items of a given type of equipment
NA003	(Modification Summary Report): Provides matrices of INC/NINC TDs by serial numbers
NAT01	(Aeronautical Technical Directive Index--Format 1): List of TDs in the sequence of the TD file with selected information about each i.e., CCB and ECP number
NAT10	(NAVAIR-00-500C Report): Lists selected TDs applicable to a type, model, series aircraft

TABLE 5.2 (Continued)

NAT11	Complete list of all information applying to a TD that is in the TD/Applicability Files
REP21	(Reference File Listing): Complete list of all data applicable to select serial numbered items including INC/NINC TDs

The history file was established to reduce active file volume and operating costs and to provide a permanent record of historical modification transactions. [Ref. 14]

Aircraft reporting custodians (squadrons) and their functional wings (staffs) are provided quarterly summary reports of all technical directive transactions applicable to aircraft under their cognizance. These reports are referred to as the TDSA List 2 and TDSA List 4 reports. The TDSA List 2 lists all published technical directives applicable to but not incorporated in assigned bureau/serial numbers, and the TDSA List 4 lists all published technical directives applicable to and incorporated in assigned bureau/serial numbers. Following verification with the previous listings, the newly received listings are maintained in the technical directive section of the aircraft/engine logbook. It is the responsibility of reporting custodians to report all list omissions or errors to the Naval Aviation Logistic Center TDSA Officer (Code 242). Annually, reporting custodians receive the TDSA List 4H (Historical Incorporated Data) which, following verification is also maintained in the aircraft/engine logbook. The TDSA List 4H indicates the incorporation status of all applicable technical directives.

Naval Air Rework Facilities are tasked to audit each aircraft/engine during overhaul and correct all discrepancies found in the TDSA Lists 2 and 4 on file in the aircraft/engine

logbook. This audit by depot facilities was implemented to provide a stable, consistent and reliable means of ensuring data accuracy throughout the fleet. [Ref. 14]

B. NAVAL AVIATION LOGISTICS DATA ANALYSIS (NALDA) SYSTEM

In 1970, the Naval Aviation Logistics community recognized that all of the elements of the logistics network--repair parts, support equipment, personnel skills, technical data and facilities must be considered together because of their close relationship and interdependence [Ref. 15]. In recognition of this requirement, the concept of the Naval Aviation Logistics Data Analysis (NALDA) system was formulated. The central objective of the NALDA system is to provide a significantly improved logistics data analysis capability to support the NAVAIR Headquarters, fleet type commanders and field activities involved in the analysis and management of logistics and engineering [Ref. 15]. NALDA has achieved this objective by providing a "state-of-the-art" NAVAIR corporate data base system tailored to support various NAVAIR logistic management information systems, user data analysis programs, and interactive query requirements.

The NALDA prototype system first became operational in May 1976, and was a major step in total system development. The prototype demonstrated that integrated application programs and interactive data analysis can enhance material readiness, safety and resource allocation [Ref. 15]. NALDA

moved from prototype to Phase 1 operational capability in October 1981 with the following system applications:

1. Analytical Maintenance Program Analysis Support System-- a tool to support reliability centered maintenance concepts
2. Aviation Maintenance Engineering System--a tool to increase operational readiness by correcting maintenance and supply problems
3. TDSA--a tool to manage the incorporation of technical directives in aircraft, engines, components and ground support equipment. This system provides a duplicate data base that can be directly accessed by user activities.

NALDA Phase II will incrementally incorporate numerous additional programs during fiscal years 1982 through 1985. Programs for Phase II incorporation which have impact on configuration management status accounting are: [Ref. 15]

1. Engine composition and tracking--a program to project and track material and workload requirements for serial numbered engines and critical engine components
2. Engineering change proposal, tracking and evaluation-- a program to monitor and evaluate all engineering change proposals from initial action by the NAVAIR change control board to ultimate disposition, including their installation as technical directives
3. Configuration management serial number accounting and tracking--a system to track and manage the configuration status of aviation weapon systems to support NAVAIR application programs

4. Kits management information system--a program to track the location, quantity and condition of technical directive change kits

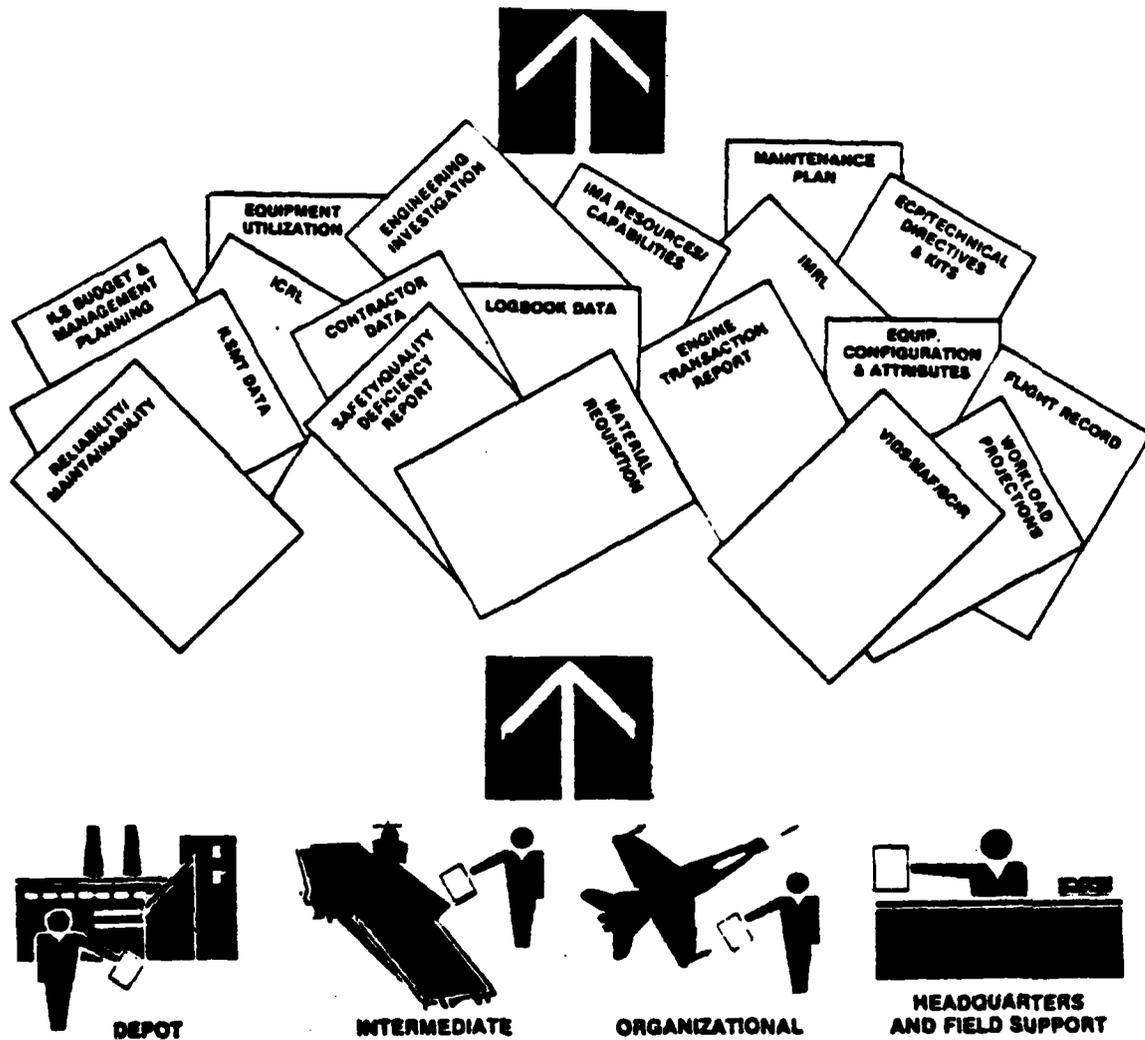
Since NALDA is an analysis system and not a data collection system, it imposes no additional data reporting burdens on the fleet. NALDA receives maintenance, supply, configuration, operations, material, safety, readiness and other logistics data from existing data collection systems such as the Maintenance Data Collection System, the Naval Aviation Maintenance Program, the Aviation Supply Office, Master Data File, Weapons System File, Naval Air Rework Facilities and many other sources as indicated in Figure 5.2.

This data is entered into a centrally integrated data bank organized using a data base management system named System 2000. The System 2000 query language makes it possible for non programmers to communicate directly with the computer. The principal function of the System 2000 data base management system is to edit and organize input data, then load and subsequently update the data bank.

In addition, the data base management system can calculate various summary and statistical data, develop graphics, perform simulations and provide various modeling and forecasting outputs, as illustrated in Table 5.3. NALDA is an evolutionary management information system which will incrementally expand through subsequent development phases as new user requirements are approved for incorporation.

- SAFETY CENTER
- NATSF
- NARFs
- CONTRACTORS
- NAVAIR/NALC
- ASO

- N
A
L
C
O
M
I
S
- 3M-MDS/NAMSO
 - SIDMS
 - LOGBOOKS
 - AEMSIETRs



NALDA DATA SOURCES
FIGURE 5.2 (REF. 15)

TABLE 5.3 NALDA [Ref. 15]

SYSTEM 2000 DBMS

- * Natural Language
Interactive Query
- * Report Writer
User Strings
- * Cobol, Fortran, PLI

SPECIALIZED SOFTWARE

- * Statistics
- * Graphics
- * Simulation
- * Modeling
- * Forecasting

APPLICATION SUBSYSTEM INTERFACES

- | | |
|--------------|-------------|
| * AMPAS | * SMRA |
| * AMEN | * RIP |
| * TDSA | * DAP |
| * AIMI | * MIR |
| * VAMOSC-AIR | * LSAR |
| * SM&R-IMP | * ECP-TRAK |
| * ICRL-IMP | * COMSAT |
| * ECOMTRAK | * CURES-INT |
| * MPI | * KITS-MIS |
| * SNOAP | * SRC-REP |

USER COMMUNITY

MANAGERS

ENGINEERS

LOGISTICIANS

ANALYSTS

VI. LOCAL CONFIGURATION MANAGEMENT STATUS ACCOUNTING SYSTEMS

In this chapter the deficiencies of the TDSA and NALDA Systems are discussed. The overwhelming necessity for real time and accurate aviation maintenance management information has lead to the development of numerous independent systems at various management levels throughout the Navy. (Because these systems are not standardized, distributed or utilized on a NAVAIR-wide basis, they are referred to as "local" systems throughout the remainder of this thesis.) Although highly maintenance management oriented, local systems often integrate accurate and timely configuration status accounting data to improve overall information system effectiveness. Four local systems representing specific airframe, engine and avionic applications are reviewed.

A. TDSA DEFICIENCIES

In December 1978, following a comprehensive audit of the NAVAIR modification program, the Naval Audit Service reported:

The TDSA system, designed to provide the current configuration of all Naval aircraft and approved modifications to be installed, is replete with incomplete and unreliable data. As a result the system output is not reliable without extensive reconciliation. [Ref. 16]

As part of this evaluation, the Naval Audit Service reviewed the NAVAIR Technical Directive Application File for airframe changes, updated through 31 December 1977. The Application File contained 14,832 records of which 5,983 involved kit

installations either already incorporated or to be incorporated. Using computer aided analysis, the Naval Audit Service found the following deficient areas:

1. Missing Data. Thirty-five percent of the 14,832 records were lacking manhour accounting data and thirty-two percent of the 5,983 records concerned with kit installations were lacking cost accounting data.

2. Unreliable Data. Of the 14,832 records reviewed, 7,757 (fifty-two percent) had actually been rescinded; however, only 1,833 (twelve percent) of the TDSA records were identified as being rescinded. Records indicated that 207,355 modification kits had been incorporated. However, only 49,329 kits were actually recorded as having been procured. Additionally, a review of aircraft inspections (bulletins) revealed a quantity of 348 kits incorporated, despite the fact that these inspections do not require kits. Finally, a comparison of records indicating the total number of "equipment items affected" with records indicating total number of technical directives incorporated/not incorporated revealed 211,093 units affected and 256,109 incorporated/not incorporated technical directives, an error of eighteen percent.

Although the above examples are few in number, they represent the magnitude of the problem that still exists today. In 1982, the Naval Audit Service reported that the Naval Air Systems Command and Naval Supply Systems Command "still have not agreed on how to carry out and implement a configuration

status accounting program and that management within the Department of the Navy has not resolved the problem." [Ref. 17] It further stated that the continued lack of accurate, complete and timely configuration information is adversely affecting fleet operations, modification kit inventory management, depot maintenance and supply support within the Naval aviation community.

Naval operating forces are becoming increasingly concerned about system performance degradation resulting from configuration errors. Commander, Naval Air Force, U.S. Atlantic Fleet studied fifty-eight configuration related mishaps that occurred during the eighteen month period ending 30 June 1978. The study found that the Navy incurred over \$100 million in aircraft damage during that period as a result of inadvertant aircraft component removal, change removal, installation of incompatible replacement components and failure to incorporate authorized changes. [Ref 16]

A study conducted by the Fleet Material Support Office in 1980 revealed that aviation consolidated allowance parts lists for recently deployed F-14 squadrons did not authorize twenty-five percent of the required parts [Ref. 18]. The lack of complete, accurate and timely configuration status accounting data contributed significantly to these problems [Ref. 18].

Although the Naval Aviation Logistics Command Management Information System (NALCOMIS) is being designed to provide Naval aviation activities with an automated configuration status

accounting system, there is no credible schedule indicating when NALCOMIS will be implemented. This, coupled with the inadequacies of current information systems, has forced aircraft maintenance managers at all levels to take aggressive, independent action to obtain or produce local systems that improve their control over configuration management.

Special purpose management information systems are additionally created because it is often less expensive, easier, and faster to construct a new system than to correct existing systems or accelerate implementation of planned systems. In many cases, managers simply cannot or will not wait for a properly planned and implemented management information system. In other cases, limitations in the budget process encourage proliferation. Although the limited cost of a specialized system to satisfy a single project is easily justified, redesign of existing systems is sometimes more cost-effective and results in a system with implicit integration.

Local systems range from personal hardware and software to sophisticated, Navy funded, contractor supported systems. With few exceptions, these systems are not compatible with each other or NALCOMIS, and they are not standardized in any way. Although numerous systems exist, Table 6.1 is a listing of those configuration management related local systems currently recognized by the Navy. The remainder of this chapter discusses four significant local systems that have been

TABLE 6.1 LOCAL CONFIGURATION STATUS ACCOUNTING SYSTEMS

ACRONYM	SPONSOR(S)	CONTRACTOR(S)	MAINT LEVEL/ FUNCTION
SIDMS	CNAL	PRD	I/SSC
ARMS	MAG 14/ NAVAIR	PCI	O/I/SSC
FAMMS	NAVSUP/ TYCOMS	NAVY	I/SSC
AMS	NAVMAT	CACI/IBM	O/I
Measure	NAVAIR	CERBERONICS/ DELPHI	I
TMS	NAVAIR	MACAIR	
ADPE/FMF	CMC	UNK	O/I Partial
TICS	NAVAIR	NAVY	
LAMS	NALC	SAI	IMRL
ATSS	OPNAV	SYSCON	Training Personnel Asset Mgt
LINDA	CNAP	SYSCON	General
SPORT	CNAL/ OCEANA	WANG	SSC
* VAMP	CNAP/AIMSO	Mantech	VAST Mgt
* CMIS	CNAP	GRUMMAN	O
* ECOMTRAK	NAVAIR/ NALC	VSE	O/I
* CAMS/ PLS	CNAL	SYSCON	O

* Reviewed in this chapter

developed to independently manage configuration of avionics equipment, airframes and engines.

B. VERSATILE AVIONICS SHOP TEST (VAST) AVIONICS MANAGEMENT PROGRAM (VAMP)

The TDSA system currently provides no capability for tracking changes to avionics weapon replaceable assemblies incorporated at the intermediate or depot maintenance levels. Although data recording these changes is entered in the Maintenance and Material Management System in the same way that airframe change incorporations are entered, the Naval Aviation Logistics Center produces no consolidated list for avionics changes that are equivalent to the airframe change List 2 and List 4. Likewise, avionics change incorporation information is not available through NALDA. Because the maintenance data collection system does not have the capability to track avionics components by serial number, avionics technical directive incorporations are tracked only by numbers of change kits documented as having been used. Consequently, each intermediate maintenance activity has devised and pursued its own system for component serial number configuration status accounting. Due to the magnitude and complexity of the task, most of these systems are manually tracked within the workcenter that incorporates the change in the specific piece of avionics equipment. However, one area where a computerized system has been developed is in those workcenters where the weapon replaceable avionics assemblies are repaired on the Versatile Avionics Shop Test (VAST) bench.

Versatile Avionics Shop Test is a computer controlled test system designed to be used by intermediate and depot level aviation maintenance activities. VAST is composed of a group of independent, general purpose stimulus generator and measurement instruments called building blocks that are necessary to test highly sophisticated avionics equipment. Because of building block independence, VAST stations can be readily adapted to support a wide variety of present and future avionics systems.

Growing interest in and increased utilization of automatic test equipment, coupled with concern over avionics equipment configuration management has resulted in development of a prototype automated VAST management program by Mantech Corporation. The VAST Automated Management Program (VAMP) currently being prototyped has the following specific objectives: [Ref. 19]

1. Decrease weapon replaceable assembly (WRA) turn-around time through better utilization of shop replaceable assembly (SRA) pool and other assets awaiting parts

2. Decrease the required management manhours to track WRA run selection parameters allowing more time for direct supervision

3. Decrease technician manhours expended on paperwork allowing more time for WRA production

4. Provide serial number tracking of VAST building blocks, VAST supported WRAs and VAST supported SRAs

5. Increase identification of VAST supported problem components

6. Improve configuration management of VAST supported weapon replaceable assemblies

7. Increase utilization of VAST station hardware through more efficient control of station configuration

8. Collect station information for "real time" trend analysis useful in detecting problem areas, or identifying components which require special attention

9. Reduce documentation data errors through the use of automatic verification routines within the system

Currently VAMP divides VAST operations into four main functional areas: 1) supervisory function programs, 2) maintenance action form processing, 3) station status programs and 4) parts availability programs. As these objectives indicate, VAMP is more than just a configuration status accounting system. However, only those methods and procedures generally dealing with configuration management of avionics equipment and the VAST station itself are addressed here with respect to each of these functional areas.

1. Supervisory Functions

Original Maintenance Action Form input to the VAMP system is done through the use of this function. In addition, existing maintenance action form data currently within the system can be modified or corrected. Other basic supervisory functions include ad-hoc querying of maintenance data and accessing preformatted reports and lists.

With regard to configuration management, this function contains a change monitoring program that automatically examines every weapon replaceable assembly part number and serial number as it is entered into the system to determine if an avionics change needs to be incorporated in that assembly. If a change is required, the program automatically prepares the maintenance action form and posts the pending maintenance action to the appropriate files. This program provides management with the capacity for real time identification of the exact configuration status of any given VAST supported weapon replaceable assembly.

2. Maintenance Action Form Processing

The documentation of material to be ordered, including avionics change kits, and the completion of maintenance action forms is achieved automatically within this function. In the case of completed avionics changes, the incorporation data is entered in the computer under the appropriate menu driven option, and the system prints the necessary data on the proper form. Configuration status changes resulting from any of these actions are automatically posted to the appropriate files.

Real time status of all outstanding maintenance actions (including technical directive incorporations) are available for verification or ad-hoc status checks. Queries can be made by work unit code, status (i.e., awaiting maintenance, awaiting parts), part number, serial number, avionics change number or supply requisition number.

3. Station Status Programs

Procedures for reporting the configuration of the VAST system itself have been incorporated. VAMP has been designed to track and record station status data for one or all stations. Before any station status change can be made by the operator, the VAMP system performs verification to ensure that proper conditions exist throughout the VAST system to justify a status change (i.e., station status is not being changed from down to up when there is an outstanding maintenance action against the station). This verification is designed to ensure maximum data integrity of configuration identification within the VAST system.

Under VAMP, VAST station configuration status can be quickly displayed and reviewed. Building blocks currently installed in a given station can be identified to the serial number level, thus providing an accurate real time station configuration tracking system. Maintenance and supply actions are automated for all actions involving building blocks. This automated function includes documentation of all removal, installation, cannibalization and calibration actions. Additionally, the system provides for automated supply requisition and maintenance/supply status change documentation.

4. Parts Availability Programs

The ability to quickly determine the availability of required parts plays a significant role in maximizing VAST workcenter throughput. As a result, procedures that allow

parts availability to be quickly and easily determined have been incorporated into this function. The system can be queried to determine whether or not a required part or technical directive change kit is available for issue by the supporting Supply Department.

Another useful feature of VAMP with regard to parts requirements and availability involves a set of routines which screen the configuration of all awaiting parts assets for required parts. Rather than allow these assets to remain unused and send still another unit to the awaiting parts locker, the required parts can be cannibalized from a unit already awaiting parts so that the other unit can be made ready for issue.

Telephone discussion with VAMP managers at the prototype site indicates that the VAMP system has significantly enhanced management of the VAST workcenter and configuration control of the assemblies under VAST cognizance. However, there is no quantitative data available to determine its actual level of effectiveness [Ref. 20]. This lack of data is a result of the relatively short time VAMP has been in operation and the fact that it has been tested at only one site.

The major limitation currently impacting VAST/VAMP management is supply support. The inventory data base of replacement parts and technical directive change kits has not been entered into the system. Consequently, VAMP can not determine if a replacement part is actually in stock. Another supply-related limitation involves the set of routines which

search awaiting parts assets for needed parts. This feature is utilized only eight hours per day Monday through Friday because of a shortage of supply personnel. Since maximum utilization of the VAST station requires 24-hour operation, greater access to supply data could provide significant increases in VAMP efficiency and effectiveness.

VAMP provides an effective means of monitoring, controlling and accounting for avionics component configuration. Fully compatible with NALCOMIS, VAMP is the only automated system in the Navy developed specifically to manage avionics components. Given the lack of interface systems, VAMP is only capable of tracking component locations when the component is physically within the VAST workcenter. Additionally, VAMP is designed to manage only VAST supported components which comprise a small percentage of the total NAVAIR avionics inventory.

The VAMP system is a first generation management information system enhancing VAST workcenter throughput and configuration management of avionics weapon replaceable assemblies. Data provided by VAMP developers indicates that the system is currently being expanded to solve some of the deficiencies and limitations discussed herein [Ref. 19]. If provided with upline reporting capability to NALCOMIS and NALDA, and if expanded to include all intermediate level weapon replaceable avionics assemblies, VAMP has the potential to become an even more effective avionics configuration accounting system. VAMP

may lead the way to increased readiness by combining effective decision-making tools and useable management information for configuration status accounting.

C. CONFIGURATION MANAGEMENT INFORMATION SYSTEM (CMIS)

The Configuration Management Information System (CMIS) is a computerized system designed to reflect the present status of all major changes affecting supported aircraft at the organizational level. It was developed by Grumman Aerospace to provide summary level information concerning configuration change requirements and configuration status in the complex, dynamic environment of multiple aircraft configurations at multiple sites and overhaul facilities. CMIS provides a wide variety of reports for planning and management visibility which highlight the remaining actions necessary to ensure incorporation of changes into all affected aircraft. An on-line, single source data base accessible through a nationwide tele-network enables CMIS to support a wide variety of user applications and requirements. The CMIS system utilizes an IBM 370 computer located at Grumman's Bethpage, New York facility. The language employed for the system is ANS COBOL Version 4.

The functional system consists of two separate data bases (Figure 6.1): [Ref. 21]

1. Master Data Base with the following capabilities:
 - a. Update data contained within the system
 - b. Create new reports

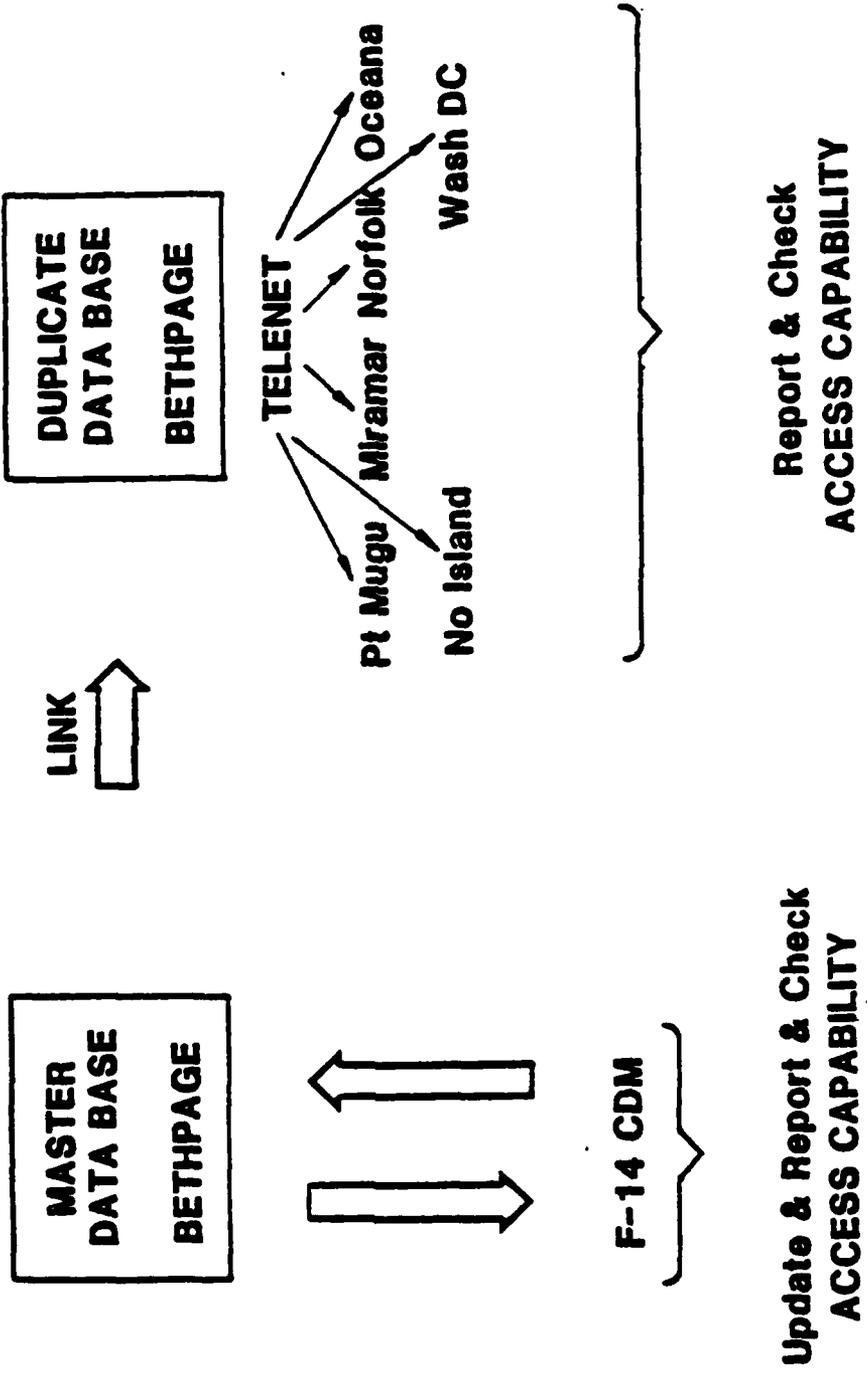


FIGURE 6.1 CMIS FUNCTIONAL DIAGRAM (REF. 21)

- c. Control site access
 - d. Produce all standard/catalogued reports
 - e. Provide check output option
2. Duplicate Data Base with the following capabilities:
- a. Produce selected standard/catalogued reports
 - b. Provide check output option

CMIS design permits only the users of the Master Data Base (Grumman) the capability to develop new reports. Duplicate Data Base users (Fleet) are permitted access to only catalogued existing reports. Adequate flexibility, however, has been build into the system to provide unique user reports to a specific user upon request.

Data input to the Master Data Base is accomplished entirely by Grumman Aerospace in Bethpage. The Product Baseline for each specific block of aircraft bureau numbers is entered during production and updated during the Operations and Support Phase with data provided from user/supported activities (Figure 6.2). The CMIS system is operated independently from the Navy Maintenance Material Management System and is not designed to interface with NALDA or NALCOMIS. Update data submitted by user/supported activities is provided to Grumman on specially designed formats/reports or in some cases on existing Navy report forms.

Upon completion of data inputs/updates to the Master Data Base, a transfer routine immediately updates the Duplicate Data Base with the latest information. Data is contained or stored in the Master Data Base in a matrix format. Each

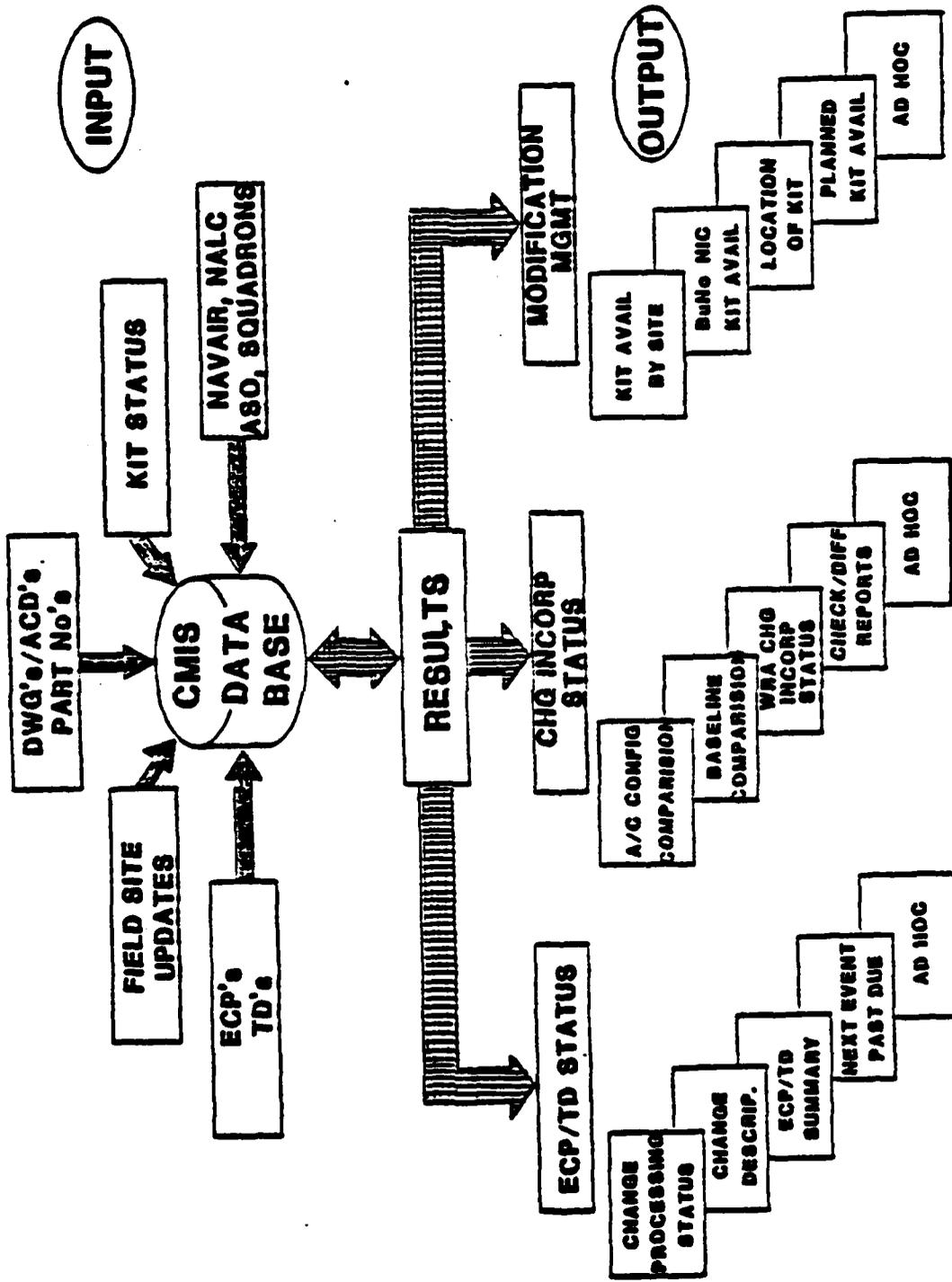


FIGURE 6.2 CMIS DATA BASE (REF.21)

data address is composed of change identification numbers corresponding to the appropriate engineering change proposal and technical directive number.

Once user access has been established through the log-on procedure and telenet system, two menu driven options are provided: Report Output and Check Output. Selecting the Report Output option of CMIS provides the user access to sixty-four standard/catalogued reports designed to aid in change planning, identification, descriptions and overall change management. Table 6.2 provides a listing of available reports. Reports are selected by catalogue number and are formatted for high speed printers with wide carriages (210 characters) to provide maximum data.

Selecting the Check Output option of CMIS provides the user with the capability to compare a given target baseline aircraft configuration with the "actual" configuration of another aircraft or group of aircraft. For example, assume a deployed F-14 squadron onboard an aircraft carrier in the Indian Ocean has lost an aircraft at sea and that an immediate replacement aircraft of identical configuration is required. The user would simply select the appropriate target baseline and input the bureau numbers of all potential replacement aircraft. The Check Output option of the CMIS system would identify all differences between the target baseline and actual configuration of each potential replacement bureau number entered, thereby significantly simplifying the selection process.

TABLE 6.2 CMIS USER REPORTS [Ref. 21]

* ECPs IN PROCESS
 * ECPs NOT REQUESTED
 * ECPs REQUESTED BUT NOT SUBMITTED
 * ECPs SUBMITTED BUT NOT APPROVED BY ACCB
 * ACPs APPROVED BY ACCB--NO FORMAL AUTH RECEIVED
 * ECPs WITH PRODUCTION AUTH AND NOT RET AUTH
 * ECPs RETRO AUTH--ALL KITS NOT ORDERED
 * PTR PROGRAM
 * REDUCED-ECPs RET AUTH NOT ALL KITS ORDERED
 * ECP SUMMARY
 * ECP NUMBER/STATUS SEARCH--QUERY
 * CHANGE DESCRIPTION ECP--QUERY
 * ACTIVE ECP STATUS SORTED BY ECP
 * RM & S PROGRAM
 * ACTIVE CHANGES BY CATEGORY--QUERY
 * CHANGES BY RANK--QUERY
 * ANCILLARY EQUIPMENT CHANGES
 * SELECTED ANCILLARY EQUIPMENT CHANGES--QUERY
 * TECH DIRECTIVE SUMMARY
 * TECH DIRECTIVE NUMBER/STATUS SEARCH--QUERY
 * CHANGE DESCRIPTION TD--QUERY
 * ACTIVE ISSUED TECH DIRECTIVES
 * CONFIGURATION DIFFERENCES--ALL A/C VS BASELINE
 * PRE DD250 TECH DIRECTIVE INCORPORATION
 * TDS NOT ISSUED
 * TITLE KEY WORK SEARCH--QUERY
 * REMARKS KEY WORD SEARCH--QUERY
 * SYSTEM STATUS SEARCH QUERY
 * ACD NUMBER/STATUS SEARCH--QUERY
 * A/C 183 PLUS SDLM CHANGES (SDLM 1)
 * BLOCK 95 PLUS SDLM CHANGES (SDLM 2)
 * ACD SUMMARY
 * CMIS WEEKLY NEWS
 * SELECTED ECP EFFECTIVITY & INCORP STATUS
 * SELECTED TD EFFECTIVITY & INCORP STATUS
 * TIME COMPLIANCE REQUIREMENT TD INCORPORATION STATUS
 * SEL TD NOT INC BY SEL BUNO
 * SEL TD INC BY SEL BUNO
 * TDS NOT INCORP BY SELECTED BUNO
 * TDS INCORP BY SELECTED BUNO
 * CONFIG DIFFERENCES--SELECTED BUNO VS BASELING--RQD TDS
 * TD NIC & PAST RECISSION DATE BY SEL BUNO
 * TCR TDS NOT INC BY SEL BUNO
 * TD NIC BY SEL COMPLIANCE RQMT & SEL BUNO
 * SEL TD NOT INC BY SEL SQUADRON
 * TDS NOT INC WITHIN SEL SQUADRON (BUNO)

TABLE 6.2 (CONTINUED)

- * TDS NOT INC WITHIN SEL SQUADRON (MATRIX)
- * CONFIG DIFFS--WITHIN SEL SQUADRON--REQD TDS (MATRIX)
- * CONFIG DIFFERENCES--SELECTED SQDN VS BASELINE--RQD TDS
- * TDS NIC & PAST RECISSION DATE BY SEL SQUADRON
- * TCR TDS NOT INC BY SEL SQUADRON
- * SEL TD NOT INC BY SEL LOCATION
- * TDS NOT INC BY SEL LOCATION (BUNO)
- * TDS NOT INC WITHIN SEL LOCATION (MATRIX)
- * CONFIG DIFFS--WITHIN SEL LOCATION--REQD TDS (MATRIX)
- * TDS NIC & PAST RECISSION DATE BY SEL LOCATION
- * TCR TDS NOT INC BY SEL LOCATION
- * SEL TD NOT INC BY SEL SHOP NOS
- * TDS NOT INC WITHIN SEL SHO NOS (MATRIX)
- * TDS NIC & PAST RECISSION DATE BY SEL SHOP NOS

The CMIS system is an excellent configuration management tool for use at the functional wing or type commander level. It provides improved accuracy over the TDSA system and its counterpart, NALDA. This is reflected in Table 6.3 which provides CMIS system accuracy figures as reported by Grumman Aerospace. Because CMIS does not depend on the Maintenance Data Collection System for input data, it tends to be fifteen to thirty days more current than TDSA or NALDA.

The CMIS outputs are very readable and display ample information in a relatively small space. A sample output is provided in Figure 6.3. The number of formatted reports offered is large and varied enough to accommodate nearly all information requirements. The system has been successfully used at the Commander, Naval Air Force, U.S. Pacific Fleet Fighter Class Desk (type commander) to monitor and schedule F-14 depot maintenance and deployment requirements up to five years in advance. CMIS successfully aggregates the configuration information required by mid- and upper-level managers for making aircraft assignment and technical directive incorporation decisions.

On the other hand, CMIS has the capability of monitoring only those changes physically incorporated in the basic airframe (airframe changes). It cannot track avionics changes to weapon replaceable assemblies, powerplant changes to engines or aircrew system changes (e.g. ejection seats). CMIS is not designed to interface with NALDA or NALCOMIS, and it is currently available for only Grumman products. It creates a

TABLE 6.3 CMIS DATA BASE AND CONTENT [Ref. 21]

FIELD	PERCENT OF DATA INPUT	ACCURACY OF INPUT DATA
ECP Number	100	100
ECP Type	100	100
ACD Number	100	100
TD Number	90	100
TD Category	100	75
TD Issued	100	90
Title	100	75
Usage Code	100	100
ECP Requested	100	100
ECP Submitted	100	100
ECP Planned/Actual FY Funding	100	100
ECP Proposed Effectivity	100	100
ECP Proposed Authorizarion Data	100	100
ACCB	100	100
Production Authorization	100	100
PRB Number	100	100
First Production A/C	100	100
Production Effectivity	100	100
Block	100	100
Retrofit Authorization	100	100
First (Earliest) Retrofit A/C	95	90
Retrofit Effectivity	100	90
Pre DD-250 TD Incorporation A/C	100	100
Kits Required	100	100
Kits Ordered	100	100
Projected TD Issuance Date	100	100
Start TD Validation	100	100
Complete TD Validation	100	100
Start TD Verification	100	100
Complete TD Verification	100	100
Scheduled TD Issuance	100	100
Submittal of TD to NATSF	100	100
TD Issuance Date	100	100
TD Rescission Date	100	100
TD Compliance Requirement	25	100
Last Event Code	100	100
Last Event Date	100	100
Next Event Code	100	100
Next Event Date	100	100

TABLE 6.3 (Continued)

FIELD	PERCENT OF DATA INPUT	ACCURACY OF INPUT DATA
Text (Description)	10	100
- Associated Changes	10	100
- Remarks	10	100
- Kit ID Numbers	10	100
- Other	0	0
WRA Part Number	10	100
Retrofit Plan	100	100
Maintenance Level	100	90
Installation Manhours	100	90
System Impacted	100	90
Mean Flight Hours Between Failure Delta	100	100
Maintenance Manhours per Flight Hour Delta	100	100
Major Category of Change (Reliability, Performance)	100	100
Rank Within Category	100	100
Deconfigurable Change	50	25
SDLM 1 Change	100	100
SDLM 2 Change	100	100
Tech Problem Review Item	100	100
Remarks	100	100
Production A/C INC/NINC	100	100
Retrofit A/C INC/NINC	100	100
Not Incorporated Total	100	100
Complete/Disapproved	100	100
A/C Bureau Numbers	100	100
A/C Shop Numbers	100	100
Squadron Assignment	100	100
Site Location	100	100
Carrier Location	100	100
WRA Change Incorporation Status	0	0

*** TD'S NIC & PAST RECIBSION DATE BY BEL LOCATION ***

T	C	TECH DIR	S	ECP	T	Y	TITLE	LOCATION	NDT	INCORPORATED	NEXT	EVENT	RETR	M	IMS	REMARKS
K	AAC	407A1	3	373	D		CONVEYOR ELEMENTS-HINGE PIN	JFK			RD	12/31/80	D	14		
									159009	159010	159013	RD				
									159017	159018	159019					
									159021	159024	159025					
									159421	159422	159434					
									159437	159449	159454					
									159610							
L	ACC	404	3	494	V		REPLACE SEAT DISCONNECTS	JFK			RD		OHL	D	4	MARF TD
									159009	159010	159013	RD				
									159017	159018	159019					
									159021	159024	159025					
									159421	159422	159434					
									159437	159449	159454					
									159610							
K	AFC	557	3	490	D		INERTIAL MEASUREMENT UNIT	JFK			RD		RAM	D	7	RAMEC L-8
									159009	159010	159013	RD	12/31/81	RAM	0	3
									159017	159018	159019					
									159021	159024	159025					
									159421	159422	159434					
									159437	159449	159454					
									159610	161147	161149					
									161150	161155						
K	AFC	619	3				AICB INLET RAMP MARKINGS	JFK			RD	06/30/78	SDL	I	14	
									159009							
J	AUC	1714	3	439	C		VDIO CONV PWR TRANS FIX	JFK			RD		SDL	D	42	ALT RETRO
									159009	159010	159013	RD				
									159017	159018	159019					
									159021	159024	159025					
									159421	159422	159434					
									159437	159449	159454					
									159610							

FIGURE 6.3 SAMPLE CMIS OUTPUT [REF. 21]

duplicate configuration status accounting data base which must be maintained and verified against the TDSA data base. At the present time, the maintenance of that data base is done by Grumman Aerospace through a contract with the Navy. This arrangement fails to provide a timely method for collecting data from and supporting deployed squadrons and carrier air wing staffs, since telenet is not available to deployed carrier based units.

CMIS is an effective contractor-developed, contractor-run system that is valuable to Navy managers. However, in order to fully benefit from CMIS, the Navy must develop the capability to maintain and update the system within its own configuration management information system structure.

D. ENGINE COMPOSITION TRACKING SYSTEM (ECOMTRAK)

Engine management presents numerous unique configuration related problems. For instance during engine build-up, following rework or repair, engine life-limited components must be matched with other components having similar "life remaining" in order to optimize overall engine service life. Additionally, all components installed must be matched for configuration compatibility. All applicable unincorporated technical directives must be identified and incorporated during each overhaul or repair, as it is not economically or operationally sound to remove engines from operational or nonoperational aircraft solely for technical directive incorporation.

In many cases the incorporation of a technical directive alters a component's "service life remaining" which in turn might alter the engine's service life. Finally, engine components are tracked by their assigned serial numbers and by the engine serial number in which they are installed. On most jet engines, the serial number plate is attached to the main gear box. If this gear box is replaced and the serial number plate is not switched (a common occurrence), the configuration status information of the installed engine components can become quickly confused or invalid.

Because the NAVAIR Maintenance Material Management system, of which the TDSA system is a part, does not manage these complex problems, the Engine Analytical Maintenance Program was developed to identify those actions required to develop and maintain engine composition/configuration tracking. Additionally it identifies those engine management functions to be performed to support reliability centered maintenance. In conjunction with the Engine Analytical Maintenance Program, the Automated Engine Composition Tracking System (ECOMTRAK) is being developed to provide on-line information necessary to manage aircraft engine configuration and maintenance.

When implemented, ECOMTRAK is planned to be fully compatible with NALCOMIS and will extract all input data from the Maintenance Data Collection System of the Maintenance Material Management System. The implementation of ECOMTRAK for each specific engine requires the performance of the following

sequential events by aircraft engine support and management activity commands:

- | | |
|------------|--|
| Phase I | Selection of items to be tracked |
| Phase II | Tracked item data input |
| Phase III | Engine composition data collection and input and ECOMTRAK file maintenance |
| Phase IIIA | Depot implementation |
| Phase IV | Engine asset management |

The ECOMTRAK System is currently being developed and maintained by NAVAIR through contractor support. When fully implemented and properly maintained, ECOMTRAK will provide real time engine management information for use as follows:

1. To project spare part support requirements
2. To forecast intermediate and depot engine workload
3. To establish depth and scope of engine repair
4. To assist fleet operators with management of component life limits
5. To assist in establishment of fixed allowance lists
6. To determine the impact of technical directives
7. To determine the impact of component life limits

None of the above tasks can be effectively accomplished without the availability of up-to-date, accurate comprehensive engine configuration information.

Within ECOMTRAK, reliability-centered maintenance analysis logic is used to determine which components to track. Other items being scheduled for tracking include high value, long

procurement lead time items and items with technical directive or configuration impact. Both repairable and consumable items are being identified for tracking by the application of Military Standard 266 Reliability Centered Maintenance logic.

Data sources being utilized for ECOMTRAK file construction include maintenance plans, illustrated parts breakdowns, technical directives, engineering change proposals, local instructions, engine logbooks and planned maintenance requirements for each specific type/model/series engine. After initial data entry, data base maintenance is accomplished at the organizational and intermediate levels by continuous entry of maintenance actions (including technical directive incorporation), flight activity data, custody change data and depot maintenance data. A visual representation of the update process is depicted in Figure 6.4.

Unlike most of the existing configuration management programs in the Navy, ECOMTRAK is not a stand alone system. It has been designed to interface directly with the TDSA system and NALDA and is completely compatible with NALCOMIS. When fully implemented, ECOMTRAK is designed to:

1. Track all engine parts by serial number providing location and condition
2. Generate reports that provide data on available parts for best match engine build-up
3. Automate engine build-up data collection

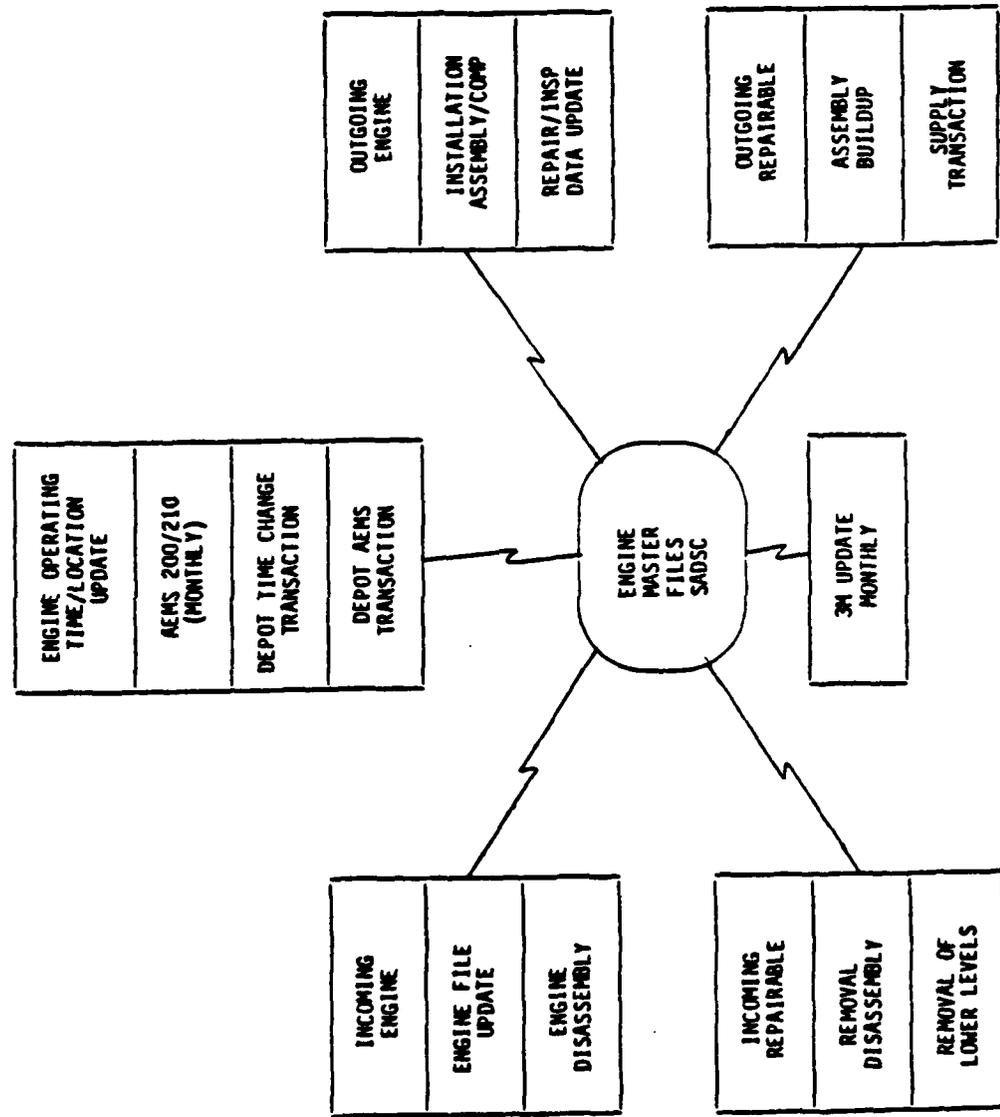


FIGURE 6.4 ENGINE MASTER FILE UPDATE

4. Automatically screen all data for correct application
5. Automatically produce all engine logbook records
6. Automatically update the TDSA engine data bank
7. Provide current technical directive Lists 02 and 04
for each processed engine
8. Produce a scrap parts file
9. Automate parts ordering
10. Produce preformatted reports identified in Table 6.4.

TABLE 6.4 ECOMTRAK REPORTS

* ENGINE REPORTS

- * Engine Status Report
- * Critical Components Tracking Report
- * Engine Associated Critical Component Status Report
- * Engine Hard Time Report
- * Fleet Component Rejections Projected Report

Although ECOMTRAK is still in the development phase, it has the potential to significantly enhance engine configuration management by providing engine/component serial number tracking. With the advent of ECOMTRAK, all of the required data on any given engine will be available in an accurate, accessible format at the management level where it is required.

E. PORTABLE LOGISTIC SYSTEM (PLS)

The Portable Logistic System (PLS) is a Commander, Naval Air Force, U.S. Atlantic Fleet (CNAL) initiative designed to provide an improved aircraft maintenance management information system at the squadron level. It is a functional extension of and logical outgrowth from several existing automated systems--the Aviation Training Support System, the Resource, Configuration and Scheduling Subsystem and the Comprehensive Asset Management System [Ref. 22]. The Aviation Training Support System, which is designed and installed as a dedicated training system, contains a subsystem defined as Resource, Configuration and Scheduling which was designed to match aircrew and syllabus training assignments with a correctly configured aircraft. The Comprehensive Asset Management System was developed from the Resource, Configuration and Scheduling subsystem to maintain configuration data on and status of aircraft, engines and other selected aeronautical equipment.

PLS is designed to be a distributed processing system within functional/carrier air wing organizations. At each geographic location, both ashore and afloat, PLS provides communication facilities for remote data entry and data query. Squadrons communicate via cable/fiberoptics with colocated functional/carrier air wings. Although PLS provides for remote access capability by higher level managers such as Commander, Naval Air Force, U.S. Atlantic Fleet when both activities are shore-based, communication between ashore and afloat units is restricted.

The distributed PLS system is configured with minicomputer central processing units, mass storage and input/output devices. A typical squadron allocation of hardware is depicted in Table 6.5, and a typical functional wing and carrier airwing hardware allocation is tabulated in Table 6.6.

Each squadron system supports the functional requirements of squadron users. Certain data are provided on a routine basis to the functional wing system ashore or carrier airwing system afloat depending on squadron location. The wings then exchange data between carrier and shore location for updating specific aircraft and personnel training data bases. This distributed design concept is depicted in Figure 6.5. PLS fundamentally uses a two level hierarchical design configuration. The design is hierarchical in that data is originated at the squadron and relayed to the wing system for the purpose of data backup and information exchange. The distributed feature of PLS allows squadron systems to function even in the event of a functional/carrier air wing system failure.

Because PLS is not compatible with NALCOMIS, its expected life will depend on NALCOMIS implementation. PLS will be terminated when NALCOMIS becomes operational at each PLS site. Although not specifically planned within the PLS concept, data can be supplied directly to systems such as TDSA or the Engine Analytical Maintenance Program.

TABLE 6.5 PLS SQUADRON HARDWARE ALLOCATION

<u>QUANTITY</u>	<u>DESCRIPTION</u>
1	PDP 11/23 CPU, 256 KB Memory 1 MB Floppy Disk
8	Serial Communication Ports
1	27 MB Winchester Disk Drive and Controller
2	Hard Copy Terminals
2	CRT Terminals
1	Uninterruptable Power Supply

TABLE 6.6 FUNCTIONAL/CARRIER AIRWING HARDWARE ALLOCATION

<u>QUANTITY</u>	<u>DESCRIPTION</u>
1	PDP 11/23 CPU, 256 KB Line Clock 1 MB Floppy Disk
16	Serial Communication Ports
1	134 MB Winchester Disk Drive and Controller
8	Optical Link Drivers
4	Hard Copy Terminals
4	CRT Terminals
1	Magnetic Tape Drive and Controller
1	Uninterruptable Power Supply
1	300 LPM Printer and Controller

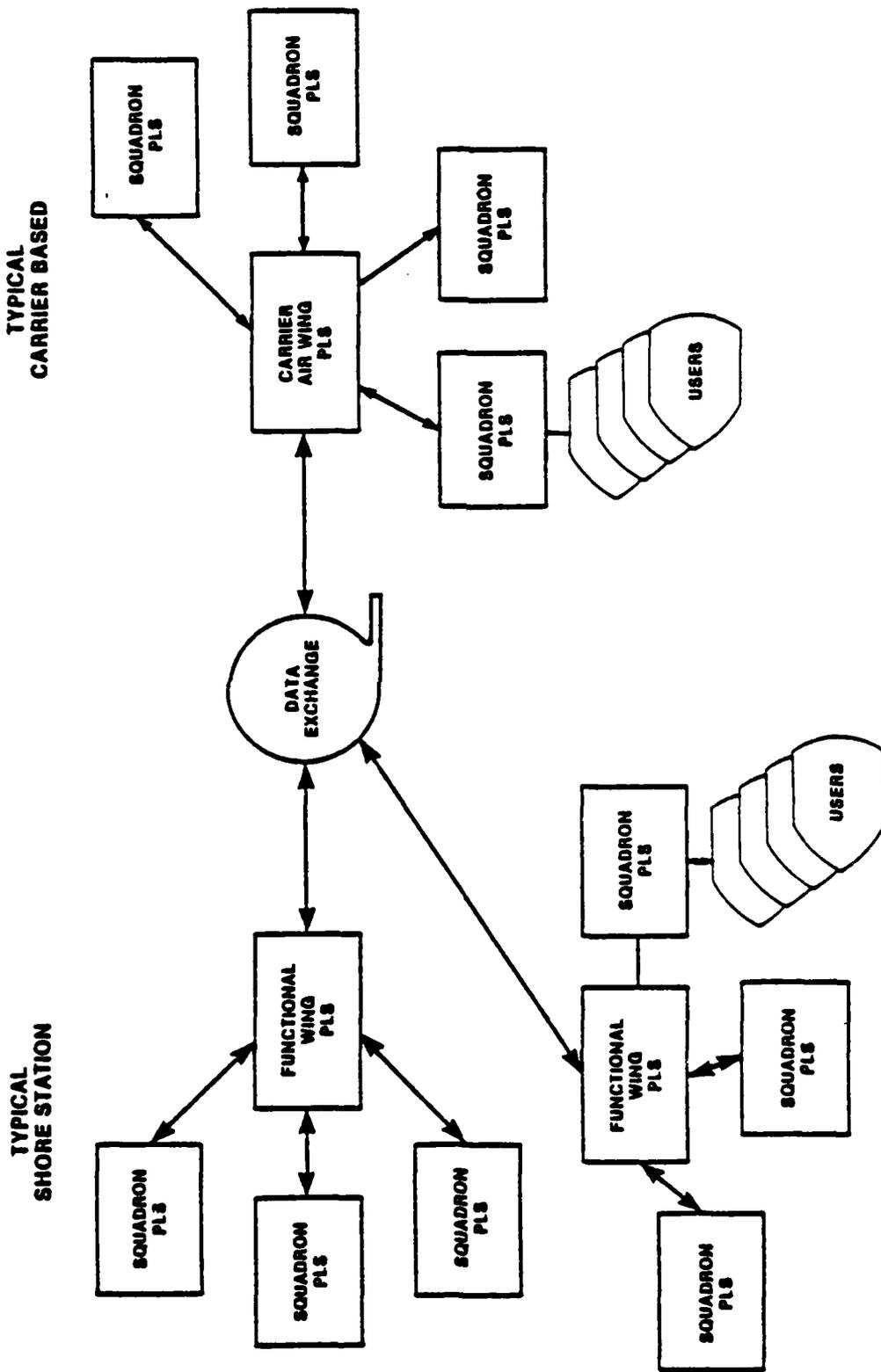
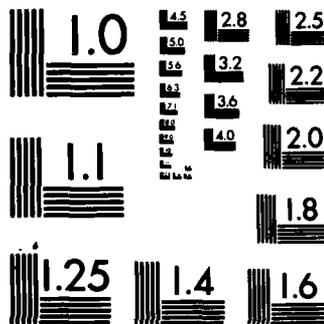


FIGURE 6.5 DISTRIBUTED PLS (REF. 22)



MICROCOPY RESOLUTION TEST CHART
 NATIONAL BUREAU OF STANDARDS-1963-A

Input data to PLS include: the Naval Aircraft Flight Record (OPNAV 3700/2), X-Ray (OPNAV 5442-1), Engine Transaction Report, Visual Information Display System/Maintenance Action Form, Aircrew Debrief Forms and Personnel Record Forms. As indicated in Figure 6.6, these inputs will automatically produce historical files and the following standard outputs: Technical Directive Catalog, Technical Directive Incorporation Status Report, Aircraft Transaction X-Ray Message, Engine Transaction Report Message, End of Operating Quarter Report, Aircraft Accounting Record, Record "A" Report, Daily Flight Time Report, Personnel Summaries and Aircrew Training Status.

The technical directive catalog output of the PLS system is produced automatically at the end of each month or upon query. This report summarizes all of the significant data contained in the technical directive source document (Visual Information Display System/Maintenance Action Form). Additionally, it specifically describes the status and effectivity of each technical directive issued for each type of aircraft, engine or aeronautical equipment. The Configured Item Status output of the PLS system is generated daily, upon query, or as directed. It is specifically designed to provide the maintenance manager with real time information regarding configuration impacts and removal schedules. This report contains status information on each individual serialized component installed in assigned aircraft and engines. The Technical

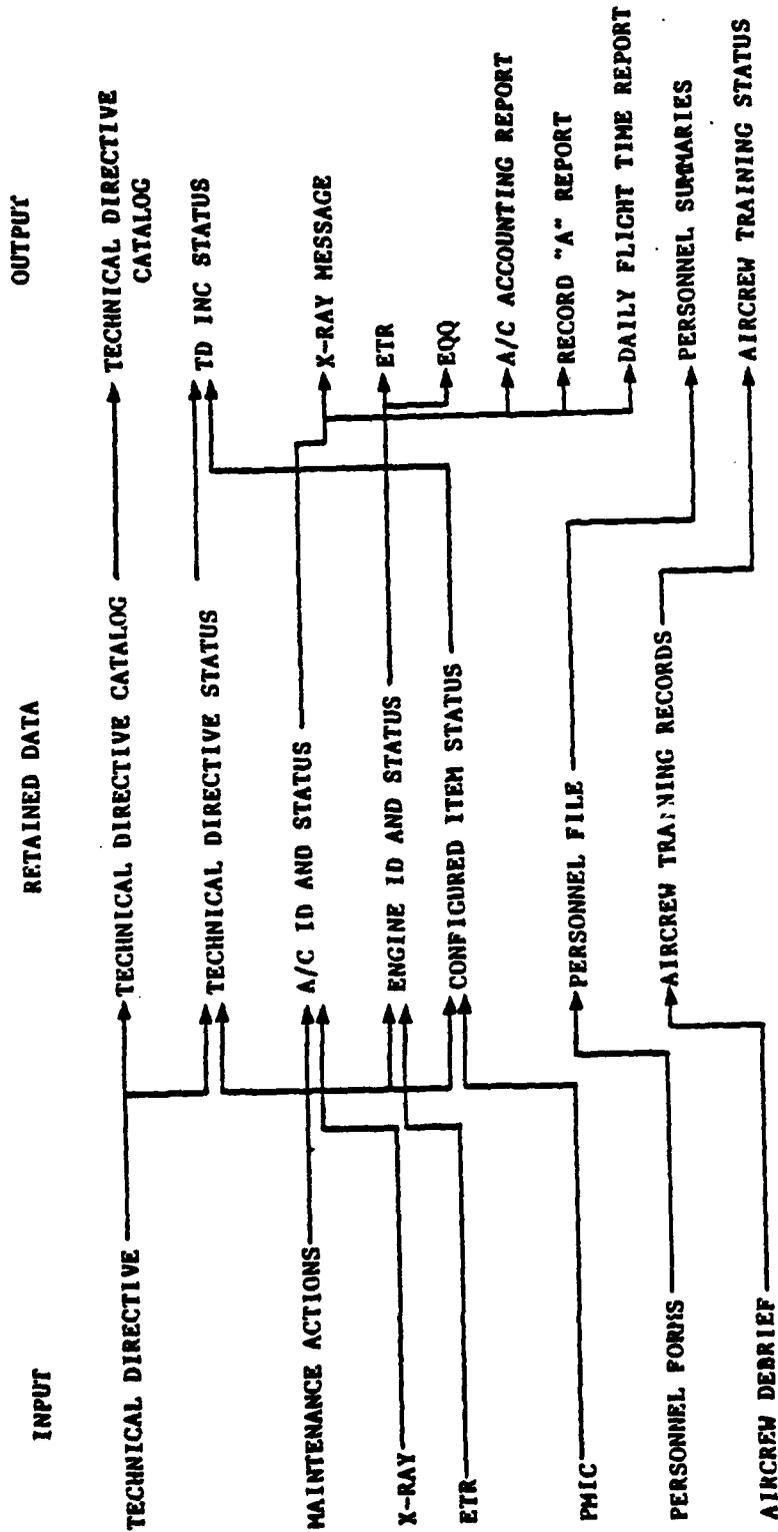


FIGURE 6.6 SYSTEM WORKLOAD SUMMARY (REF. 22)

Directive Incorporation Status output is produced monthly or upon query. It provides a summary of the status of incorporated/not incorporated technical directives in each assigned aircraft or engine. This output can be utilized to verify the TDSA Lists 02 and 04 on a real time basis. Although additional PLS outputs provide significant management information, they are not directly related to configuration status accounting and are therefore not discussed in this thesis.

One advantage to organizational level management is that PLS is a bottom-up system. It was designed at the working level which is in sharp contrast to most other systems, including NALCOMIS, which have been designed from the top down. It is the authors' opinion that top-down systems are frequently designed around reporting requirements rather than around organizational level management information needs. PLS provides both real-time configuration management information and summary data formatted to meet higher level information and report requirements.

PLS is capable of maintaining configuration status accounting data only on technical directives physically incorporated and documented by the reporting custodian (squadron). Although PLS provides serial number component control, it is deficient as a result of its inability to track technical directives incorporated in avionics, engines or other aeronautical equipment by intermediate or depot activities.

The fact that PLS is neither a NAVAIR-wide system nor interactive with the NAVAIR prescribed systems is a major drawback. Specifically in the area of configuration status accounting, PLS does nothing more than duplicate and compile the data currently available in the Maintenance Data Collection System. Because PLS data entry requires transcription of the manually originated maintenance data entry form (Visual Information Display System/Maintenance Action Form), the level of system accuracy will not be significantly improved. However, the information will be more current, as data entry is done at the squadron level, rather than at a remotely located data processing facility.

F. SUMMARY

In this chapter four of the many independently developed configuration status accounting/maintenance management information systems have been reviewed. VAMP was specifically developed for use at the intermediate level of maintenance to manage only VAST supported avionics components. CMIS, developed by Grumman Aerospace, applies to only F-14 aircraft specific modifications accomplished at either the organizational or depot levels of maintenance. PLS, a CNAL initiative, is being developed to provide improved maintenance management/configuration status accounting information at the organizational and functional/carrier air wing levels. With regard to configuration documentation, PLS only accounts for modifications

incorporated at the organizational and depot levels of maintenance. ECOMTRAK is being implemented to provide on-line information necessary to manage engine configuration and maintenance at the organizational, intermediate and depot levels.

Of these four systems, only VAMP and ECOMTRAK are designed to be compatible with NALCOMIS and NALDA. CMIS and PLS, although valuable tools, duplicate TDSA and each other. All four systems reviewed in this work duplicate the data entry requirements of the TDSA System. With the exception of ECOMTRAK, none of the systems are designed to support serial number tracking of components as they migrate through the three levels of maintenance. Additionally CMIS and PLS do not track the configuration status of aircraft installed engines, weapon replaceable assemblies and ejection seats.

The major advantages all four systems have over the TDSA and NALDA systems are improved accuracy, timeliness and accessibility of maintenance management information necessary to support the aviation maintenance effort. The major disadvantage of local systems in general is the lack of NAVAIR system standardization and integration. Consequently, logistic support based on the information provided by these systems is less than optimum.

VII. NAVAL AVIATION LOGISTICS COMMAND MANAGEMENT
INFORMATION SYSTEM (NALCOMIS)--THE FUTURE

A. HISTORY

The proliferation, redundancy and inconsistency of existing management information systems has been a topic of concern in the Navy for several years. Rapidly advancing technology has greatly increased the complexity of Naval aircraft and the number of actions required to maintain them. As a result, the volume of information needed to forecast, schedule, monitor and report maintenance actions has also increased. The Naval Aviation Maintenance and Material Management System was devised and implemented in 1965 to collect and process this information. Constrained by the automated data processing technology of the time, it is only a partially automated system. Data is originated manually and then later keypunched into a computer. The increased volume of transactions and the transition from manual collection and input to automated compilation and storage has introduced problems that open the system to skepticism and distrust by the users.

In an attempt to improve carrier aircraft readiness, the Chief of Naval Operations established in 1970 the Carrier Aircraft Maintenance Support Improvement (CAMSI) Project. With regard to shipboard aircraft maintenance and support management, the CAMSI findings indicated that an acceptable level of efficiency could be obtained in the most practical and cost effective

manner through the improved use of automated data processing equipment [Ref. 23].

In response to the CAMSI findings, NAVAIR and the Naval Supply Systems Command initiated a joint project in 1972 titled Shipboard Aviation Command Management Information System (SACOMIS). The purpose of the SACOMIS project was to design and develop an automated management information system, and the SACOMIS Automated Data Systems plan concept was approved by the Chief of Naval Operations in 1974. Also in that year, the Chief of Naval Operations directed that SACOMIS additionally include Naval Air Stations, Marine Corps Air Stations, Marine Aircraft Groups, Helicopter Aircraft Carriers and Helicopter Assault Aircraft Carriers. At this time the title of the program was changed from SACOMIS to NALCOMIS. Thus, what started as a carrier aircraft specific project was expanded to include all of Naval and Marine Corps aircraft. It is intended to be an effective, real time, automated, user-oriented system for aviation maintenance and logistic support personnel. Its purpose is "to improve operational readiness of Navy and Marine Corps aviation units through improvements, via automation, of aircraft maintenance and supply management effectiveness." [Ref. 15]

NALCOMIS is being developed using a modular approach with the Module I Automated Data Systems Plan submitted in October 1976. This module was certified in 1977 and applied to only

the Organizational Maintenance Activity (OMA), Intermediate Maintenance Activity (IMA) and Supply Support Center (SSC) areas of Naval and Marine Corps aviation. The following discussion of NALCOMIS deals with NALCOMIS Module I.

B. NALCOMIS SYSTEM DESIGN

NALCOMIS was initially designed as a site-oriented centralized system in which each naval air station, aircraft carrier, etc. would have a central processor and a single integrated data base. However, this concept proved to be unsatisfactory for supporting the requirements of Marine Corps and Navy users. Consequently, it was changed to an Independent/Distributive Data Base design. It is currently comprised of three Independent Functional Processes (IFPs), one each for the OMA (IFP-A), IMA (IFP-B) and SSC (IFP-C). The accompanying hardware consists of an independent Remote Peripheral Subsystem Processor located at each OMA and at the IMA. The remote processor of each unit holds the data base unique to that unit. A central processor holds the Common Data Base (data common to or required by all users). There is also a networking provision that allows access for authorized users to data in the distributed data bases and the Common Data Base. Required interfaces to provide data to external systems are being provided for all three IFPs. Interface with the Naval Aviation Maintenance and Material Management System is currently planned.

The change to the Independent/Distributed Data Base design offers several advantages over the original centralized design with regard to satisfying the needs of the users. It allows the system to be implemented on a squadron-by-squadron basis without interfering with deployment schedules and other requirements. With each unit possessing its own remote processor and storing its own data base, the response time from the system is optimized. The distributed remote processors allow units to deploy and still retain their automated organizational level capability, a critical requirement for Navy and Marine Corps units. Failure of one component of the system does not render the entire system unusable. This would not have been possible under the central processor concept.

C. NALCOMIS PROVISIONS FOR CONFIGURATION STATUS ACCOUNTING

In general, NALCOMIS automates the manual Visual Information Display System/Maintenance Action Form which is currently used for recording, controlling and monitoring aircraft maintenance. It also collects, processes and stores flight activity data and personnel management data. In addition, IFP-B (IMA) provides repairables management capabilities and IFP-C (SSC) includes repairables management and requisition processing functions. All IFPs include a Configuration Status Accounting Subsystem. To date, IFP-A (OMA) is the only Independent Functional Process completed, and it is being tested at one Naval Air Station and one Marine Corps Air Station. Consequently

the documentation for IFP-A Configuration Status Accounting Subsystem is more concise and detailed than that for either IFP-B or IFP-C.

1. IFP-A

The Configuration Status Accounting Subsystem of IFP-A provides:

...those functions required to establish the aircraft configuration record and to maintain configuration of the engines and components that make up aircraft or Support Equipment (SE) and will include capability for serial number tracking and Technical Directive (TD) management. [Ref. 24]

Those configuration items that require serial number tracking as directed by higher authority can be accommodated under IFP-A. In addition, each command may select and track additional items through this subsystem.

The three main divisions of this subsystem are Engine Configuration, Component Configuration and Technical Directive Management. The Engine Configuration section tracks specific engines and/or engine module serial numbers for installed and uninstalled engines. It also maintains aeronautical equipment service record information for engines and engine modules.

The Component Configuration section tracks aircraft, support equipment, and engine components by serial number. If the components are controlled by individual cards in the engine logbook, they are specially flagged, since additional information is required in the NALCOMIS record.

The Technical Directive Management section tracks information relating to technical directives for aircraft, support equipment, engines or components. It indicates applicable technical directives for specific bureau and/or serial numbers and the technical directive incorporation status. Upon technical directive incorporation, a notice is printed for maintenance control to make the required logbook entries.

Data for this subsystem is initially established through a manual configuration update menu. Actual aircraft configuration, current technical directive applicability, engine configuration, engine installation status, and component configuration are initially entered through this option. Additionally, this option is used to add or delete records or aircraft/engines/components that are received or transferred.

There is also a provision for an automated configuration update. This portion of the subsystem interacts with the Maintenance Activity Subsystem (automated Visual Information Display System/Maintenance Action Form) to automatically update established configuration records. This automated update occurs when maintenance actions affecting configuration are performed, such as technical directive incorporation or equipment installation and removal. The automated configuration update encompasses engines, engine components, aircraft and support equipment. In addition, the technical directive update section provides a notice to maintenance control if the incorporation of a technical directive requires a part number change.

Also included in the Configuration Status Accounting Subsystem of IFP-A is a configuration interchangeability/compatibility section. For components whose configuration is maintained through this subsystem, a listing of those components which may or may not be interchangeable can be manually recorded by Federal Supply Code or Manufacturer/Part Number.

Configuration information may be retrieved in the form of inquiries and reports. The inquiries available are:

1. Engine Serial Number Location
2. Component Configuration Location
3. Technical Directives
4. Interchangeability/Compatibility

The first two options provide location information for specific engine or component serial numbers, i.e. where an engine or component is installed. This information may also be obtained for all engines assigned to an organization. The Technical Directive inquiry gives technical directive information for a specific technical directive code and a specific aircraft/engine/component. The fourth inquiry lists interchangeability/compatibility information for a specific Federal Supply Code or Manufacturer/Part Number.

The hard copy reports available are as follows:

1. Aircraft Configuration (including engines and components) for a specific type/model/series or bureau number or for all aircraft within a squadron

2. Engine Configuration (including modules and components) for a specific type/model/series or serial number or for all engines held by a squadron

3. Technical Directive Configuration for a given technical directive code and number. This report lists the technical directive's applicability to squadron held items and whether or not the technical directive has been incorporated in those items

4. Component Location of a specific Federal Supply Code or Manufacturer/Part Number for the bureau number plus any interchangeable parts listed for that number

The IFP-A Configuration Status Accounting Subsystem concept established a preferred configuration for each aircraft, engine and component. The actual configuration for a particular aircraft, engine and/or component can then be compared to its preferred configuration and discrepancies reported. The preferred or optimum configuration profiles are created, revised, or deleted in the Manual Configuration Update portion of the subsystem.

2. IFP-B and IFP-C

As stated above, the IFP-B and IFP-C portions of NALCOMIS are not complete, and the documentation concerning the Configuration Status Accounting capabilities is not yet detailed. In general, the IFP-B is intended to have the IFP-A capabilities for engines, components and support equipment as well as the ability to track technical directives. The IFP-C is intended

to have only the inquiry and report generating capability for Configuration Status Accounting and only when the IFP-A and IFP-B functions are available.

D. CONFIGURATION STATUS ACCOUNTING IMPROVEMENTS

NALCOMIS offers many improvements to the current configuration status accounting system. It gives the organizational and intermediate maintenance levels a real-time interactive management information system for monitoring actual aircraft/engine/support equipment configuration and technical directive incorporation status. When provided with upline reporting capability through the Naval Aviation Maintenance and Material Management System interface, NALCOMIS in conjunction with NALDA corrects many of the problems that invite criticism of the current system.

Data accuracy within NALCOMIS is improved for several reasons.

1. Visual Information Display/Maintenance Action Forms are no longer hand written, and their transcription via key punch is no longer required.

2. The data within each remote processor is self verified and updated. Therefore, incompatible maintenance action information can not be entered. Once current data is entered in one area it is updated throughout the data base.

3. Fewer individuals originate the information and enter it into the system.

4. Reconciliation of hand written data with machine generated reports is not required.

5. Transactions with missing data (such as technical directive incorporation manhours) are not accepted.

6. Misplaced and lost configuration lists are not a problem, as new lists can be generated as needed.

It is anticipated that there will be improved standardization of all configuration information, especially across functional wings, type commands and carrier air wings. The depth and organization of configuration data is consistent, allowing mid-level and upper-level managers to make comparisons and compilations. Serial number tracking of components, which is presently done manually through a varying number of local systems (if it is done at all), is performed in a structured and manageable form.

Management of technical directive change kits is greatly improved. Kit managers have access to more up-to-date, complete information concerning kit requirements, issue and incorporation. This in turn gives them more control over kit procurement, redistribution, cannibalization and disposal.

Significant improvements can be expected in aircraft/engine/support equipment performance and safety as the system develops. An improved management information system results in more accurate weight and balance data. The movement of components from one aircraft or engine to another can be more accurately tracked. With up-to-date, accurate information

there is less chance of installing incompatible components. Technical directive change requirements are more readily identifiable, allowing units to take advantage of the safety and performance improvements which were the bases for the changes. As a result, technical directive incorporation brings about improved design, stability, control and mission capability.

Implementation of NALCOMIS is expected to improve the logistic supportability of the aircraft and supporting equipment. If the configuration of these items can be accurately ascertained, spare parts and material support can be better planned and implemented. This in turn allows the proper provisioning in both the range and depth of spare parts required and identifies those parts that may be purged to open up needed storage space and reduce inventory holding costs. In addition, maintenance technician training can be correctly scheduled based on the actual equipment to be supported. Improved provisioning and training contributes to the improved safety and performance discussed above.

E. CONFIGURATION STATUS ACCOUNTING DEFICIENCIES

Even with the improvements NALCOMIS brings to configuration status accounting, some problem areas will remain. For example, logbook entries will still be accomplished manually with the resulting possibilities for errors. Consequently, the requirement for verification between the logbook entries and the configuration information held by NALCOMIS will still exist. A

provision for an automatically printed logbook page would greatly enhance the system.

There is not at present an Independent Functional Process planned for use at the functional wing, type commander or carrier airwing staff levels. As the distributed system is currently designed, configuration information across an airwing would be obtained from each squadron remote processor and manually aggregated. A staff level process for extracting and sorting this information is required to convey the data to upper management levels. In addition, staffs require a long range configuration planning capability, such as that currently used in conjunction with the Grumman Configuration Management Information System. NALCOMIS contains information about aircraft that is essential for planning overhaul and deployment assignments. Such information should be made available to those managers who are making these decisions.

The distributed system allows an air station or carrier to continue operation in the event of a remote processor failure. However, backup capability for a squadron should its remote processor fail must be addressed. It is unacceptable for maintenance operations to be halted for even short periods due to the inaccessibility of the information held by NALCOMIS, and manual backup would systems only defeat the purpose of NALCOMIS. Redundant hardware and spare components should be provided within NALCOMIS (especially in remote location) to

allow units to continue operation while inoperative hardware is being repaired.

At the present time, NALDA provides information on only airframe and engine technical directive changes. This capability must be expanded to include other changes such as avionics, aircrew and support equipment.

Finally, the implementation of NALCOMIS must be carefully planned. If the current configuration data base is used in its present form, the system will be inaccurate from the start. Significant time and effort will be required to ensure that technical directive status accounting records are accurate and up to date with regard to the actual configuration of the aircraft.

VIII. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

Based on configuration status accounting research conducted for this thesis, the following conclusions are made:

1. The existing TDSA and NALDA systems lack the means to identify, collect, sort, collate and communicate configuration status accounting data in a timely and accurate manner.

2. Local systems developed as a result of budgetary limitations and TDSA/NALDA system deficiencies provide significantly improved configuration status accounting information but only for their specific application.

3. The proliferation of locally developed systems lack overall coordination, integration and standardization. On the whole this decreases NAVAIR logistic support and maintenance management effectiveness.

4. NALCOMIS, with modification, has the potential to satisfy NAVAIR configuration status accounting management information needs.

B. RECOMMENDATIONS

Based on the above conclusions, the following recommendations are made:

1. Expedite, to the maximum extent possible, development and full implementation of NALCOMIS. Additionally, include

within NALCOMIS provisions for upline reporting to functional wings, carrier air wings and type commanders.

2. Develop as a basic aviation maintenance data collection goal, one-time entry of each data element for use by all aircraft maintenance management information systems.

3. Expand NALDA to include all technical directive change categories and comprehensive component serial number tracking. Provide additional NALDA terminals at all user sites. As an interim measure, improve TDSA timeliness by increasing the distribution frequency of Lists 02 and 04.

4. Authorize the continued operation of all existing local systems, restricting investment in system improvement, until NALCOMIS has been implemented fully.

5. Develop a NAVAIR committee to review and approve emergent and existing management information systems to ensure integration with NALCOMIS.

6. Initiate action to improve the accuracy of the TDSA/NALDA data base by a) reducing errors during Visual Information Display/Maintenance Action Form transcription and b) enforcing depot level technical directive verifications conducted during rework.

7. Increase the utilization of ECOMTRAK and VAMP to cover all intermediate and depot avionics and engine types.

APPENDIX A
ACRONYMS LIST

AIMSO	Aircraft Intermediate Maintenance Support Office
CAMSI	Carrier Aircraft Maintenance Support Improvement
CI	Configuration Item
CMC	Commandant of the Marine Corps
CMIS	Configuration Management Information System
CNAL	Commander, Naval Air Force, U.S. Atlantic Fleet
CNAP	Commander, Naval Air Force, U.S. Pacific Fleet
DOD	Department of Defense
ECOMTRAK	Engine Composition Tracking
I	Intermediate Maintenance Level
IFP	Independent Functional Process
ILS	Integrated Logistics Support
IMA	Intermediate Maintenance Activity
MAG	Marine Air Group
NALC	Naval Aviation Logistics Command
NALCOMIS	Naval Aviation Logistics Command Management Information System
NALDA	Naval Aviation Logistic Data Analysis
NAVAIR	Naval Air Systems Command
NAVMAT	Naval Material Command
NAVMATINST	Naval Material Command Instruction
NAVSUP	Naval Supply Systems Command
O	Organizational Maintenance Level

OMA	Organized Maintenance Activity
OPNAV	Chief of Naval Operations
PLS	Portable Logistics Support
SACOMIS	Shipboard Aviation Command Management Information System
SRA	Shop Replaceable Assembly
SSC	Supply Support Center
TDSA	Technical Directive Status Accounting
TYCOM	Type Commander
VAMP	VAST Automated Management Program
VAST	Versatile Avionics Shop Test
WRA	Weapon Replaceable Assembly

APPENDIX B
GLOSSARY

1. AVIATION MAINTENANCE AND MATERIAL MANAGEMENT SYSTEM (3-M): A subsystem of the Naval Aviation Maintenance Program designed for the purpose of providing maintenance data collection, manhour accounting and aircraft accounting.
2. ALLOCATED BASELINE: The formally designated allocated configuration identification fixed as a product of the demonstration and validation phase of the life cycle.
3. AUDIT: To inspect records and procedures.
4. BASELINE: An approved reference point for control of future changes to a product's performance, construction and design.
5. CARRIER AIR WING: The staff directly responsible for providing operational, maintenance and administrative support to all assigned squadrons located onboard the same aircraft carrier.
6. CHANGE: Within the context of configuration control, a formally recognized revision to a specified and documented Navy material requirement. Includes design changes, engineering changes, field changes, technical directive changes, changes in specifications or other related requirements.
7. CHANGE IDENTIFICATION NUMBER: A number assigned to a data package defining an equipment engineering change. It is used to control, sequence and account for production, implementation, and retrofit actions relating to the change.
8. COMPONENT: A part, subassembly, assembly or combination of these items joined together to perform a function.
9. CONFIGURATION: The functional and/or physical characteristics of hardware/software as set forth in technical documentation and achieved in a product.
10. CONFIGURATION ITEM (CI): An aggregation of hardware/software, or any of its discrete portions, which satisfies an end use function and is designated by the Government for configuration management. CIs may vary widely in complexity, size, and type, from an aircraft, electronic

or ship system to a test meter or round of ammunition. During development and initial production, CIs are only those specification items that are referenced directly in a contract (or an equivalent in-house agreement). During the operation and maintenance period, any repairable item designated for separate procurement is a configuration item.

11. CONFIGURATION MANAGEMENT: A discipline applying technical and administrative direction and surveillance to (1) identify and document the functional and physical characteristics of a configuration item, (2) control changes to those characteristics, and (3) record and report change processing and the implementation status of approved changes.
12. CONFIGURATION STATUS ACCOUNTING (CSA): The recording and reporting of an approved configuration identification, and the status of proposed changes to the approved configuration and implementation status of approved changes.
13. CONFIGURATION CHANGE: A general term which signifies that the configuration of an item has been or will be changed through the configuration control process.
14. DEPOT LEVEL: The top level of the three levels of maintenance. Generally considered industrial in nature.
15. ENGINEERING CHANGE PROPOSAL: A document that proposes change to a Navy material item in accordance with applicable bulletins, regulations, standards and other directives.
16. EQUIPMENT: An item designed and built to perform a specific function as a self-contained unit or to perform a function in conjunction with other units. It is the same as a product.
17. FUNCTIONAL BASELINE: The functional configuration identification initially approved by the customer.
18. FUNCTIONAL WING: The staff directly responsible for providing operational, maintenance, and administrative support to similar aircraft squadrons located in the same geographic area.
19. INTERFACE: A region common to two or more elements, systems, projects or programs, characterized by mutual physical, functional, and/or procedural properties.

20. INTEGRATED LOGISTIC SUPPORT (ILS): A composite of the elements necessary to assure the effective and economical support of a system or equipment at all levels of maintenance for its programmed life cycle. The elements include all resources necessary to maintain and operate an equipment or weapons system, and are categorized as follows: (1) planned maintenance, (2) logistic support personnel, (3) technical logistic data and information, (4) support equipment, (5) spares and repair parts, (6) facilities, and (7) contract maintenance.
21. INTERMEDIATE LEVEL: The middle level of the three levels of maintenance.
22. KIT: A collection of carefully identified and controlled items used to build a module, printed circuit board, sub-assembly or assembly.
23. LIFE CYCLE: The period covering the design, development, manufacture, operation, maintenance, logistic support and repair of an equipment.
24. MODIFICATION: A change to an equipment and spares allowed only after the contract has been revised.
25. NAVAL AVIATION MAINTENANCE PROGRAM (NAMP): The system prescribed by Chief of Naval Operations Instruction 4790.2B to manage overall aviation maintenance within the Navy.
26. ORGANIZATION LEVEL: The lowest of the three levels of maintenance. In aviation it is the squadron level.
27. PRODUCT BASELINE: The product configuration identification initially approved by the customer.
28. SHOP REPLACEABLE ASSEMBLY (SRA): A subcomponent of a weapon replaceable assembly removed as a result of an intermediate level maintenance action.
29. SUBASSEMBLY: Two or more parts that form a portion of an assembly replaceable as a whole but having a part or parts that are individually replaceable.
30. SUBSYSTEM: A major functional subsystem or group of items that is essential to operation completeness of a system.
31. SYSTEM: A composite of subsystems, assemblies, skills, and techniques capable of performing and/or supporting an operational (or non operational) role. A complete system includes related facilities, items, material, services and personnel required for its operation.

32. TECHNICAL DIRECTIVE: An official document describing technical information, instructions and safety procedures related to operation, maintenance, installing or modification of an equipment.
33. TECHNICAL DIRECTIVE INDEX: A record of all technical directives by weapon system, weapon, system, or commodity from the date the technical directive number is assigned until the technical directive is rescinded or cancelled.
34. TECHNICAL DIRECTIVE COMPLIANCE STATUS REPORTS: A series of reports that record the compliance status of all formal and interim changes in the NAVAIR system, including kits, material, and manhour information.
35. TYPE/MODEL/SERIES (T/M/S): Refers to the type, model and series of aircraft in the NAVAIR inventory (i.e., A-4J-- A is type Attack, 4 is the model and J is the series).
36. VALIDATION: As used herein, validation comprises those evaluation, integration and test activities carried out at the system level to assure that the finally developed systems satisfy the mission requirements of the system specifications.
37. VISUAL INFORMATION DISPLAY SYSTEM/MAINTENANCE ACTION FORM (VIDS/MAF): The single form used to document all maintenance actions in support of the aviation Maintenance and Material Management System.
38. WEAPON REPLACEABLE ASSEMBLY (WRA): A component removed from an aircraft by an organizational level maintenance action.

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