NPS-LM-09-128

# ACQUISITION RESEARCH SPONSORED REPORT SERIES

## An Analysis of the United States Naval Aviation Schedule Removal Component (SRC) Card Process

29 December 2009

by

**LCDR Anthony Staffieri, USN,**

**LCDR Eric Holsti, USN, and**

**Lt. William Gray, USN**

Advisors: Dr. Geraldo Ferrer, Associate Professor, and

Dr. Nicholas Dew, Assistant Professor

Graduate School of Business & Public Policy

**Naval Postgraduate School**



Prepared for: Naval Postgraduate School, Monterey, California 93943

The research presented in this report was supported by the Acquisition Chair of the Graduate School of Business & Public Policy at the Naval Postgraduate School.

**To request Defense Acquisition Research or to become a research sponsor, please contact:**

NPS Acquisition Research Program
Attn: James B. Greene, RADM, USN, (Ret)
Acquisition Chair
Graduate School of Business and Public Policy
Naval Postgraduate School
555 Dyer Road, Room 332
Monterey, CA 93943-5103
Tel: (831) 656-2092
Fax: (831) 656-2253
e-mail: jbgreene@nps.edu

Copies of the Acquisition Sponsored Research Reports may be printed from our website www.acquisitionresearch.org

NPS-LM-09-128

# NAVAL POSTGRADUATE SCHOOL

## MONTEREY, CALIFORNIA

**An Analysis of the United States Naval Aviation Schedule Removal Component (SRC) Card Process**

**29 December 2009**

**by**

**LCDR Anthony Staffieri, USN,**

**LCDR Eric Holsti, USN, and**

**Lt. William Gray, USN**

Advisors: Dr. Geraldo Ferrer, Associate Professor, and

Dr. Nicholas Dew, Assistant Professor

Graduate School of Business & Public Policy

**Naval Postgraduate School**



Prepared for: Naval Postgraduate School, Monterey, California 93943

THIS PAGE INTENTIONALLY LEFT BLANK

# Abstract

Schedule Removal Component (SRC) cards provide aviation part information such as flight hours accumulated, last-installed date, last removal date, and last depot-level inspection or overhaul date.  When a naval aviation squadron receives an SRC–card-designated part not accompanied by its respective paper card, naval instruction restricts the part from being installed on the aircraft.  This prevents the aircraft from flying, which directly affects squadron readiness levels and mission capability.  The difficulty of adequate SRC card custody and tracking lies in the current inter-organizational process.  The objective of this project is to study the SRC card process by examining its purpose, card production and inherent custody imperfections.  A Product Lifecycle Management (PLM) model is introduced for discussion and serves as a valuable concept for Automated Information System (AIS) implementation using Unique Identification (UID) technology.  An AIS with UID transformation technology in a Web-based environment embraces current DoD mandates and can greatly reduce the millions of realized dollar losses associated with the current process.  Improvement of the SRC-card custody process will virtually eliminate the loss of critical part documentation, which leads to attributable increases in aircraft availability and squadron readiness throughout all of naval aviation.

**Keywords:** PLCS, PLM, NALCOMIS, SRC card, Readiness, FST, part penalty

THIS PAGE INTENTIONALLY LEFT BLANK

Acknowledgments

The authors would like to thank all the individuals that have contributed to the successful completion of this project. Specifically, we would like to thank Drs. Geraldo Ferrer and Nick Dew for their instruction and guidance throughout this process; Ms. Jane Zimmerman, Logistics Automation Manager of COMFISCS, for making us part of the team and for her vision that the ultimate beneficiary should always be the war fighter; Mr. Pat Montgomery, Program Manager for CMIS/ATCM, and Mr. Paul Allen and Thomas Stallings of Serco, Inc., for providing critical data, invaluable insight and countless hours of phone and email correspondence about their respective database systems; and to all those individuals both named and unnamed, we would like to say thanks for all that you have done.

LCDR Eric Holsti would like to express his appreciation to his teammates, professors and friends for the encouragement and direction they have bestowed to make this project a success. Mostly, he would like to thank his beautiful wife, Jessy, and his inspiring sons, Caleb and Jackson, for having patience throughout this endeavor and without whom none of this accomplishment would have been possible.

LT William Gray would like to thank his teammates and professors for the extraordinary efforts that made this project a reality.  He would like to thank his family and friends for the love and support that they provided throughout this entire process. He would especially like to thank his amazing wife, Carol, his daughter, Zoe, and sons, Wil and Rip, without whom none of this accomplishment would have been possible.

LCDR TJ Staffieri would like to express his gratitude to his family, friends and teammates for the support they provided throughout this endeavor.  Specifically, he would like to thank his wonderful wife, Cathy, and two sons, Nick and Matt.  “You guys are my inspiration, encouragement and support system, which I rely on more

than you will ever know. My accomplishments and accolades pale in comparison to what I receive from each of you every day. I love all of you very much, and thank you for making my life wonderful.”

# About the Authors

**Lieutenant Commander Anthony J. Staffieri** enlisted in the United States Navy in October 1987 as a Naval Nuclear Electrician. After graduating from the Nuclear Power program, he was selected for instructor duties at Nuclear Prototype Ballston Spa, NY. During this time, he was selected to attend the United States Naval Academy, Class of 1994. After graduation from the Academy, he attended Naval Flight Officer School in Pensacola, FL, where he received his wings of gold in March of 1996. He has since been assigned to VS-32, VT-4, Commander Second Fleet, CSCWL LANT and VS-22 holding numerous operational positions throughout each tour. In July 2008, he reported to the Naval Postgraduate School as a student at the Graduate School of Business and Public Policy studying Financial Management for the Department of Defense. He graduated in December 2009 with a Master's of Business Administration. Following graduation, he went back to Pensacola for instructor duty at the School of Aviation Safety.

**Lieutenant Commander Eric Holsti** enlisted in the United States Navy in December 1986 in the delayed entry program. He graduated from basic training in RTC Great Lakes, IL, in November 1987. Upon completion of basic training, he attended Aviation Electronics Technician (AT) "A" school in Millington, TN. From A school, he reported to the Green Pawns of VA-42 Fleet Readiness Aviation Maintenance Program in Oceana, VA, for advanced avionics training. Upon completion of his training, he reported to his first duty station, AIMD Sigonella, NAS Sigonella. During this tour, he applied to and was accepted to the Navy's Broadened Opportunity for Officer Selection and Training (BOOST) program. Upon completion of BOOST in 1991, he attended Jacksonville University in the ROTC program. After commissioning, he attended Aviation Maintenance Duty Officer School. His first duty station as a commissioned officer was VFA-125, where he served as the Line Division Officer and Quality Assurance officer from 1996-1999. His next duty station was VFA-94, where he served as the Maintenance Material

Control Officer, Assistant Maintenance Officer, Material Control Officer, and Aircraft Division Officer from 1999-2002. During this tour, he completed two WESTPAC deployments including the first strike campaign during Operation Enduring Freedom. He then transferred to VR-54 as the Maintenance Material Control Officer from 2002-2005. During this tour, the command earned its first Battle “E” award, first Holcombe Award for Maintenance Excellence, and a Navy Unit Commendation for efforts supporting Operation Iraqi Freedom. From VR-54, he transferred to Fleet Readiness Center (FRC) New Orleans as the Maintenance Department Head from 2005-2007. From the FRC, he transferred to Commander Naval Air Reserve Forces Command (CNARFC) as the Type Commander (TYCOM) VR/VP/Engine/Support Equipment Class Desk Officer. From CNARFC, he accepted orders to the Naval Postgraduate School in Monterey, CA, where he earned a Master’s of Business Administration in the Graduate School of Business and Public Policy. After completing his degree requirements, he was assigned to Fleet Readiness Center South West overseeing DEPOT production in San Diego, CA. Personal awards include the Navy and Marine Corps Commendation Medal (three awards), Navy and Marine Corps Achievement Medal, and various unit and campaign awards.

**Lieutenant Will Gray** is a Southern California native; he joined the Navy after a 10-year career with the Long Beach Unified School District. LT Gray earned his commission through the Aviation Officer Candidate School (AOCS) in Pensacola, FL. After completing AOCS, he reported to Aviation Maintenance Officer (AMO) School at Whiting Field, FL. Upon completion of initial training, LT Gray reported as a Division officer in Strike Fighter Squadron 151 (VFA-151) in Lemoore, CA. LT Gray completed multiple deployments with VFA-151. LT Gray received follow-on orders to VFA-192 in Atsugi, Japan, where he held multiple jobs including the Maintenance Material Control Officer and Assistant Maintenance Officer positions. Following a successful tour with the forward deployed Naval forces in Japan, LT Gray received orders to the Naval Postgraduate School in Monterey, CA. Lieutenant Gray graduated in December 2009 with a Master’s of Business Administration degree and continued on to the USS Ronald Regan, San Diego, where he worked as the Aircraft Division Officer (IM-2) in the Aviation Intermediate Maintenance Department.

THIS PAGE INTENTIONALLY LEFT BLANK

NPS-LM-09-128

# ACQUISITION RESEARCH SPONSORED REPORT SERIES

---

**An Analysis of the United States Naval Aviation Schedule Removal Component (SRC) Card Process**

**29 December 2009**

**by**

**LCDR Anthony Staffieri, USN,**

**LCDR Eric Holsti, USN, and**

**Lt. William Gray, USN**

Advisors: Dr. Geraldo Ferrer, Associate Professor, and

Dr. Nicholas Dew, Assistant Professor

Graduate School of Business & Public Policy

**Naval Postgraduate School**

THIS PAGE INTENTIONALLY LEFT BLANK

# Table of Contents

## List of Acronyms and Abbreviations

| | |
|---|---|
| ADUSD-MR&MP: | Assistant Deputy Under Secretary of Defense for Materiel Readiness & Maintenance Policy |
| AIA: | Aerospace Industries Association |
| AIS: | Automated Information System |
| AIT: | Automatic Identification Technology |
| ALGS: | Autonomic Logistics Global Sustainment |
| ALIS: | Autonomic Logistics System |
| AMSU: | Aeronautical Material Screening Unit |
| ASD: | Aviation Support Division |
| ATCM: | Aeronautical Time Cycle Management |
| AZ: | Aviation Administrationman |
| BCM - | Beyond Capability of Maintenance |
| CAD: | Computer-aided Design |
| CBM: | Condition-based Maintenance |
| CHARTS: | Change History and Review Tracking System |
| CMB: | Contact Memory Buttons |
| CMIS: | Configuration Management Information System |
| CNAF: | Commander Naval Air Forces |
| CONOP: | Conduct of Operations |
| CoC: | Certificate of Conformity |
| DEX: | Data Exchange |
| DCU: | Document Control Unit |
| DoD: | Department of Defense |
| ERP: | Enterprise Resource Planning |
| FDT: | Fleet Design Team |
| FRP: | Fleet Response Plan |
| FST: | Fleet Support Team |
| HQMC: | Headquarters, Marine Corps |
| IMA: | Intermediate Maintenance Activity |

| | |
|---|---|
| ISO: | International Organization for Standardization |
| LPO: | Leading Petty Officer |
| MAF: | Maintenance Action Forms |
| MDU: | Material Delivery Unit |
| MMCO: | Maintenance Material Control Officer |
| NAE: | Naval Aviation Enterprises |
| NALCOMIS: | Naval Aviation Logistics Command Operating Maintenance Information System |
| NAMP: | Naval Aviation Maintenance Program |
| NAVAIR: | Naval Air Systems Command |
| NC: | Not Carried |
| NIS: | Not in Stock |
| NKO: | Navy Knowledge Online |
| NON- RFI: | Not Ready for Issue |
| ODUSD-AT&L: | Office of the Deputy Under Secretary of Defense for Acquisitions, Technology, and Logistics |
| OEM: | Original Equipment Manufacturer |
| OOMA: | Optimized Organizational Maintenance Activity |
| OSD: | Office of the Secretary of Defense |
| OWP: | Outer Wing Panel |
| PBL: | Performance-based Logistics |
| PC: | Production Control |
| PHM: | Prognostics Health Management |
| PLCS: | Product Lifecycle Support |
| PLM: | Product Lifecycle Management |
| PMIC: | Periodic Maintenance Information Card |
| RFI: | Ready for Issue |
| RCM: | Reliability Centered Maintenance |
| RDL: | Reference Data Libraries |
| SDC: | Statistical Data Cards |
| SIM: | Serialized Item Management |
| SK: | Storekeeper |

| | |
|---|---|
| SSU: | Supply Screening Unit |
| STEP: | Standard for the Exchange of Product Model Data |
| TAD: | Temporary Assigned Duty |
| TD: | Technical Directive |
| TEF: | Trailing Edge Flaps |
| TMS: | Type Model Series |
| UID: | Unique Identification |
| UII: | Unique Item Identifier |
| USN: | United States Navy |
| WAWF: | Wide Area Work Flow |

THIS PAGE INTENTIONALLY LEFT BLANK

# I. Introduction

## A. Purpose

Over the lifespan of an aircraft, specific parts are installed, removed and replaced. While transferring a part from one aircraft to another, custody and ownership rights generally transfer at both intra-organizational and inter-organizational levels.[1] Because some of these aircraft parts are critical to flight safety, they have strictly specified lifecycle maintenance requirements that must be accurately completed, logged, tracked and stored. The United States naval aviation community uses a Configuration Management Information System/Aeronautical Time Cycle Management Program (CMIS/ATCM) Repository for this purpose. The ATCM is an Oracle relational database server that retrieves data through SQL *Plus. The database maintains part-tracking data throughout the entire service life of a component.

Within the Oracle CMIS server, two databases, the ATCM and COMTRAK, are regularly accessed by Repository and Dycomtrak personnel for data retrieval and updating of parts. These tracking databases serve two important purposes. First, they serve as a part-lifecycle data library. Second, examination of historical part-performance data by engineers can be used to refine current preventive maintenance practices to minimize or prevent unexpected, catastrophic part failures. Ultimately, part-lifecycle management processes strive to measure and ensure the highest levels of aircraft safety, operational availability, and squadron readiness.

To achieve these highly desired maintenance metrics, civilian and military aviation organizations alike are beginning to discover and implement Product

[1] For the U.S. Navy, intra-organizational custody change entails part movement from one work center to another within a squadron, whereas inter-organizational custody change refers to the part being transferred to or from an outside command such as a Depot.

Lifecycle Management (PLM) concepts. This ideal closed-loop concept encompasses internationally standardized data-exchange software technology. The PLM model takes a business approach toward managing part information from cradle to grave. Because part lifecycles can be measured in decades for many parts used in aircraft, an internationally accepted data-exchange (DEX) language should be considered. PLM is not about one piece of technology; it is about numerous pieces of technological processes that are standardized across the part's lifecycle. Technological innovations like Contact Memory Buttons (CMB), magnetic and optical stripes, Unique Identification (UID), Radio Frequency Identification (RFID) and smartcards can be used in PLM systems.[2] This research recommends a PLM system that is Web-based and uses DoD- mandated UID technology as the future for data management. Since many aircraft parts are transferred between different aviation units throughout their lifecycles, the process of electronically accessing accurate part history at any time or location is essential. As stated in CIMdata commentary, "Effective collaboration throughout a product's lifecycle requires the ability to accurately integrate and share product data that is created and used within multiple applications—and that environment must be sustained for as long as the product is in use; sometimes even longer" (CIMdata, May 2009).

This research focuses on the United States Navy's (USN's) cradle-to-grave aviation-part-lifecycle process using the F/A-18 Hornet, the Naval Aviation Logistics Command Operating Maintenance Information System (NALCOMIS), and Schedule Removal Component (SRC) cards (hard-card aspect). More specifically, it discusses the Automated Information Technology (AIT) mandate, in the Department of Defense (DoD), and why it should be implemented into a Web-accessible database. Although the study centers on the Navy's F/A-18 Hornet community and its interaction with the ATCM Repository, the background, analysis and recommendations could be applied to any Navy Type Model Series (TMS) aircraft

[2] CMB technology is being used in some military aviation communities.

and any other hard-card type process. To support the research, we explore the current SRC card process used in the Dycomtrak program and the CMIS/ATCM Repository program. Then an analysis of recognized cost savings is presented and discussed.

## B. Background

Several parts installed on the F/A-18 Hornet require an SRC Card. Together, NALCOMIS and SRC cards track expended flight hours and completed maintenance actions over a part's lifetime for each SRC-designated part[3] as the part goes from one command to another. In the sense of a PLM model, NALCOMIS and SRC cards would be regarded as the beginning elements of a naval-aviation-wide PLM-type system. The physical SRC card (see Figures 1 and 2) is an 8 ½ by 11-inch piece of cardstock paper that provides the following part data: complete maintenance history, installation and usage, accumulated flight hours, installation and removal dates, and last depot-level inspection or overhaul dates for all SRC-card-designated parts.

As seen in Figures 1 and 2, from the *Naval Aviation Maintenance Program (NAMP) Instruction* (*Commander Naval Air Forces Instruction 4790.2A*), the SRC card is very thorough and unambiguous. It outlines a specific part's history as it travels from one command to another and from one aircraft to another. It would be synonymous to a diary of someone's life. Updated and maintained on file by a maintenance administrator, an SRC card alone can have a direct input on squadron readiness. Because two different database systems (discussed later) are currently used throughout naval aviation, this card gets filled out using handwritten or computer-generated entries.

---

[3] Only parts designated by an aircraft's Periodic Maintenance Information Card (PMIC) require an SRC card. These parts have approved mandatory removal and replacement intervals as well as requirements that require special monitoring with emphasis on failure trends.

OPNAVINST 4790.2H

# SCHEDULED REMOVAL COMPONENT CARD

**SECTION I - IDENTIFICATION DATA**

| A. NOMENCLATURE | B. WORK UNIT CODE | C. FSCM | D. REPLACEMENT INTERVAL | E. REPLACEMENT DUE |
|---|---|---|---|---|
| F. PART NUMBER | G. SERIAL NUMBER | H. FST | | |

**SECTION II - INSTALLATION DATA**

| A. DATE | B. BUNO / SERNO INSTALLED ON | C. TOTAL AIRCRAFT / EQUIPMENT HOURS OR COUNTS | | | | D. TOTAL HOURS OR COUNTS ON ITEM | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

**SECTION III - REMOVAL DATA**

| A. DATE | B. TOTAL AIRCRAFT / EQUIPMENT HOURS OR COUNTS | | | | C. TOTAL HOURS OR COUNTS ON ITEM | | | | D. REASONS FOR REMOVAL AND JOB CONTROL NUMBER |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

OPNAV 4790/28A (REV. 2-01) S/N 0107-LF-983-5400 PERMANENT RECORD

**Figure 1. Front of Scheduled Removal Component Card**
(COMNAVAIRFOR, 2009)

| SECTION IV - TECHNICAL DIRECTIVES | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A. TECHNICAL DIRECTIVE IDENTIFICATION | | | | | | | | B. STATUS | C. TITLE/REMARKS | D. COMPLIANCE | | E. SIGNATURE |
| (1) CODE | (2) BASIC | (3) INT | (4) REV | (5) AM | (6) PT | (7) KIT | (8) PRI | | | (1) BY (Activity) | (2) DATE | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |

| SECTION V - REPAIR / REWORK / OVERHAUL | | | |
|---|---|---|---|
| A. DATE | B. ACTIVITY | C. DESCRIPTION | D. SIGNATURE |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

OPNAV 4790/28A (REV. 2-01) REVERSE

**Figure 2. Back of Scheduled Removal Component Card**
(COMNAVAIRFOR, 2009)

The SRC cards are maintained with the aircraft logbook or the equipment service record for as long as the component is installed on an aircraft. When the component is removed from the aircraft and transferred to another command, the SRC card must physically accompany the component. In fact, in an e-mail from Bob Lindauer of Boeing, he specifically addressed this issue as experienced by him while serving as an F/A-18 Technical Representative (TECH REP) at sea. “I have even witnessed (the mishandling of component paperwork) on occasion, particularly aboard ship due to space restrictions. Spare parts arrive and are unpacked and many times, the necessary paperwork is discarded. Seems to me that something like an embedded RFID chip is the obvious way to go” (Lindauer, 2009).

Although research is ongoing in regards to the use of RFID technology in the shipboard environment, the physical attachment of technical data such as an SRC-card to a specific part does not seem to be addressed. Per the *Naval Aviation Maintenance Program (NAMP) Instruction* (*Commander Naval Air Forces Instruction 4790.2A*), SRC-card-designated parts cannot be installed without an SRC card for safety-of-flight-related reasons. NALCOMIS is an in-house (squadron centric) network database designed to aid in the complex process of scheduling, planning, and performing aircraft maintenance. It is accessible by any squadron member but provides administrator privilege abilities, if necessary.

For the purpose of this research, focus is placed on the tracking and documentation function of aircraft parts and their respective lifecycle histories. The goal is three-fold: first, prevent the loss of critical part-history information, which centers on flight hours and Technical Directives (TD) applicable to that part; second, prevent the loss of SRC cards; and third, reduce the number of errors on these cards.

There are two versions of the NALCOMIS database: NALCOMIS OOMA (Optimized Organizational Maintenance Activity) and NALCOMIS Legacy. Legacy and OOMA are a large leap in the evolution of aviation-maintenance recordkeeping and preventive maintenance practices. What used to be a pen-and-paper aviation maintenance process is now mostly digitalized, streamlined and efficient. Time sumps such as hand-prepared Maintenance Action Forms (MAFs) and Equipment Statistical Data Cards (SDCs), which are used to identify needed part repairs and track equipment degradation, were a painstaking part of maintenance days of old.[4] Now processed electronically, NALCOMIS provides management with real-time

---

[4] MAFs are used by both pilots and aircraft maintainers to document items that did not work correctly in flight or in initial testing following installation- therefore needing repair or replacement. Not all issued MAFs will prevent an aircraft from flying, just those that are deemed a safety of flight issue by maintenance directives or a pilot's discretion.

accurate and legible data, resulting in an efficient means of tracking life-limited parts. Currently, NALCOMIS data is not accessible from the field.

## C. Basis for Research

Naval Air System Command (NAVAIR) is employing aspects of the Office of the Assistant Deputy Under Secretary of Defense for Materiel Readiness and Maintenance Policy (ADUSD-MR&MP) Conduct of Operations (CONOP) to explore IUID benefits within the DoD maintenance environment through its warfighting partnership with the Navy Enterprise and the NAE.[5] The NAE's vision toward the construct of single-process ownership is vital to establishing a culture of cost-wise readiness and providing improved materiel management, balanced logistics support, and higher availability through faster turnaround times. (Navy Enterprise, 2009) The NAE's vision and the ADUSD's Item-unique Identification (IUID) CONOP document can be applied to NALCOMIS through an NAE procedure known as Serialized Item Management (SIM). SIM is a unique identification system that contains specific asset information. The goal is to reduce the cost of operations through assets optimization, reduce investments in spares, increase operational availability without additional costs, and make lean investments in material management functions (Naval Air System Command, 2009b). The CONOP document ties SIM and IUID together, providing conceptual background, essentials, concept-in action, responsibilities, and an implementation template based on past DoD successes.

This research intends to highlight a specific aviation maintenance process (SRC cards) that is in need of attention. We show that by applying NAE AIR*Speed* concepts to this process, a large facet of aviation maintenance would enjoy time and money savings due to decreased workloads, increased accuracy, and much-

---

[5] NAVAIR provides unique engineering, development, testing, evaluation, in-service support, and program management capabilities for airborne weapons. It is the principal provider for the Naval Aviation Enterprise (NAE), but contributes to every Navy warfare enterprise in the interest of national security.

improved readiness levels.[6] Utilizing a Web-based environment for SIM purposes can save the naval aviation community millions of dollars per year, if employed correctly and applied universally in the name of AIR*Speed*. AIS' employed in conjunction with the present NALCOMIS systems or as a separate Web based database, will provide substantial cost reduction and readiness enhancements using prognostics in a condition-based maintenance (CBM) and reliability-centered maintenance (RCM) environment.

The Web-based enhancements would greatly improve the struggling processing capacity of the CMIS/ATCM Repository database. Employing only three personnel in a system that takes at least four to meet current demands, the Repository is unable to adequately fulfill its part in the lifecycle tracking mission. It has consistently maintained a large backlog of hard-cards awaiting entry into the ATCM database. This backlog combined with understaffing, prevents the database from being current and hampers service to the Fleet.

Moving to a Web-based or PLM system will address these issues and help save the Navy millions of dollars in part penalties presently being recognized because of the current hard- card procedures. Lost or inaccurate SRC-cards can result in substantial part-life penalties that indirectly convert to dollars lost per part flight hour. Shown in the analysis chapter, the F/A-18 A-D Fleet Support Team (FST) reported part penalties of over $2.5 million dollars in just a six month period. That was only from the structural part of the aircraft and included data on only four of the 120 TMS that exist in the Navy today.

[6] NAE AIR*Speed* is a continuous process improvement for the Naval Aviation's non-production, transactional service environment. The Theory of Constraints and Lean and Six Sigma provide a means for employees to improve how NAVAIR does business at every level.

## D. Methodology

The methodology applied in this research project consists of the following steps:

1. Conducted a literature review of books, articles, electronic media, and other library resources.

2. Conducted a survey, targeting specific naval-aviation maintenance personnel regarding the SRC-card process.

3. Conducted a thorough review of PLM models.

4. Conducted a review of the current UID mandates and implementations in the DoD.

5. Conducted a site visit to Naval Air Station Lemoore, CA.

6. Conducted a site visit to Naval Air Systems Command (NAVAIR), Patuxent River, MD.

7. Conducted a site visit to Fleet Support Team (FST) in San Diego, CA.

8. Observed and analyzed current UID, SIM and NALCOMIS applications supported by NAVAIR.

9. Conducted a review and analysis of typical Navy materiel-logistics processes in the aviation-logistics process.

10. Prepared a summary and made recommendations.

THIS PAGE INTENTIONALLY LEFT BLANK

# II. Process and Innovation

The birth of an SRC-card is generally recognized at the squadron level. When a new part arrives from the OEM, a squadron must initiate a new SRC-card for that item. In the case of older parts, the squadron facilitates the SRC-card process by filling the card in with part lifecycle information as the part is installed and removed from an aircraft. Outside of the squadron, the SRC-card follows the part everywhere it goes. From repair facilities to other squadrons, the card must remain with the part at all times.

The card maintains the accurate lifecycle of a given part so that squadrons and repair facilities know when a part should be serviced and/or replaced. These cards periodically get sent to the CMIS/ATCM Repository and depending on specific TMS, a copy will also go to Dycomtrak. ATCM and Dycomtrak manually enter the data into a database that is later used for Fleet servicing. Currently, Fleet personnel do not have access to these databases which is why innovations such as PLM could be a welcomed upgrade to the current database system.

## A. Process Flow for an F-18 SRC-Carded Item

The following description outlines the current process flow for an SRC-carded item as it leaves the custody of an operational squadron.

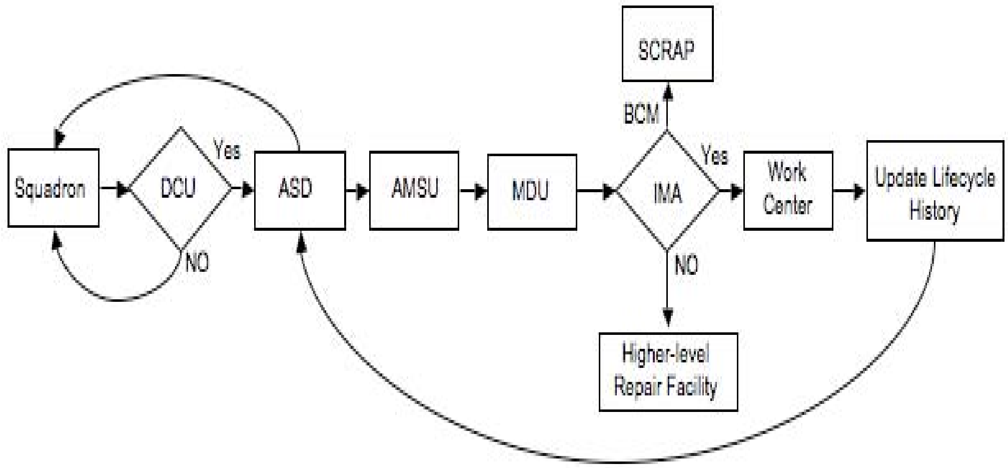



**Figure 3. SRC-carded Item Process Flow Chart**

### 1. Operational Squadron

An SRC-carded item is removed as the result of component failure or required periodic maintenance. Once the respective squadron work center removes the component, it retrieves the SRC card associated with the component from the squadron's Logs and Records department. Squadron Logs and Records personnel are responsible for maintaining physical custody of the SRC card and documenting lifecycle history updates on the physical SRC card such as hours flown, technical directives, and reason for removal. A copy of the updated SRC card is forwarded to the Configuration Management Information System (CMIS) Repository, located at Commander Naval Air Systems Command (COMNAVAIRSYSCOM AIR-6.8.4.3) in Patuxent River, Maryland. The original SRC card, which has been updated by the Squadron, is packaged with the associated non-RFI component and exchanged for an RFI component.

### 2. Document Control Unit (DCU)

Once the MAF is issued and a requisition document DD 1348 for a replacement RFI part is transmitted to the Aviation Support Division (ASD), DCU personnel process the request. The receiving squadron will be notified that its requested material has been processed for issue, or provided a status of Not Carried (NC) or Not in Stock (NIS). If the item is in stock and processed for issue, then the order is sent to the Material Delivery Unit (MDU) to be pulled from the shelf and delivered.

### 3. Aeronautical Material Screening Unit (AMSU)

The AMSU personnel screen non-RFI parts prior to induction into the Intermediate Maintenance Activity (IMA). The AMSU determines if an IMA work center has the correct level of repair capability for the particular part. It also verifies the non-RFI part to ensure the part number, serial number and cage match the associated MAF and that all associated logs and records, including the SRC card, are present with the part. Under the AMSU is the Material Delivery Unit, which is responsible for the transportation of components.

### 4. Material Delivery Unit (MDU)

The MDU personnel collect non-RFI-SRC-carded parts from the squadron and exchange them for replacement RFI parts. Squadron personnel verify the part number; serial number and cage number of newly acquired RFI parts and ensure they have a valid SRC card associated with the part. The MDU personnel obtain the squadron retrograde component and screen the non-RFI part to ensure that the part number, serial number and cage number match the associated MAF and that all associated logs and records, including the SRC card, accompany the part. The MDU personnel transport non-RFI parts to the Aeronautical Material Screening Unit (AMSU).

### 5. Intermediate Maintenance Activity (IMA)

If the IMA has repair capability and the part is not beyond the capability of maintenance (BCM), Production Control (PC) assigns a work center and work priority for the part. Once inducted the repairable is transported to its assigned work center. If the IMA work center does not have repair capability, the part is forwarded to the next-higher-level repair facility. The IMA work center or higher-level repair facility receives the non-RFI part and performs the required maintenance action in order to return the part to an RFI condition.

Once the maintenance action for a particular part is complete, the part's lifecycle data is updated by documenting the information on the part's associated SRC card. A copy of the part's updated SRC card is forwarded to the CMIS Repository. A historical copy is maintained for at least 12-months to provide a historical backup to the copy held by the CMIS Repository.

The original SRC card, which has been updated to reflect the most current lifecycle history by the work center, is packaged with the associated RFI part. Once the IMA or higher-level repair facility has completed the required maintenance action and the part is returned to an RFI status, the DCU screens the MAF to verify that all maintenance and supply-history information has been accurately documented. The DCU approves the MAF and transmit this information to the Supply Screening Unit (SSU).

### 6. Supply Screening Unit (SSU)

The SSU personnel receive the RFI part, along with its associated logs, records and MAF. They verify the material condition of the part as indicated on the MAF. The SSU personnel also verify that the required documentation associated with the part is present. Required documentation includes an RFI tag, a copy of the MAF, and all applicable logs and records, including SRC cards for those parts that require SRC cards. Once the SSU personnel have verified the component is RFI and contains all of its associated logs and records documentation, it is packaged for shipment or storage.

RFI parts that are large or easily damaged are placed in various reinforced containers, wooden crates, or in packing materials within a cardboard box. When a part is placed inside a container, associated logs and records are contained in a separate MAF bag inside the container, which is then sealed. A copy of the MAF and its associated requisition document is placed in a MAF bag and affixed outside the container.

If an item is not too large or sensitive to damage, the part may be packaged in standard materials such as bubble wrap or barrier paper. If an item is wrapped and not placed inside a storage container, then its associated logs and records are placed externally in an MAF bag but separate from the MAF. Once the RFI part is properly packaged for storage or shipment, it is received by the MDU.7. SSU Transfers Custody Of RFI Component to MDU

### 7. SSU Transfers Custody of RFI Component to MDU

When the MDU personnel pick up the RFI part from the SSU, they verify that the part is adequately packaged and the requisition document matches the part's RFI tag. Once the part's packaging and documentation has been verified, the MDU personnel transports the RFI part to the ASD to be retained on a storeroom shelf for future requisition, or it is delivered to an operational squadron filling an outstanding requisition-document requirement.

### 8. Accumulating Lifecycle History

A repairable part cycles through periods of storage as supply stock, periods of usage, and periods under repair, accumulating an extensive lifecycle history. As parts move through the system their associated logs and records must accompany them to ensure data integrity is maintained. Logs and records information is used by operational squadrons to monitor usage, periodic maintenance requirements, and adherence to mandated technical directives. It is also used by repair facilities to determine inspection requirements and identify maintenance discrepancy trends.

#### 9. RFI Components Direct from the Manufacturer

The ASD receives RFI parts via the repair cycle to fill outstanding requisition-document requirements and replenish its levels of warehoused stock. The ASD also receives new RFI parts directly from the manufacturer to replenish warehouse stock levels or to fill an outstanding requisition by an operational squadron. If an item is received from the manufacturer and is new, it is the responsibility of the requisitioning activity to initiate a new SRC card for the part.B. NALCOMIS, CMIS Repository and DYCOMTRAK

## B. NALCOMIS, SRC Cards and the CMIS Repository

#### 1. NALCOMIS, SRC Cards and the CMIS Repository

The Naval Aviation Logistics Command Management Information System (NALCOMIS) is used to track and manage aircraft maintenance and material data throughout all Navy squadrons. This intra-squadron database is primarily used by squadron maintenance personnel for day to day management of aircraft maintenance. NALCOMIS can generate many different types of maintenance reports that aid in the tracking and planning of in-progress and future aircraft maintenance requirements. The reports also provide means to collect statistical data that can lead to the identification of high-failure parts or maintenance practices. Reports can be generated based on a particular component part number, work center, work unit code, date of maintenance action, inspection date, or scheduled removal date.

There are currently two NALCOMIS software systems in use. Together, NALCOMIS Legacy and NALCOMIS OOMA have greatly improved the Navy's methods of performing, tracking and documenting aviation maintenance, although legacy is susceptible to some manipulation. In fact, component-lifetime information listed on an SRC card is still transcribed by hand in squadrons using the Legacy system providing ample opportunity for error or illegibility. NALCOMIS OOMA addresses the issue by using electronic logsets that provide a printout of the information that goes onto the actual SRC card. However, like Legacy, OOMA suffers from one significant inability that strikes at the heart of any PLM system: They are not networked with other squadron or Depot-level NALCOMIS servers outside the command and do not communicate lifecycle data with any central information Repository. They are essentially a stand-alone system vulnerable to complete or partial data loss. There have been initiatives in the past to develop a paperless SRC-card process, but currently, such a system does not exist.

When an aircraft part is removed, reworked or manufactured and then prepared for shipment to a different facility, the part must be accompanied by its respective SRC card or Certificate of Conformance of some type when coming from the OEM (Lindauer, 2009).[7] OOMA allows the maintenance administrator to print out the SRC card, but Legacy requires that the administrator updates the card by hand. The NALCOMIS systems do not have the ability to generate and send an electronic card to other commands or databases, so maintenance administrators must ensure that an accurate SRC card physically accompanies a shipped part. If an SRC card is not received by a follow-on command, research is conducted to re-create a new one. Research is also needed if the card is received but does not have adequate information.

In accordance with *NAMP* (*OPNAVINST 4790.2* series) and *PMIC* direction, all SRC cards for fixed and rotary-wing TMS must be sent by mail to the ATCM Repository, located in Patuxent River, MD. The idea is to have a large, accurate, and

---

[7]Per e-mail on August 27, 2009, from Bob Lindauer of the Boeing Hornet Support Network, Boeing aircraft provides a Certificate of Conformance, RFI tag or SRC card with each part it delivers.

updateable database containing all Fleet aircraft hard-card data. The *NAMP* says the following about the importance of SRC-card tracking:

> The evolution commences upon receipt of a tracking form, (ASR, MSR, or SRC) from any maintenance activity. The forms are sorted, analyzed, categorized, and then processed for manual data keypunch entry into the database. Data is removed from the record and maintained on file in the ATCM/IS where it is evaluated for accuracy and data integrity. Once validated, the data is used by skilled analysts to assist maintenance activities in reconstructing component history or aiding engineering activities in developing RCM analyses. Data analysis is commonly performed in a part number to serial number format but may be modified as circumstances dictate. (Naval Air Systems Command, 2009a)

This large Oracle SQL *Plus relational database could be accessed online, but it is currently not set up to take advantage of that ability - so the use of the U.S. postal system is the current *NAMP*-directed method for sending updates to the ATCM Repository database. As mentioned earlier, the ATCM Repository is NAE's primary part-lifecycle database that contains information found on SRC cards and other hard data used in the maintenance process.[8] If a Fleet aviation unit receives a part but no SRC card, then *NAMP* and PMICs direct users to call the ATCM Repository to re-build an SRC card for that specific part. Parts cannot be installed on aircraft without this information. Fleet SRC-card information requests to the ATCM Repository and Dycomtrak (discussed later) break down into two categories: either missing/lost card or data accuracy/readiness (verifying hours listed on a card, validating part numbers, verifying TDC compliance and/or repair/overhaul data). The SRC card re-creation effort can take from one hour to one month, depending on how difficult it is for the ATCM Repository or Dycomtrak to research and resolve the card discrepancy. In a worst-case scenario where no information can be found on a particular part of

---

[8] The CMIS Repository is not the only part information database used in naval aviation. All Navy and Marine helicopters, AV-8B's and V-22s are directed by their respective PMICs to send part information to Dycomtrak. Dycomtrak is similar in responsibility to the CMIS Repository, but Dycomtrak is not responsible for maintaining information for all Marine Corps and Navy TMS; *NAMP* gives that responsibility to the CMIS Repository.

concern, a flight-hour penalty may be assessed or a complete scrapping of the part may result as directed by the Fleet Support Team (FST). These part penalties cost millions of unrecognized dollars to the Navy each year.

Lost or inaccurate SRC cards are a common problem around the Fleet, as highlighted by a survey conducted in conjunction with this research (see Appendix A). The results showed that 95% of the 42 respondents had previously received parts not accompanied by an SRC card. Among these respondents, 50% said this resulted in a flight schedule delay or cancellation, and 60% said they had to cannibalize or borrow parts from other aircraft. Moreover, 21% of respondents reported 20 or more occurrences of missing SRC cards, and some added comments with regard to missing cards of “way too many,” “greater than 100,” and “too many to count.” NAVAIR sent out a similar survey in late 2006 to the SH-60 Seahawk community in order to access the handling of maintenance hard-cards such as SRC cards. Their results overwhelmingly concluded that the SRC-card process was in need of revamping.

The ATCM Repository database is updated each time a new SRC card or other hard-card is received by mail. However, as of March 2008, the ATCM Repository had a backlog of 7,427 total hard-cards awaiting database entry and was receiving, on average, 210 cards a day.[9] These backlogs manifest themselves into an inaccurate database that may lead to erroneous lifecycle information provided to the users of this information. Installation and use of parts that have exceeded their useful life increases the potential of part failure and is not an acceptable practice. Because lifecycle database tracking is not just a military-aviation issue, Product Lifecycle Management (PLM) software is constantly being developed, refined and implemented throughout the worldwide aviation community.

---

[9] Data comes from Excel database spreadsheet provided by the Program Manager of the CMIS Repository, Mr. Pat Montgomery.

The ATCM Repository's database does not currently collaborate with an online server to provide Web site access, but this functionality can be enabled. Data retrieval is only available to the ATCM Repository staff, unless specific permission is requested and received from the program manager. The ATCM Repository employs three fulltime civilians to enter SRC data into the database and to help remove the current backlog. There is no requirement for these personnel to have any background in military-aviation administration or maintenance practices. The ATCM Repository also employs three to four Navy personnel from the various aviation communities. They primarily query the database in direct support of Fleet lifecycle information requirements, but they can also help to update and maintain database information.[10] With that said, the ATCM Repository Program Manager, Pat Montgomery, mentioned understaffing as a primary concern. Mr. Montgomery said that he had made numerous requests to the Navy for increased staff, but there isn't any indication that an increase will happen soon. In fact, as of August 2009, the ATCM Repository was scheduled to lose one of the four enlisted members already on staff with no replacement. The staff works Monday through Friday fulltime with no overtime permitted.

Limited collaboration abilities in NALCOMIS combined with a part Repository that is not accessible online, are typical of the worldwide aviation community. Commercial airlines battle this problem frequently since similar aircraft are used across multiple carriers, all of who use different computerized maintenance databases. This limited access reduces information visibility. The use of an internationally accepted software architecture (or DEX) that stores the history of common aviation parts shared in different aircraft is a shortfall currently being addressed by the international aviation community. Implementing a secure, common

[10] Navy personnel working at the CMIS Repository do not have specific background or time-in-job requirements. They are sent to an abbreviated maintenance administration school prior to answering phones and accessing the database.

architecture of exchanging, tracking and maintaining lifetime aircraft-part data for a given industry or organization may yield numerous advantages and falls in line with the PLM model discussed later. Implementing a PLM concept in the SRC-card process would address the ATCM Repository issues by simultaneously increasing process efficiency, 24/7 data availability to the Fleet and cost savings not presently enjoyed.

### 2. Dynamic Component Tracking (Dycomtrak)

Contractually funded on an annual basis, the Dycomtrak program was uniquely setup opposite the ATCM Repository in direct association with SH-60 procurement. The staff of Dycomtrak is not Navy or DoD personnel, but a part of Serco Group PLC, an international service company. Located in Cherry Point, NC, Dycomtrak has a similar purpose to the ATCM Repository but it is not responsible for tracking all 120 naval aviation TMSs. It is staffed by 30 personnel (seven in H-60s alone), who average more than 19 years in military aviation maintenance and administration. Using a database known as COMTRAK, Dycomtrak was originally designed for dynamic/finite life-component tracking for the T56 and T64 Engines but its purpose has expanded significantly over the years to track the H-60, H-1N/W, H-46, H-53 and V-22 and their respective engines. The expansion brought about a large influx of hard-cards but currently maintains no backlog. An e-mail from Dycomtrak Logistics Analyst Thomas Stallings stated that Dycomtrak received an average of 2,400 hard-cards per month between January and July 2009, with an average of 400 Fleet-data requests per month for missing or lost hard-card information (Stallings, 2009).

Since helicopters have a large number of dynamically moving parts, a problem not common to most fixed-wing aircraft, Dycomtrak's CMIS database was designed a little differently than the ATCM Repository. Its database tracks and stores part data like the ATCM, but it also calculates the different hourly flight-time tracking requirements of dynamic parts. More specifically, there are interchangeable parts between different helicopter series such as SH-60B/F/H/R etc. These parts can have different lifetimes based on the environment and expected usage demand for that series of helicopter. A new rotor, for example, might have 7,000 hours useful life in a "B" series, but only 6,000 hours useful life in an "F" series. Since this rotor can be used on the "B" and "F" series, its usage must be closely tracked to ensure a part does not exceed its series-dependent lifecycle. In fact, as of August 2009, Dycomtrak's staff has identified and prevented the installation of 54 different overtime parts among all TMSs it serves (Allen, 2009). Had these parts been installed and flown, the consequential costs could have been immeasurable.

Administratively, Dycomtrak also acts somewhat similarly to the ATCM Repository. Data sent to them using e-mail, the U.S. postal service, or fax is used to update the database. Fleet-information requests break down into the same two categories as those of the ATCM Repository: missing/lost card or data accuracy/readiness requests. For TMSs serviced by Dycomtrak, respective PMICs request SRC cards to be sent directly to Dycomtrak by mail or e-mail.[11] Although e-mail is Dycomtrak's primary means of communication and database upkeep, one- to four-man tiger teams conduct site visits on an annual basis to review and verify aircraft-logbook records against the current COMTRAK database. Copies of necessary documentation are made for subsequent entry in the COMTRAK database.

As with the ATCM Repository, NALCOMISs do not share a common network with the COMTRAK database. Also like the ATCM, the COMTRAK database is not accessible online but can be enabled to be so. Currently, COMTRAK is updated manually as part information is received or collected on site visits. Although the

[11] The research team spoke with many Fleet Aviation Administrative personnel in charge of sending SRC cards to Dycomtrak. It was evident that most did not know they were supposed to send SRC cards to both CMIS/ATCM and Dycomtrak as noted on their PMIC. The teams conducted on-the-spot training to ensure the correct procedures were understood.

information may be subject to delay, according to a NAVAIR survey conducted in late 2006, most commands serviced by Dycomtrak were happy with the timeliness of information provided and the service received. Most respondents said that Dycomtrak staff took less than an hour to provide part information for a missing or incorrect SRC card. Some survey respondents felt that lack of adequate training for the Administrativeman rating was the main weakness of the process.

It is important to point out once again that Dycomtrak is a contracted service for the Navy. In the past, this contract has gone unfunded or "off-line" for undisclosed budgetary reasons. During that timeframe, TMSs served by Dycomtrak did not have access to COMTRAK's part's lifecycle database and therefore had essentially no way of correcting hard-card information or rebuilding a card if one was lost. Logistical Analyst Thomas Stallings wrote the following in an e-mail:

> When I talk about being "off line" I'm referring to a period of time when the 'contract year' has ended and funding for the continuing year is not yet in place. The last time the funding wasn't in place for the H-60 program the engineers were inundated with requests and they ended up "high timing" parts to the point where they needed to be scrapped. This obviously can be very expensive. (Stallings, 2009)

He is referring to the large number of information requests that got directed to the engineers of the Fleet Support Team (FST). The FST is not staffed for this type of activity because there are generally just one or two people that actually search part-information when requested by Dycomtrak.

## C. Upcoming or Available Process Innovations

The loss of information caused by misplaced SRC cards can be addressed with the adoption of PLM software that is designed to handle information in a common collaborative format that is useful and accessible by the entire company or industry not just by one facet of either. As Jahadi and Mason (2008) write, "The wide diversity of computer systems and information formats used in the supply network is becoming a barrier to effective communication of engineering information across the supply chain, resulting in unnecessary costs as vital information is manually converted or even reentered into new systems" (p. 1). It should be understood that in the quote above, "communication of engineering information" does not mean that PLM concepts involve only the engineering process-although that was the traditional definition. Companies were concerned about getting the computer-aided engineering design (CAD) software to collaborate with the machines that actually fabricated the product, and the PLM concept was born. It has only been in the past 5 to 10 years that the traditional PLM concept has blossomed into a company and industry-wide configuration-management necessity with a few goals in mind: streamlining the fabrication to delivery process, product validation and verification throughout its lifecycle, and quality of data through configuration-management feedback. Surveys such as those conducted by the Aerospace Industries Association (AIA) support the critical need of industry-wide collaboration standards.[12] Only half of AIA's surveyed members felt there was a seemless flow of information internal to their organizations. The AIA supply members reported that an average of 5.8 different ways were required to do the same job because of interface issues with each different client (Jahadi & Mason, 2008). It is reasonable to believe that those results would be analogous to results of a similar DoD survey, should one be conducted. The survey partially explains why there is a tremendous push by the aviaition industry to develop a common standard. The other reason arises from the lifecycle of the product itself, which can be many decades. The longitivity of both the B-52 and H-46 programs prove that there is a need to maintain lifecycle information over extended periods.

[12] Founded in 1919, the AIA represents over 100 of the major aerospace and defense manufacturers and over 175 suppliers of civil, military, and business aircraft, helicopters, unmanned aerial systems, space systems, aircraft engines, missiles, materiel, and related components, equipment, services, and information technology.

### 1. Product Lifecycle Support (PLCS) and the NAVAIR Experiment

To achieve a seamless collaboration (PLM concept) process between all stakeholders and providers, military aviation organizations are discovering Product Lifecycle Support (PLCS) technologies that are now being developed by several companies around the globe. The PLCS model takes a business approach towards managing part information from cradle-to-grave. Since many aircraft parts are transferred between different aviation units throughout their lives, the ability to electronically access a given part's history is essential. "Effective collaboration throughout a product's lifecycle requires the ability to accurately integrate and share product data that is created and used within multiple applications—and that environment must be sustained for as long as the product is in use; sometimes even longer" (CIMdata, May 2009).

The PLCS model falls in line with the NAE's vision to efficiently deliver the right force, with the right readiness, at the right time- both today and in the future. In 2007, the NAE, through Navy Air System Command (NAVAIR), completed a PLCS pilot project using basic aircraft delivery data from an SH-60. In minutes, the PLCS system completed a NALCOMIS OOMA data-entry task that would have normally taken two weeks using five fulltime personnel (Finley, 2007). Deputy Under Secretary of Defense for Acquisition and Technology, James Finley, went on to say, "The successful pilot compelled us to extend the tool to a more robust production effort that can readily proliferate to other DoD and contractor users. A data exchange standard based on PLCS was developed and used to transfer delivery, maintenance, and configuration data among maintenance management systems" Using these results, the NAE could investigate, test and implement PLCS technologies to improve the SRC-card process. This would drive the SRC-card process toward a single process of ownership, enhance cost-wise readiness, provide improved materiel management, and ensure higher availability through faster turnaround times. In this case, the common DEX (data exchange) environment inherent to PLCS systems would provide a secondary DoD benefit, Total Asset Visibility (TAV). TAV gives logisticians and controllers another means of asset accountability and location determination: the core intention of UID DoD mandates.


**Figure 4. PLCS Model**
(After Mason, 2008a)

The four-part Product Lifecycle Support model (Figure 4) is receiving a lot of attention in the PLM world because it provides a feasible roadmap for common collaborative architecture that can be used by many different types of organizations and industries. The red box symbolizes a standardized software architecture that would allow sharing aircraft part information from the OEM to the user and to the entire supply chain throughout a part's entire lifetime, using a central Repository and standardized database software language (Figure 4).

Ironically, despite NALCOMIS having a database architecture comparable to that depicted in Figure 4, *NAMP* SRC's hard-card requirements must remain because NALCOMIS does not collaborate with either CMIS Repository. Each part transferred from one command to another must have an accurate, updated SRC card, or part installation could be delayed per *NAMP* instruction. This single point of failure leads to cannibalization of other squadron aircraft, missed sorties and/or reduction of squadron readiness as identified in our research survey results.

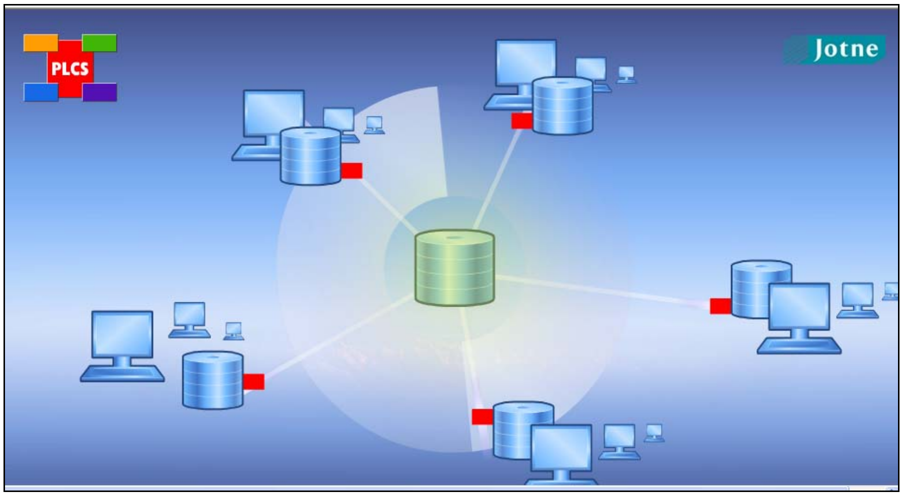



**Figure 5. PLCS Model Using Common CMIS Repository[13]**

The PLCS implementation effort is spearheaded by an international consortium that includes both governments and businesses such as the DoD, Boeing, the UK Ministry of Defense, Finnish Defense Forces, the Norwegian Ministry of Defense, the FMV (Swedish Ministry of Defense), BAE SYSTEMS, Rolls Royce, Lockheed Martin, and SAAB. Its concept forms the foundation of the J-35 Joint Strike Fighter (JSF) maintenance and logistics program known as ALIS (pronounced "Alice"), which is discussed later. PLCS also meets the standard set by the International Organization for Standardization (ISO) for the exchange of product model data (STEP), which enables the creation, management, documentation and tracking of a part. Noted by PLM consulting firms, these advantages make PLCS a necessity for aviation organizations. "Since all data is converted via data exchanges (DEX) and stored in a PLCS definition, the information can be relatively easily monitored for consistency during the ongoing exchange processes. This data

---

[13] Caption presented in PLCS concept video available on the JOTNE EPM Technology news Web site: http://www.epmtech.jotne.com/

validation helps maintain product information quality and integrity even in highly-distributed and heterogeneous environments” (CIMdata, May 2009).[14]

To emphasize the necessity of PLCS concept applications, it is useful to consider the Boeing 737. On April 16, 2009, Boeing produced its 6,000 737. It is flown by more than 115 different airlines and is made up of “367,000 parts; an equal number of bolts, rivets and other fasteners; and 36 miles (58 kilometers) of electrical wire” (Addams, 2003). Unlike the military’s use of jets, many of these jets are leased, many of these jets are leased and therefore the airlines do not maintain large spare-part inventories, if any at all. A landing gear strut from a 737 used in Brazil may be serviced and sent to an airline in the United States. Flight safety alone dictates the absolute necessity of maintaining adequate lifecycle data on the strut. But Boeing’s part database does not openly collaborate with every airline worldwide that uses its products because there is no agreed upon standard. This can lead to lost lifecycle data and a delay in part installation as this data is queried. This delays the return into service of an expected asset and even worse, could lead to a catastrophic event should the part be installed without proper service-lifetime knowledge.

The PLCS model is based on an Automated Information System (AIS) that takes advantage of AIT such as Unique Identification (UID)/Unique Item Identifier (UII) technology, which is now mandated by the DoD and applicable to all DoD acquisition processes.[15] The DoD’s UID purpose is two-fold:

> Establish policy and prescribe the criteria and responsibilities for creation, maintenance, and dissemination of UID data standards for discrete entities.

---

[14] ISO STEP standard 10303-239 provides a flexible application-specific information model. The model can be tailored to any activity using Reference Data Libraries (RDL). The role of a RDL is to complete the semantics of the PLCS model necessary for deployment in any activity.

[15] The UID/UII is a unique component identifier that contains data elements encoded into Data Matrix bar codes that are applied to every qualifying government item. By having each item marked and scanned, the DoD is creating a continuously updated inventory registry that is available for reporting via their Wide Area Workflow (WAWF) system.

> UID standards will enable on-demand information in a net-centric environment, which is an essential element in the accountability, control, and management of DoD assets and resources. It also establishes policy and assigns responsibilities, for the establishment of the Department's integrated enterprise-wide UID strategy and for the development, management, and use of unique identifiers and their associated authoritative data sources in a manner that precludes redundancy. (Under Secretary of Defense (AT&L), 2007).

As mentioned earlier in the background section, ADUSD-MR&MP CONOP and the NAE SIM strategy were developed in an effort to support this policy.

### 2. Joint Strike Fighter (JSF) Autonomic Maintenance Vision

The current JSF maintenance process being implemented by Lockheed Martin centers on the Autonomic Logistics System, known as ALIS. Lockheed Martin plans to take advantage of AIT technology like UID and RFID to implement a PLCS-type system. Mitch Kaarlela (2004) of Lockheed Martin stated that "it is encouraging to realize that our JSF vision for Auto-ID is similar in many ways to the DoDs UID vision. This indicates that independent organizations have recognized a common need and come to a common conclusion—automated part identification must be done to reap downstream data usage benefits" (p. 12).

The JSF logistics program is fairly simple in concept but large in scale. It encompasses the entire logistical and operational chain from part manufacture to part retirement in eight different countries purchasing the JSF. It is designed to last for as long as the airplane remains in service. Unlike most military aircraft, JSF has the ability to communicate in flight with its maintenance system, ALIS. Its Prognostic Health Management (PHM) System abilities allow it to determine when a part is about to hit a lifecycle limit or needs repair. ALIS then alerts the maintenance team of the new or upcoming maintenance requirement so that personnel are ready to troubleshoot and evaluate the problem before the airplane ever lands. More importantly, the communication links between ALIS and JSF should help ensure that the correct ready-for-issue (RFI) part needed from supply arrives before installed parts “die,” based on lifecycle maintenance requirements.  The goal is to have the right part at the right place at the right time, without ever lifting a pen to fill out paperwork.

An e-mail from ALIS Maintenance Management IPT Lead, Mr. Jim Helfst, explains how the JSF maintenance and logistics concept will perform operationally. The e-mail is based on a hypothetical in-flight radar failure.

> ALIS gets the fault code (Health Reporting Code: HRC) from the pilot’s data cartridge (Portable Memory Device: PMD).  ALIS processes the HRC: filter, correlate and identifies a troubleshooting matrix to clear the fault.  HRC work order sent to CMMS. Maintenance Control Chief sees the new work order on squadron status or air vehicle status screens.  Maintenance Control Chief notifies the work center supervisor to work the radar fault (HRC work order). Work center supervisor opens up the work order and reviews the solution set (trouble shooting tree) that contains maintenance actions that will fix the radar fault.
>
> Work center supervisor or maintainer selects the solution they will work and orders the replacement part required. They order the A-13 Line Replaceable Component (LRC).  CMMS automatically checks the aircraft as-maintained to determine the part number for the A-13 LRC and automatically send this information to supply (no more ordering the wrong part).  Retail supply determines if there is a prime or substitute A-13 LRC on hand. Assume there is one available. Supply returns the notification to CMMS that a specific serial number (IUID) is available for pick up. CMMS automatically add the serial number (IUID) to the work order. Once the work order is closed the new serial number will be added to the as-maintained.  Work center supervisor or maintainer within moments is notified that there is an A-13 CCA available to be issued and maintainer prepares to go to the aircraft to remove and replace the A-13 LRC.
>
> Supply locates the Electronic Equipment Log Book (EEL) for the specific serial number A-13 LRC in the ALIS data base and sends the file pointer for this log book to CMMS. CMMS stages the EEL with the work order. If there is an Aircraft Data File that needs to be loaded once the LRC is installed. The EEL contains a pointer to the Aircraft Data File. CMMS added this pointer to the work order and ensures the Aircraft Data File is moved to the PMA that the maintainer will use at the aircraft. Once at the aircraft the maintainer loads this Aircraft Data File as part of the work order process.

> The EEL: Captures significant maintenance actions, replaces paper records used in legacy programs and supports Autonomic Logistics data quality needs, maintenance events that impact configuration, removals and installations, Time Compliance Technical Directive (TCTD compliance), Maintenance events that support determination of item pedigree, Scheduled inspections, Ready-for-Issue (RFI designation), Reference pointers to associated files that are required to remain with the physical part for use at the point of maintenance or in support of maintenance or supply. The maintainer removes the old A-13 LRC from the aircraft and returns it to supply, supply issues the new A-13 LRC. Behind the scenes when the maintainer selected on the work order that they removed the faulty A-13 LRC serial number was removed from the aircraft as-maintained. The EEL for the removed LRC is updated with usage information along with the radar HRC fault information. The faulty A-13 LRC goes back to the Original Equipment Manufacturer (OEM) along with the updated EEL. OEM has information to determine what is wrong with the LRC, repairs it and changes the EEL from unserviceable to ready for issue. This LRC is then returned to the JSF inventory for use on another service aircraft.
>
> Maintainer verified that the faulty A-13 LRC serial number (IUID) was correct. They have a bar code scanner attached to a portable maintenance aid (PMA) allowing the maintainer to check the part information at the point of maintenance that can be used to verify the serial number/IUID. CMMS displays the current A-13 LRC serial number as well as the new A-13 LRC that is installed, maintainer needs to verify that they are removing the same serial number part and installing the correct part. ALIS cannot take the human out of the loop to make this fool proof. The new A-13 LRC is installed and now the as-maintained captures the new serial number. The EEL tracks the installation and starts capturing on aircraft usage. Assume the LRU is a life limited component: The EEL contains the life remaining on the component and ALIS will fire off a work order prior to the components life limit expiration. All of this is tracked behind the scenes. (J. Helfst, personal communication, July 10, 2009)

Since each ALIS will be centrally connected to strategically placed master servers around the world, part availability and aircraft/part-usage time will be continuously tracked for future research or time-critical data calls. Misplacing SRC cards will be virtually impossible meaning little to no costly part-lifetime penalties like those experienced today. JSF will be used by military Services worldwide, allowing a global common pool of spare parts to be established and maintained as shown in Figure 6.

Figure 6 describes the conceptual spare-parts process for the JSF as seen by the contractors. This single supply chain will rely on a centralized inventory-management process within automatic logistics/global sustainment operations, executed by an Autonomic Logistics Global Sustainment (ALGS) operations center and run by contractors (Lockheed Martin, 2007).

## JSF PBL Spares Support

| | |
|---|---|
| JSF Global Spares Package (GSP) – A global inventory level at a Regional Warehouse managed by Team Lockheed Martin (LM) managed spares (repairables and repair parts) stocked at To Be Determined (TBD) geographic locations, to support the contract specified, customer defined Air System performance and flying hour requirements (e.g. sortie generation rate, aircraft availability, number of flight hours, etc.) for all JSF aircraft. | JSF Base Spares Package (BSP) – A level of Team LM managed spares (repairables and repair parts) stocked at the Base Level with sufficient range and depth to support customer defined Air System performance and flying hour requirements (e.g. sortie generation rate, aircraft availability, number of flight hours, etc.) for JSF aircraft stationed/deployed to that Base. |
| JSF Deployment Contingency Package (DCP) A DCP provides mission essential F-35 spares and is designed to provide units with initial wartime support until follow-on support can be established. A DCP is a level of self-contained set of spares (repairables and repair parts) to support wartime sortie generation rates (SGR) for a customer determined level of wartime operations without benefit of replenishment until a JSF Follow-on Spares Package (FSP) can be established. A DCP provides support for deployed units in contingency and wartime environment and requires replenishment from the Global Spares Package (GSP). | JSF Follow-on Spares Package (FSP) – An augmented level of Team LM managed spares (repairables and repair parts) to support units which will forward deploy to shore bases of sufficient range and depth to support customer determined wartime sortie generation rates (number of flight hours) for a customer determined (contracted-for) number of operational days. A FSP provides sustainment support and supplements the DCP for units operating in a wartime environment and requires replenishment from the Global Spares Package (GSP). |

**Figure 6. JSF Performance-based Logistics WorldwideSpare-part Support Concept**
(From Lockheed Martin, 2007)

An operations center will perform inventory management, distribution, and transportation functions in support of the multiple spares packages outlined in Figure 6. This should ensure the right part is in the right place at the right time, but time will tell if the operation center idea will be able to handle round-the-world part support. Because the JSF will have many unique customers located throughout the world, aircraft employment could vary along with the environment in which it will be used

Last, although not included in the figure above, a JSF Afloat Spare Package (ASP) will also be stood up on CV, CVN, "L" Class Ships and any other shipboard operations required. Its function will be to maintain a sufficient range and depth to support the contract specified, customer-defined air system performance and flying-hour requirements (Lockheed Martin, 2007). This will arguably be more difficult to provide than any of the other services because Fleet naval assets do not stay stationary nor do they have always have an opportunity to fly spare parts aboard. Further, the JSF has not spent enough time in the at-sea environment to provide good estimates on which parts to stock and how many. In theory, the JSF ASP is a great idea and should significantly enhance the JSF's readiness numbers, but caution must be exercised before making bold predictions about any future success in such an unpredictable operational environment.

### 3. NAVAIR Paperless SRC-card Pilot Project

The NAVAIR Paperless SRC-card project was formed in 2006 in response to numerous Fleet requests for a better SRC-card process. "In August 2006, the Fleet Design Team (FDT) unanimously voted in favor of an initiative to eliminate dual documentation, beginning with the V-22, E-2C and VT-6 communities" (Blake, 2006). This addressed numerous issues being raised by the Fleet and was supported by a NAVAIR survey given to the SH-60 community. The effort was further supported and continued to be requested by both the ATCM program manager and Dycomtrak management. The NALCOMIS OOMA FDT membership includes both Navy and Marine Corps upper-echelon commands such as the Commander Naval Air Forces (CNAF) and the Headquarters, Marine Corps (HQMC). Its mission ranges from surveying the entire Fleet of OOMA users to proposing and addressing updates and patches for OOMA. Recognizing the need to streamline the dual documentation process currently in place for aircraft logbooks and associated records, the FDT drafted a plan to begin removal of all hard-cards, such as the SRC, beginning in October 2007.[16] The goal was to have a paperless, hard-card maintenance process implemented and running throughout naval aviation.

In order to implement the plan, the new software version would have to pass Operational Test and Evaluation (OT&E). More importantly, all squadrons, maintenance rework shops and supply centers would need to run the new NALCOMIS OOMA software version in order to be completely paperless. The new software install would be done systematically based on CNAF's Type Model Series (TMS) timetable, starting with the E-2C. As shown in Figure 7, 280 sites would receive the new OOMA version by FY11 at a cost of $73.5 million. The delivery date was moved up to FY09 by the NAE to accelerate expected cost savings attributable to the project (Foster, 2007). The number of installation sites was later reduced to 212, with a corresponding reduction in proposed installation costs ranging between $48.5 and $52.3 million. Costs included software development and funding for the training of 10 tiger teams who would, in turn, install the software and train military personnel. The project was never implemented for undocumented reasons, but we suspect the motivation may have been budgetary constraints and the inability to meet NAE deadlines.

[16] Dual documentation refers to both hardcopy aircraft logbooks and NALCOMIS OOMA Auto-Logsets. Squadrons are currently required to maintain both types of recordkeeping.

**NAVAIR Paperless SRC-card Pilot Project**
**Timeline and Cost**

280 ⟶ Total Sites Reported to NAE BOD
(Complete in 4 yrs @ $75 million)

\- 41 ⟶ Sites with Aircraft not in NAVAIR Baseline Matrix

\- 11 ⟶ Sites decomming in FY08

\- 16 ⟶ Sites completed scheduled FY07

= 212 Sites to be completed in FY08 09
(Complete in 3.4 yrs @ $56.8 million)

Note: Other Install Options discussed ranged from 2-2.7 years costing $48.5 to °o52.3 million)

**Figure 7. Paperless SRC Project Original Timeline and Costs**

## D. Other Innovative Process Considerations

### 1. Web-based Server

In late 2006, NAVAIR conducted a survey of NALCOMIS's users in an effort to identify and improve key aspects of the recording process that documents aircraft component histories. The creation of a Web site and associated Web-based and database servers was suggested by many of the survey respondents. The idea was to create a secure parts-information database that could be queried at anytime from anywhere much like what is being developed for the JSF. The Web site would allow immediate part-lifecycle information and verification while providing the ability to update part information. Survey comments suggested that this would help reduce or completely eliminate SRC-card errors and/or losses.[17]

Web-based servers have become the foundation of current computing. A person only needs to log in to his or her Amazon account or online bank account to realize the power of Web-based servers. They can be made secure and available 24/7 from anywhere in the world. Servers can accommodate large amounts of data by using technology that can be upgraded over time ensuring data integrity and availability over long periods of time. Although there are numerous types of commercial database servers available, the industry has seen the development of third-party software that allows collaboration between different database architectures.

As for Web-based services that take full advantage of this technology, Amazon stands out among its competitors. Once logged in, Amazon's Web site allows Web-based servers to talk with database servers to give current account data at anytime. The account data, such as an address, can be modified whenever necessary and is available almost immediately afterwards. Amazon servers maintain accurate inventory at a moment's notice, even with the thousands of transaction that are taking place every second.

A similar Web-based system exists (ATCM and COMTRAK) and could be employed by the ATCM program manager. The Web-capable Oracle 10g database currently in place holds critical part information needed by aviation maintainers deployed around the globe but is administratively limited in collaboration abilities. The administrator can "unlock" the database and allow Fleet users to access to the database by establishing an account with the ATCM Repository but before that action is considered, a training program will need to be established and access

[17] NAVAIR survey information was reported in a PowerPoint presentation entitled Lean Six Sigma. This presentation listed each question and its respective answer as well as number of respondents.

procedures standardized. Interestingly, the database is already UID-capable, in compliance with the DoD mandate. The ability to provide part-lifecycle information at a moment's notice would significantly reduce delays in the installation of received parts that are not accompanied by an SRC card. Further, this innovation would provide notable increases in aviation readiness for each TMS and save millions of dollars in yearly part penalties.

### 2. Unique Identification (UID) and Contact Memory Buttons (CMB)

UIDs are analogous to a social security number of an object. They are unique to a specific part and cannot be duplicated. Each UID is registered in a master DoD database that each Service and vendor must access prior to marking any component. That ensures the number is unique. As it stands now, there are different types of components from different vendors that may share the same serial number. This could lead to the ordering of an incorrect part from the supply system. UID markings would prevent this unfortunate reality while simultaneously incorporating the DoD's goal of Total Asset Visibility. UID reduces human error, eliminates data transposition errors, increases process efficiency, and increases data accuracy while allowing component tracking from cradle-to-grave.

The DoD mandates incorporating UID technology into all procurement and acquisition. This applies not only to each military Service but also to all vendors selling equipment to the DoD. With little coordination between the Services, no industry standard and inconsistent approaches to implementation, UID incorporation is taking time to mature in the DoD. But there are several DoD commands like Naval Surface Warfare Center, Corona Division (NSWC) taking aim at this technology to ensure all Services and vendors come to a common standard that is acceptable to everyone. This can also be somewhat of a daunting task because of the many different networks owned by each Service. In particular for the Navy, NMCI is currently the biggest problem. However, as shown in Figure 8, NSWC has developed a gateway to bridge the gap between the networks so that all networks can talk with the master DoD UID registry.

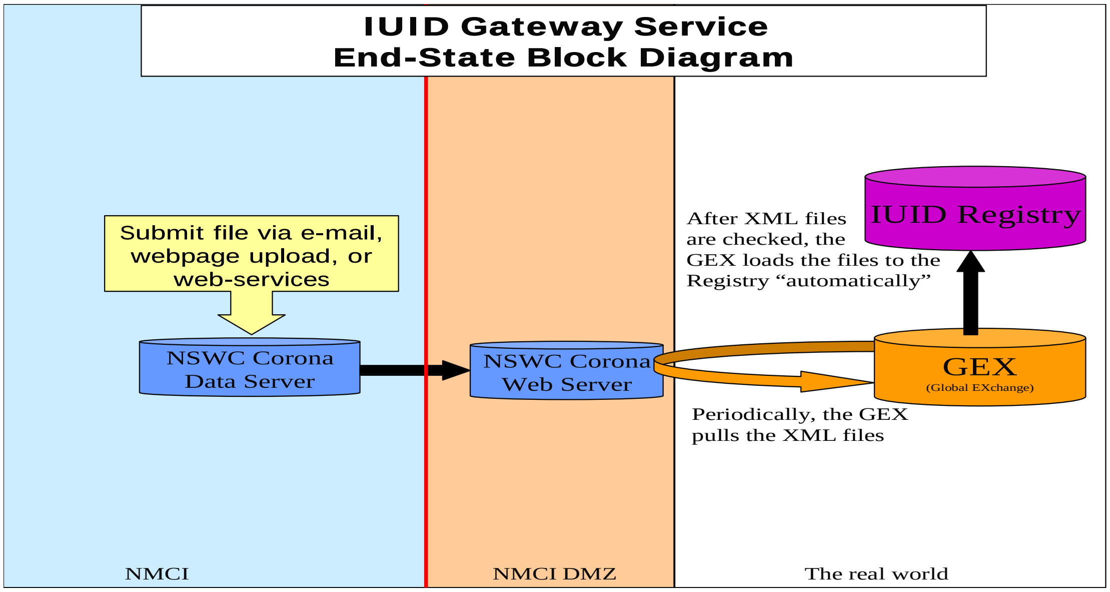



**Figure 8. Gateway Between NMCI and the DoD UID Registry**
(From MacDougall & Pompa, 2009)

Another technology designed to enhance configuration management, asset tracking, and maintenance practices throughout the lifetime of a part is the Contact Memory Button (CMB). As shown in Figure 9, the CMB supports UID, has been tested in the harshest of conditions, and is currently employed in various Army and Navy commands around the world. Navy CMB guidance, standard references, and procedures for implementation are provided by the Navy's *AIT Implementation Manual*[18] (NAVSUP, 2006). Ships, helicopters, fixed-wing aircraft, and even the Navy Seals use the technology. In fact, CMBs have "over 400 hours of incident free flight test (as of 1/2000) on main rotor blades for H-3, H-46, and H-53 helicopters at Naval Aviation Depot, Cherry Point whirl tower. This is considered naval aviation's

---

[18] The Navy's *AIT Implementation Manual* does not specifically cover IUID. It only discusses and directs implementation for CMB, RFID, Smartcards and barcodes. NAVSUP has produced separate guidance for UID implementation.

most difficult static electricity and vibration-operating environment” (MacSema, 2009). CMBs, unlike UID, provide read/write capabilities for data-storage purposes. They are battery free and become “activated” only when contacted with a probe from a CMB handheld reading device. The stored information can be transmitted wirelessly or directly plugged back in to the command database.

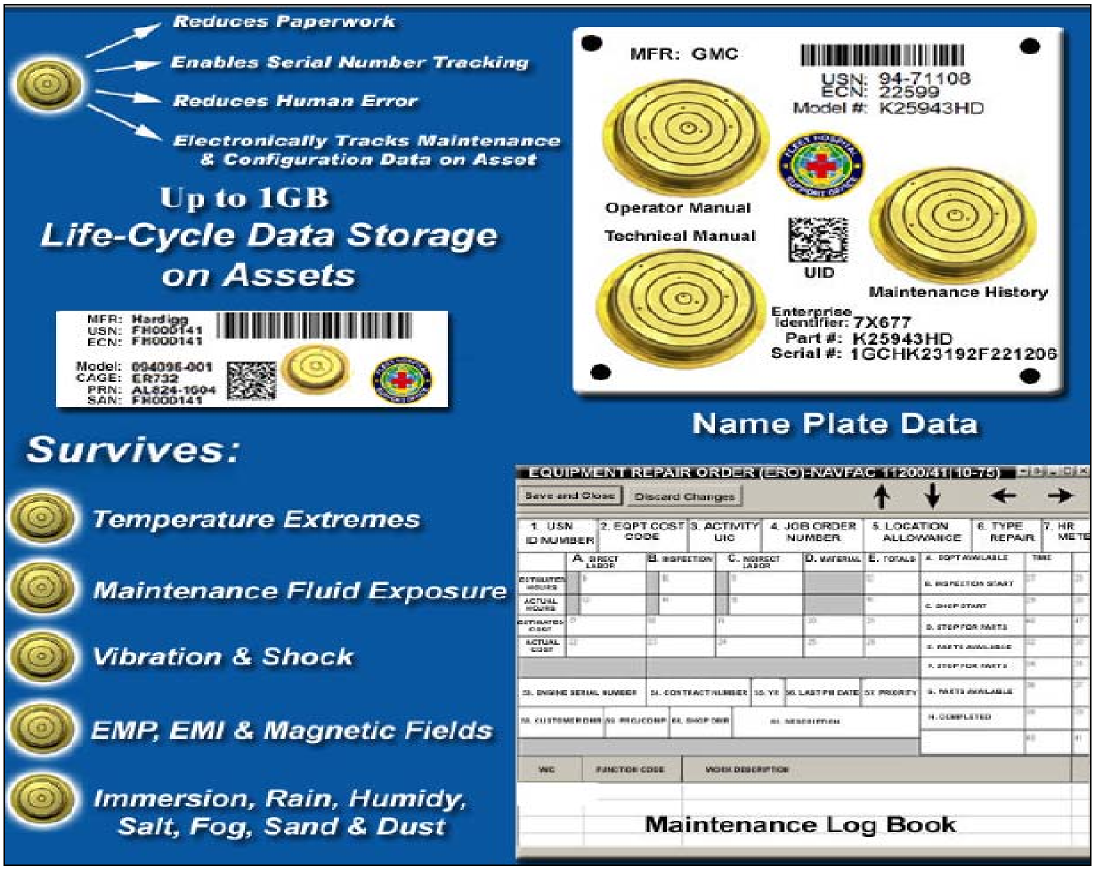



**Figure 9. MacSema, Inc. Innovative Buttonmemory CMB**
(From MacSema, 2009)

The U.S. Army’s Aviation Maintenance Automated Tracking System (AMATS) is an excellent example of AIS using AITs such as CMB and UID together in the aviation environment. They fully support the DoD Logistics AIT Concept of Operations (CONOP), promulgated in November 1997 by the Deputy Under

Secretary of Defense for Logistics (DUSD(L)), who concluded that the DoD's informational needs cannot be satisfied by just one AIT device (NAVSUP, 2006).

Developed by Avion Services and shown in Figure 10, AMATS eliminates the need for manual data entry because the component data stored on the CMB is loaded on a reader that talks directly with a unit-level database that collaborates directly with the Army's Maintenance Consolidated Database System (MCDS).[19] Figure 10 provides a networked database overview of the CMB and UID process being employed in the Army AH-64 Apache program. MCDS, Army's equivalent to Navy's CMIS Repository collaborates with Depot and Manufacturer-level systems. The results are fewer lost maintenance records, greater data accuracy, dramatic internal paperwork time savings, and almost immediate updates to the central Repository. This automated system by Avion Services would also be a potential solution for the barriers to automated implementation to the CMIS/ATCM Repository.

---

[19] The AMAT concept was the first in a series of three contractual efforts issued to Avion, Inc. in support of the Army Aviation and Missile Command (AMCOM) to develop, implement, field and sustain an Automated Information System (AIS) for Army aviation.

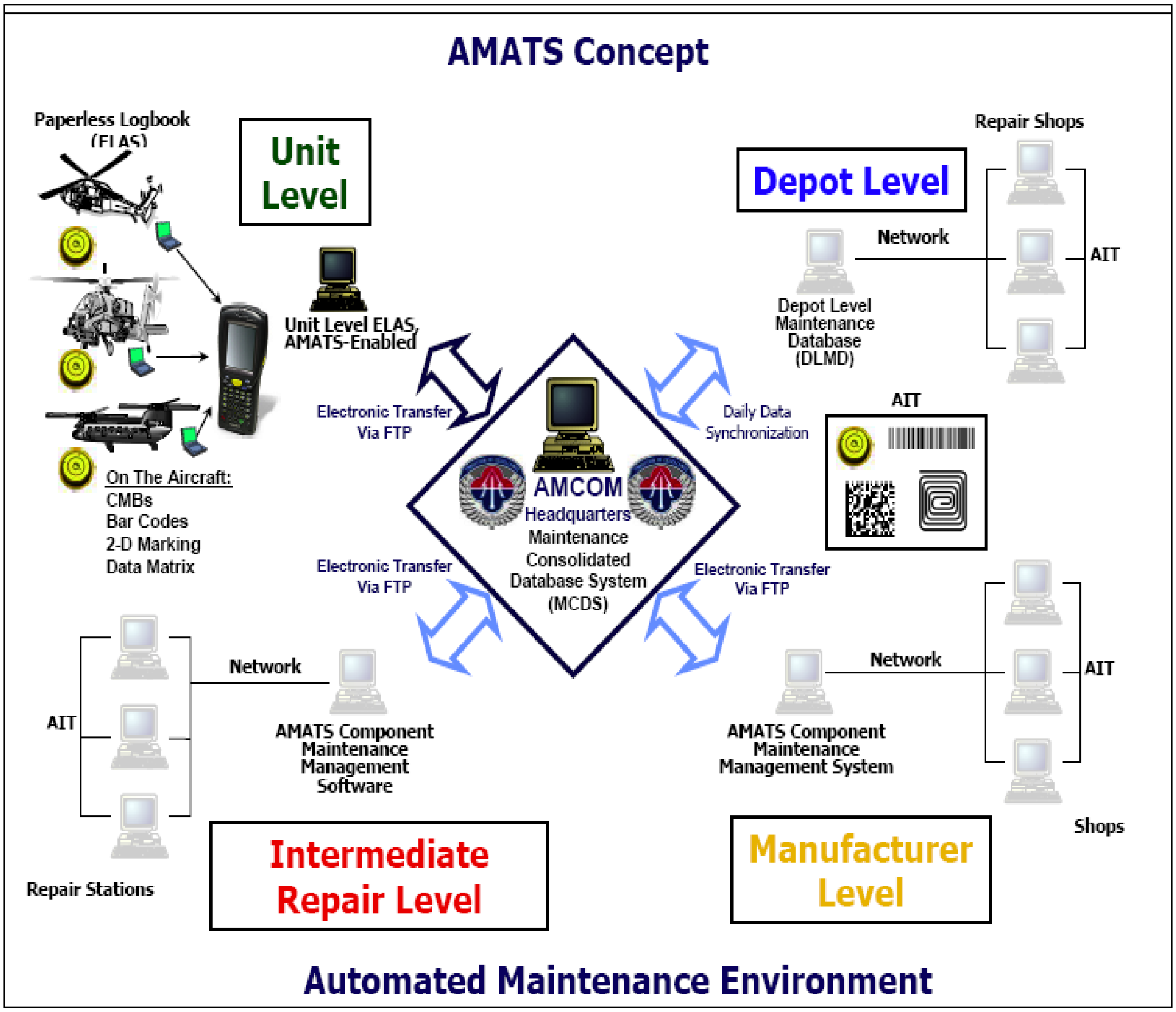



**Figure 10. U.S. Army Aviation Maintenance Automated Tracking System**
(From Buckner, 2003)

# III. On-Site Process Flow Observations

## A. Monitoring the Process Flow of an F-18 SRC-Card

Our team traveled to NAS Lemoore to observe the process flow of SRC-carded items as operational squadrons, through the supply chain and repair cycle, submit new requisition documents as previously discussed and shown in Figure 3 on page 9. The first squadron we visited was about a week out from a scheduled deployment and was preparing its aircraft for the shift to carrier operations. We met with the squadron's Maintenance Material Control Officer (MMCO), Aviation Administrativeman (AZ) Lead Petty Officer (LPO), and the Storekeeper (SK) LPO. We introduced ourselves as NPS students and explained that we were conducting thesis research analyzing the Navy's Scheduled Removal Component card process and Product Lifecycle Management.

### 1. Observation of an Operational Squadron

In our encounter, we told the group of maintenance professionals that we were particularly interested in identifying root causes of lost SRC cards and finding ways to improve the way the Navy manages lifecycle data contained on the SRC card. The initial response we received from the squadron personnel was chuckling and the shaking of heads. The MMCO informed us that their squadron was currently dealing with the exact scenario that we were researching. That morning, the squadron had an aircraft go down for maintenance. The grounded aircraft required a replacement main landing gear axel, an SRC-carded component.

The squadron completed a discrepancy MAF and transmitted a requisition document to order the replacement part from ASD. The squadron's SK LPO reported that supply had two replacement components on hand. The first replacement axel received from ASD was packaged in a container with shipping labels believed to have originated from the manufacturer. The component was initially identified as “new” and did not contain an SRC card. Upon inspection of the part, squadron work-center personnel believed the part was, in fact, used. The part looked dirty and worn and had already been removed from its packaging within the shipping container.

Not confident the axel was RFI—and given the fact that the shipping container did not contain an associated SRC card, Certificate of Conformance or RFI tag—the squadron could not guarantee the integrity of the component and chose not to install it on the aircraft. Squadron SKs contacted ASD personnel and confirmed that all logs and records associated with the component had been delivered. ASD confirmed that there was no additional documentation available for the component. The MMCO contacted the ASD officer and described the condition of the replacement axel. The squadron forwarded the identifying information for the suspect axel via an email to the ATCM Repository for disposition. Since ASD had one additional axel in stock, they agreed to issue the remaining component to fill the squadron’s outstanding requisition.

The second axel received from ASD was also placed in a container that had shipping labels believed to have originated from the manufacturer. Squadron personnel opened the shipping container, and the packaging that contained the axel looked to be intact. The shipping container did not contain an associated SRC Card, which is consistent with new parts received from the manufacturer. The packaging was removed, and the axel looked like a new component. The squadron accepted the second axel and began the removal and replacement of the damaged axel. The squadron’s Logs and Records clerk initiated an SRC card for the new axel and sent a duplicate to the ATCM Repository via standard U.S. mail.

### 2. The Document Control Unit (DCU) was not Observed

The DCU is an administrative function; the DCU personnel process requisition documents to verify required information is correctly annotated. Once the requisition is considered valid, the request is transmitted to the MDU, where the MDU personnel will pick up and deliver material from appropriate storage locations.  The DCU personnel do not physically handle components.

### 3. Observation of the Aeronautical Material Screening Unit (AMSU)

We observed the AMSU personnel that shared a common work center with the MDU. We focused particularly on the role of the MDU personnel since they performed a similar physical verification of components and their associated logs and records.  The AMSU personnel rarely received an SRC-carded component without its associated SRC card.  In instances in which components were received without SRC cards, the AMSU simply refused the turn-in retrograde component.

### 4. Observation of the Material Delivery Unit (MDU)

The MDU was located across the hallway from the Intermediate Maintenance Activities Production Control.  Both civilian and Navy personnel staffed the MDU. Navy personnel consisted of regularly billeted supply personnel and squadron personnel who had been temporarily assigned duty (TAD) to the MDU.  The work center appeared to be very busy; personnel were frequently coming and going with various repairable components.  The workspace looked organized: large storage racks lined the wall behind the service counter and the racks were clearly marked with labels titled RFI and non-RFI.  The storage racks held various parts wrapped in barrier paper and bubble wrap.  There were large items in a staging area, such as radar antennas; these items were in appropriate storage containers.

We spoke with a storekeeper (SK) who was assigned to an ASD billet and currently worked at the MDU.  The SK explained that the experience levels of personnel varied within the MDU.  For example, there were TAD personnel from the squadrons who had very little or up to three years of experience dealing with things such as MAFs, requisition documents, shipping containers, labeling, and component recognition.  There were also SKs assigned to the MDU who usually had more experience and were placed in leadership roles in which they were responsible for training TAD personnel while still performing their MDU duties. Civilian personnel also filled various roles within the MDU. Most civilians were very experienced in their duties; some civilian MDU personnel had worked in the MDU for an excess of 10 years.

The SK explained that the job was relatively easy once personnel became proficient at screening a component and verifying all the paperwork that accompanied the component. We told the SK that we were NPS students interested in the flow of repairable components through the repair and supply process, and we were particularly interested in SRC-carded components and how the paperwork travels with the component. The SK was familiar with SRC cards and explained that when he picks up a retrograde component or delivers an RFI component, the MAF should be annotated whether or not that particular component requires an SRC card. He showed us a copy of an MAF for a retrograde component that they had on the shelf. The retrograde component was an SRC-carded item, and on the MAF in the upper right hand corner, it was labeled with SRC and a "Y" for yes. He explained that if the part did not require an SRC card, then the MAF would be annotated SRC: N.

We asked what he felt the chances were that MDU personnel would pick up a retrograde SRC-carded component missing its SRC card, or deliver a component to a squadron missing its SRC card. We first discussed the chances of MDU personnel picking up a retrograde component without its SRC card. He explained that they are constantly working against the clock to meet response-time requirements, so they screen the components thoroughly. If the MAF identified that a the component required an SRC card, they would verify that the card was present and the nomenclature, part number, and serial number matched the actual component.

He continued saying that there were times when, despite the annotation on the MAF, MDU personnel had picked up SRC-carded components without verifying if the SRC card accompanied the part. He said in these instances, the MDU personnel would try to deliver the component to Production Control (PC) for induction and the IMA work centers would refuse the part because of the missing SRC card. MDU would be forced to return to the squadron that had turned in the component and request the card. In most cases the squadron had the card ready and forgot to attach it to the part, or they had in fact, lost the card and would have to re-create a new one.

When delivering SRC-carded components to the squadron, he said that most squadrons verify upon delivery that the SRC card is present. If the component is in a sealed container or box, squadrons accept the delivery most of the time without verifying if the SRC card is present. He did remember instances in which squadrons would call after a delivery and inquire about a component's associated SRC card. Squadron personnel would explain that when they opened the container, the SRC card was missing. In the event that a squadron called about a missing SRC card, MDU personnel would look around the workspace and their delivery vehicles to see if the card had been separated during the transportation of the item from supply to the squadron hangar. In most cases, the missing SRC cards were not located.

### 5. Observation of the Intermediate Maintenance Activity (IMA)

At the IMA, we spoke with a production control chief and an administrative person (AZ) from the IMA's Maintenance Administration work center. The AZ worked as the Logs and Records clerk and was familiar with the SRC card and its processing. We introduced ourselves as NPS students and explained our specific research focus. The PC chief said that he remembered dealing with the issue of lost SRC cards when he was a technician in operational squadrons. To his knowledge, missing SRC cards were not a huge issue at their IMA. If one of their work centers did receive an SRC-carded component without its associated SRC card, then the item would be kicked back to the squadron until they could produce the SRC card.

The AZ said that she is supposed to physically have custody and maintain all of the SRC cards for components that are inducted for inspection or repair, but she could not verify with confidence that all SRC cards made it to the Maintenance Administration work center. She said they had so many components coming and going that it was difficult for her to keep track of whether or not all SRC cards made it there. She was aware that there were SRC-carded components received, but she was not positive she had physical custody of each SRC card in Logs and Records. IMA work centers would bring her SRC cards after maintenance was performed on the component and would request that the SRC card be updated. She also communicated that there could be a possibility for an SRC-carded component to be inducted, have work performed on it, and leave the IMA without a logs and records clerk ever seeing the associated SRC card. She was asked if she thought work center personnel made entries on the SRC cards, but she assumed that they either made entries on the SRC card, or no entries were made on the card at all.

### 6. Observation of Aviation Support Division (ASD) Personnel

Our visit to ASD began with a discussion of the two axels that had been issued earlier in the day without their associated SRC cards. ASD personnel said it was quite common for squadrons to refuse RFI components that did not include the required SRC card. They quoted the *NAMP* in saying that a new item from the manufacturer would not include an SRC card, and it was squadron responsibility to initiate an SRC card for new components. We briefly discussed the possibility of shipping containers being reutilized to store stock assets, particularly containers that might lead someone to believe that the component had been shipped from the original manufacturer when in fact it was used. ASD personnel responded that a new component was easily distinguishable from one that was used. They would be identified by shipping information, clean fresh paint, original packaging materials that were sealed, and by the manner in which the components were packaged for shipping.

### 7. Observation of the Supply Screening Unit (SSU)

During the SSU visit, we noticed several portable bar-code scanners on the desk of a supervisor. Six were inoperable for various reasons. We were told that the technology was old and unreliable. One staff member even boasted that the technology was so old and unreliable that he could conduct a line-item inventory faster by hand. SSU personnel said that using the technology was actually cumbersome because data had to be captured and transferred via software to their inventory-control database, which required a certain level of specialized training. The bar-code scanners were manufactured in 1997 and were used infrequently, but the requisitions for replacement scanners had been submitted. The SSU personnel were aware of the SRC-card problems, but most of their quality control was to ensure that components were properly packaged and free of any leaking fluids. It was not common practice for them to open any sealed containers.

### 8. Observation of the Configuration Management Information System/Aeronautical Time Cycle Management Program (CMIS/ATCM) Repository

As mentioned earlier, an often overlooked piece of part-lifecycle management is the SRC-card tracking process. One of the most frustrating scenarios experienced by an aircraft maintenance team is when a component necessary to fix a discrepancy is received but cannot be installed because the part did not come with an accompanying SRC card. In need of critical part-lifecycle data located on a missing card, squadrons are directed by the *NAMP* to contact Naval Air Systems Command 6.0. Combining recent survey results with the ATCM Repository personnel statements, it is clear that most squadrons called the ATCM Repository because they did not know about the NAVAIR 6.0 Web site that contains an electronic means for submitting requests. Further, Web site knowledge is not part of the training for those specific aviation maintenance rates who work with SRC cards, so this knowledge only comes through word of mouth.

For the ATCM Repository to accomplish the first of its two functions (direct Fleet support via phone), it uses a maximum of four junior enlisted personnel working eight-hour days; however, there are only three currently fulfilling those billets. These sailors are the ATCM Repository's only customer-service representatives for the entire naval aviation Fleet. They do not work on holidays or weekends, and the ATCM Repository does not have after-hours service or automated assistance.

As mentioned earlier, in fulfilling its second function of maintaining accurate SRC records, the ATCM Repository employs three civilians with no naval-aviation maintenance background. They perform manual data entry into the database for each SRC card received. The ATCM Repository receives all updated hard-cards from Fleet commands at an average rate of 210 a day—51 of which are SRC cards. These three civilians open the mail and look for any potential problems with the cards, but they do not validate the information.

Because the Navy uses two different versions of Naval Aviation Logistics Command Operating Maintenance Information System (NALCOMIS), some of the SRC cards received by the ATCM Repository are handwritten and illegible.[20] This can add time and error into the data-entry process and is one reason the ATCM Repository has 3,600 cards in backlog as of late August 2009. Compounding the problem, commands typically "snail mail" updated SRC cards to the ATCM Repository after each part is transferred to an external command because there are no electronic means available to the Fleet for uploading or modifying new or existing

[20] NALCOMIS is a local (squadron-centric) network database used to track and document a part's history. Two versions are currently used: NALCOMIS OOMA (Optimized Organizational Maintenance Activity) and NALCOMIS Legacy. Legacy and OOMA are a large leap in the evolution of aviation-maintenance recordkeeping and preventative maintenance practices.

SRC-card information, so it may take several weeks before the updated information reaches the ATCM Repository, and then it takes even longer to get that data into the database.

The ATCM Repository does not have a Web site for users to query their database, but their Oracle 10g server is Web-capable just not enabled. This prevents users from having access to part information on a real-time always-available basis. If a squadron needs to obtain specific part information, a phone call to the ATCM Repository on Friday afternoon will go unanswered. The squadron must wait until Monday morning (Eastern time) to talk with the ATCM Repository personnel. The two-day-weekend delay combined with an average three-day ATCM Repository turnaround delay, leaves squadrons without an air asset for one week or more.[21] If the inquired part information is not immediately available in the database, it may be necessary to involve the Fleet Support Team (FST). FST research can take from a few days to several weeks.

The actual accounting of dollars lost by a squadron because of these delays is hard to capture. It usually manifests itself in loss of readiness, longer amounts of time to reach a certain readiness level, or the increased flight time of other aircraft to make up for the grounded asset. Unfortunately, the hindered or degraded squadron readiness and mission availability are not outside the squadrons, and they are not captured in any database. Readiness issues may show up in required extra days at sea for aircrew qualifications that were not completed due to aircraft availability. If not there, intangible readiness dollar losses may surface in later years as aircraft reach their lifetimes sooner than expected. These will be attributed to higher than normal cyclic operations but, in reality, it may simply be grounded on very inefficient and overlooked part tracking platforms.

---

[21] Average turnaround time of three days was collected during an interview with Mr. Pat Montgomery, Program Manager of Naval Air Systems Command CMIS Repository.

## B. DYCOMTRAK

### 1. SRC-card Process

Although Dycomtrak employees were not observed by the research team, many hours were spent on the phone with Dycomtrak associates. Their 30 employees work very hard to ensure the Fleet gets the vital information needed in as short a time as possible. Dycomtrak personnel, unlike the ATCM Repository, seek out database updates at each stage of a hard-card's movement through the maintenance process. Their business model pushes a proactive stance throughout a given part's lifetime to ensure each part owner/cardholder appropriately updates card information as necessary. One- to four-man tiger teams frequent squadrons, Depots and aircraft manufactures in efforts to update and validate part information in the Dycomtrak database, COMTRAK. This method seems to present few opportunities for misinformation.

SRC cards are normally received by mail as directed by the NAMP and associated PMICs, but both fax and e-mail are available as well. Most maintenance personnel observed by the research team communicated with Dycomtrak by using e-mail to send scanned-in SRC cards. This is more beneficial than mailing cards because it ensures the card is actually received by Dycomtrak. It also provides a transaction record for card movement and greatly increases the accuracy of the database since shipping delays are non-existent. As cards are received, they are handled by the appropriate Dycomtrak personnel that are responsible for a specific TMS. SH-60s, for example, have seven people working all series of that aircraft. That is essentially the size of the entire ATCM Repository staff responsible for 120 TMS. This allows Dycomtrak time to validate each card as it moves from one command to another, and again, ensures a very accurate database.

### 2. Dycomtrak and ATCM Repository Common Server

Dycomtrak and the ATCM Repository share the same data server, located in Patuxent River, MD: an Oracle-10g-based server that boasts Web server capabilities. It is technically owned by the program manager of the CMIS/ATCM Repository but accessible by both parties. The server has many different databases that do not directly collaborate with each other. That means the ATCM Repository and Dycomtrak do not directly share a common database that is queried and updated by either entity. If the ATCM Repository updates a particular part in their database, then it does not replicate into the Dycomtrak database and vice versa. Because of this, both entities must enter identical data into their respective database for the same part. Since most, if not all, TMSs served by Dycomtrak only send information to Dycomtrak, it is necessary for Dycomtrak and the ATCM Repository to spend a lot of time sharing information in order to maximize the information available to Fleet customers. This introduces inefficiencies into the system and can lead to longer delays in the retrieval of part information.

### 3. Fleet Support Team's (FST) Role

When the ATCM and COMTRAK Repository's cannot find history data on a particular part, they call their respective FST to aid in the data search. FSTs may have access to other databases that contain the needed part information, but more importantly, they also maintain a database of aircraft historical flight hours. In many cases, the FST must contact the OEM to verify that a part is new. OEMs like Boeing should always ship new parts with a Certificate of Conformity (CoC), and refurbished parts with a CoC or RFI tag. According to an e-mail from Bob Lindauer of Boeing's Hornet Support Network team,

> Either situation should indicate to the receiving squadron that the part would be considered Zero time. If, on the other hand, the part is received without any paperwork (SRC, CoC or RFI tag) then the part should be considered suspect. Unfortunately, this happens more times than one would like to consider for various reasons. Boeing makes every effort to make sure that a

> SRC card accompanies any retrograde part turned in to us. At our Fleet locations, we take the extra effort of photocopying all incoming SRC cards with parts going to repair. That way we can reconstruct the card from the point it went into repair. Again, unfortunately, the incoming SRC card is not always available. (Lindauer, 2009)

The F/A-18 FST's decision about whether to accesses a part penalty and how that penalty may impact the part lifecycle, belongs to aerospace engineers. Tim Steckman and Kurt Sauders of the North Island F/A-18E/F/G FST provided sample data on F/A-18 A-D penalized structural parts. This information is discussed further in Chapter IV-B, but the quote below explains why a part is penalized.

> If flight hours of component are found in their search but are not up to date, a penalty to the parts accumulated flight hours will result. This could result in either penalizing the hours to a point where the component is still flyable or to the point where the flight hrs are beyond the limit which will scrap the component.
>
> If no information on the component is found, this would require penalizing the component from the production date to the present. This can result in flight hour penalty beyond the life of the component and thereby lead to a scrapping of the component. (Saunders & Steckman, 2009, June 11, PPT slide 2)

This conservative approach ensures aircraft parts never exceed their designed life-limits. Unfortunately, it can also lead to unnecessary part death because the penalty exceeds the remaining life of the part.

# IV. Process and Financial Analysis of SRC Cards

## A. ATCM Repository Process Analysis

### 1. Hard-card Input (October 2008 - March 2009)

The *NAMP* along with specific TMS PMICs, provide administrative direction for hard-card processing in order to maximize the availability of TMS hard-cards in the ATCM Repository. Most originate from squadrons, depots and IMAs, but some may appear indiscriminately from an OEM or other facility that has recently found an unidentified or unmatched card. Although our research has centered on SRC cards specifically, when analyzing the ATCM Repository and its capacity to sort and input data into a database, focus needs to be directed at the total number of hard-cards processed, shown in Table 1. Received by the ATCM staff in the same manner as SRC cards, MSR and ASR cards are processed alongside SRC cards. The compounded effect of all these cards together provides a clear understanding of the process capacity and utilization of the ATCM Repository and its staff.

**Table 1. FY09 Hard-cards Processed by the ATCM Repository**

| PROCESSED REPOSITORY HARD CARDS (ACTUAL) | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Oct-08 | Nov-08 | Dec-08 | Jan-09 | Feb-09 | Mar-09 | **Avg/day** |
| MSR | 564 | 21 | 998 | 1295 | 203 | 420 | 19 |
| SRC | 761 | 1859 | 1712 | 675 | 2193 | 738 | 44 |
| ASR | 984 | 877 | 334 | 221 | 26 | 611 | 17 |
| **Total Entered in CMIS** | 2309 | 2757 | 3044 | 2191 | 2422 | 1769 | 80 |

The ATCM program manager provided the incoming card data for the months of October 2008–March 2009, as seen in Table 2. Our research did not include EHR cards because the Repository does not enter them into any type of database. Data for October, November, and March 2009 did not have updated numbers for Depot-level inputs as seen in the table, but we still elected to use it because the total numbers appeared to be reasonable and consistent.

Table 2 data does not include the backlog of cards that had not been entered from the previous month. As seen in Table 3, there has been a continuous backlog of hard-cards. As of August 2009, there were still 3,600 cards in backlog status.

**Table 2. FY09 Hard-cards Received by the ATCM Repository**

| Hard Cards Received at ATCM Repository (FY09) | | | | | | |
|---|---|---|---|---|---|---|
| **Incoming Cards** | Oct-08 | Nov-08 | Dec-08 | Jan-09 | Feb-09 | Mar-09 |
| Depot MSR | 0 | 0 | 0 | 46 | 78 | 0 |
| Depot SRC | 0 | 0 | 46 | 746 | 296 | 0 |
| Depot ASR | 0 | 0 | 53 | 101 | 43 | 0 |
| Depot EHR & Duplicates | 0 | 0 | 88 | 170 | 217 | 0 |
| **Total** | 0 | 0 | 99 | 893 | 417 | 0 |
| Contractor MSR | 0 | 0 | 0 | 0 | 0 | 0 |
| Contractor SRC | 0 | 0 | 0 | 0 | 0 | 0 |
| Contractor ASR | 0 | 0 | 0 | 0 | 0 | 0 |
| Contractor EHR & Duplicates | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total** | 0 | 0 | 0 | 0 | 0 | 0 |
| Fleet MSR | 100 | 223 | 291 | 870 | 182 | 528 |
| Fleet SRC | 200 | 1499 | 983 | 2308 | 923 | 2300 |
| Fleet ASR | 1100 | 659 | 646 | 1513 | 484 | 1100 |
| Fleet EHR & Duplicates | 4220 | 4198 | 1239 | 4755 | 954 | 4857 |
| **Total (not incl EHR)** | 1400 | 2381 | 1920 | 4691 | 1589 | 3928 |
| **Total MSR** | 100 | 223 | 291 | 916 | 260 | 528 |
| **Total SRC** | 200 | 1499 | 1029 | 3054 | 1219 | 2300 |
| **Total ASR** | 1100 | 659 | 699 | 1614 | 527 | 1100 |
| **Total EHR & Duplicates** | 4220 | 4198 | 1327 | 4925 | 1171 | 4857 |
| **Total (not incl EHR)** | 1400 | 2381 | 2019 | 5584 | 2006 | 3928 |

**Table 3. FY09 Hard-cards Backlog at the ATCM Repository**

| REPOSITORY HARD CARD BACKLOG | | | | | | |
|---|---|---|---|---|---|---|
| | Oct-08 | Nov-08 | Dec-08 | Jan-09 | Feb-09 | Mar-09 |
| MSR | 4746 | 4948 | 4241 | 3862 | 2885 | 3817 |
| SRC | 1255 | 895 | 212 | 2591 | 385 | 1515 |
| ASR | 1368 | 1150 | 1515 | 2908 | 2239 | 2095 |
| **Cards Remaining** | 7369 | 6993 | 5968 | 9361 | 5509 | 7427 |

Excel was used to calculate daily incoming card averages for each type of card in each different category: Depot, Contractor and Fleet. The results are shown in Table 4 and help form the basis for SRC-card process analysis. To calculate the average cards per day of 133, we added the total number of cards received per month then divided that sum by 130. The 130 days accounts for a 5-day workweek.

**Table 4. Total Incoming Hard-cards and Respective Averages**

| REPOSITORY INCOMING HARD CARDS FOR PROCESSING (ACTUAL) | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Oct-08 | Nov-08 | Dec-08 | Jan-09 | Feb-09 | Mar-09 | **Avg/day** |
| Depot | 0 | 0 | 99 | 893 | 417 | 0 | 8 |
| Contactor | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Fleet | 1400 | 2381 | 1920 | 4691 | 1589 | 3928 | 87 |
| **Total** | 1400 | 2381 | 2019 | 5584 | 2006 | 3928 | 133 |

### 2. Hard-card Processing

The Repository's mission statement is to "provide accurate, complete, and accessible configuration data to authorized users for the successful maintenance and operations of DoD systems." On more than one occasion, Repository leadership raised the issue of their insufficient staffing levels, and their inability to proficiently support 120 Navy TMS aircraft. The Repository lacks the capacity to provide the Fleet with timely information. The basic configuration and capacity of the current Repository includes three billets filled by active-duty Petty Officers that concentrate their efforts on responding to Fleet request for lifecycle history. There are three civilian positions that are responsible for processing paper cards and entering the lifecycle data into the ATCM database. Employees work on average 8 hours per workday, 250 days a year, processing data. We computed the yearly effective capacity that the ATCM Repository data-entry personnel possess by first identifying their designed capacity and subtracting an allowance rate for lunch and breaks. Our calculations estimated the yearly effective capacity for the ATCM data personnel to be 5,220 hours/year as seen in Figure 11.

A preliminary concern raised by the ATCM Repository leadership was the high level of demand on its minimally staffed office faced. Data awaiting entry into the ATCM database was identified as a consequence of understaffing in need of serious relief. Originally, the Repository was provided three Petty Officers that split their time performing data entry and customer support. With only three employees filling customer service and data entry requirements, data entry was not receiving the attention required. A significant backlog of unprocessed cards led to hiring three civilian personnel that only perform data entry.

Designed Capacity = (shift hrs/day) * (work days/wk) * (work wks/yr) * (# of workers)

8 hrs/day * 5 days/wk * 50 wks/yr * 3 workers = 6,000 Designed Capacity Work hrs/yr

Allowance Rate = (1 – 0.13) using 30 min for lunch and two 15 min break periods

Effective Capacity = (Designed Capacity) * (Allowance Rate)

6,000 * (1 – 0.13) = 5,220 Total Effective Capacity Work hrs/yr

**Figure 11. ATCM Data Entry Yearly Effective Capacity**

Shown in Figure 12, a liberal capacity allowance was calculated for the effective daily operation of the three dedicated ATCM data-entry personnel. It was based on an 8-hour workday, minus an allowance rate, and on a 10-minute processing time per card (estimate provided by the ATCM Repository and Dycomtrak program managers), or six cards per hour.

Daily Designed Capacity = (shift hrs/day) * (1 day) * (number of workers)

8 hrs/day * 1 day/wk * 3 workers = 24 designed capacity work hrs/day

Allowance Rate = (1 – 0.13) assuming about 30 min for lunch and two 15 min break periods

Daily Effective Capacity = (Designed Capacity) * (Allowance Rate)

24 * (1 – 0.13) = 20.88 Total Effective Capacity Work hrs/day

Daily Effective Processing Capacity = (Effective Capacity) * (Avg. Cards Processed Per Hr)

20.88 * 6 = 125.28 Card Processing Capacity Daily

**Figure 12. CMIS/ATCM Daily Estimated effective Card-processing Capacity**

Using the average daily demand of 133 cards received per day, shown in Table 4, and the average processing capacity of the ATCM Repository of 125.28 cards per day (Figure 12), it appears that the ATCM data-entry personnel are operating at a 106% utilization rate (Figure 13). These figures show that the Repository has insufficient capacity to meet the ATCM Repository's daily demand.

Estimated Utilization Rate = Estimated Daily Demand/ Estimated Daily Processing Capacity

133/125.28 = 1.06

1.06 * 100% = 106% Estimated Utilization Rate

**Figure 13. ATCM Daily Data-processing Estimated Utilization Rate**

Using actual data provided by the ATCM Repository for the months of October 2008–February 2009, as seen in Table 1 above, the numbers reflect an average data processing capacity of only 111 cards per day.

Actual Utilization Rate = Actual Demand / Actual Daily Processing Capacity

133/111 = 1.2

1.2 * 100% = 120% Actual Utilization Rate

Daily Backlog = Daily Demand – Effective Daily Processing Capacity

133 - 111 = 22 Unprocessed/Backlogged Cards Per Day

Number of Personnel Required to Meet Daily Demand = Daily Demand/(Daily Processing Capacity/3)

133/(111/3) = 3.6 or 4 Personnel Required to Meet Daily Demand

Utilization Rate = Daily Demand / (Daily Processing of 1 person * Number of Personnel)

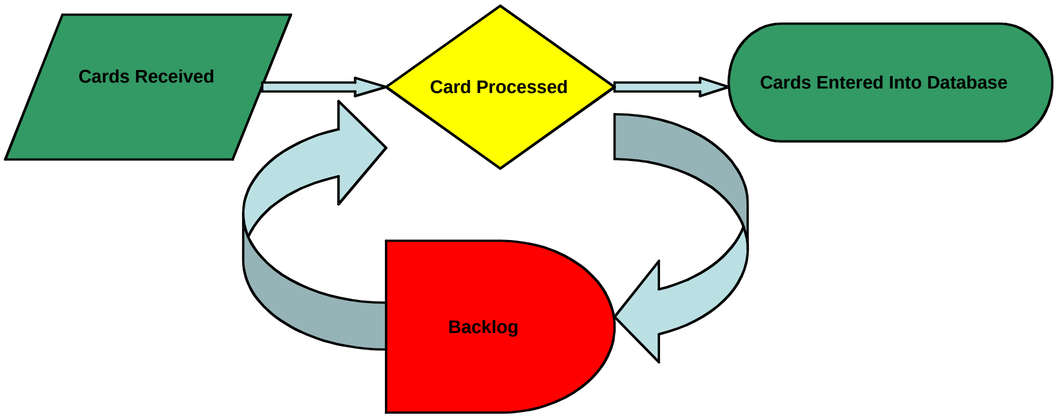
133/ (37 * 4) = 0.899 = 90% Utilization Rate

**Figure 14. ATCM Actual Effective-daily Utilization Rate and Capacity**

Comparing the difference between the estimated 125.28 cards processed daily and the average-effective processing capacity of 111 cards processed daily increases the ATCM Repository daily-average utilization rate to 90%. The increased utilization rate creates an average 22 card per day backlog, as seen in Figure 14.

Even though the Repository now employs three dedicated data-entry personnel, they are unable to meet average daily demand, as seen in Figure 14. Accumulating on average 22 unprocessed cards per day, the Repository's backlog will continue to grow, slowing the timely update of historical lifecycle data in the ATCM Repository. In order to meet average daily demand, at minimum one additional data-entry employee would be required (see Figure 14). This however, only addresses the daily card demand placed on the three personnel currently processing the incoming cards. The daily demand and processing calculations in Figure 14 do not account for the natural variability in processing times and the considerable backlog currently held by ATCM Repository.

CMIS/ATCM Repository Capacity Flowchart




The ATCM Repository Capacity Flowchart illustrates the flow of hard cards from Fleet activities to the CMIS/ATCM Repository. Once cards are received, they are manually entered into the CMIS/ATCM Repository. There is currently a backlog of data awaiting entry into the Repository database. Given the current configuration of resources and a high variability in demand, the CMIS Repository lacks the ability to provide Fleet customers with real-time or near real-time lifecycle data support.

**Figure 15. ATCM Repository Capacity Flowchart**

Since cards are sent from Fleet activities to the Repository 365 days a year, the need for processing exceeds the 250 actual work-days.[22] The total processing demand for the year equals the average daily demand of 133 cards multiplied by the work-days in a year, equaling a processing demand of 33,250 cards annually. Given the actual daily processing capacity of 111 cards per workday, the annual demand would take the ATCM Repository 300 days to complete, as seen in Figure 16.

---

[22] 250 days is based on a 5-day workweek, 52 weeks a year minus 10 Federal holidays.

Yearly Demand = Average Daily Demand * 250 work-days/yr

133*250 = 33,250 Cards Per Year

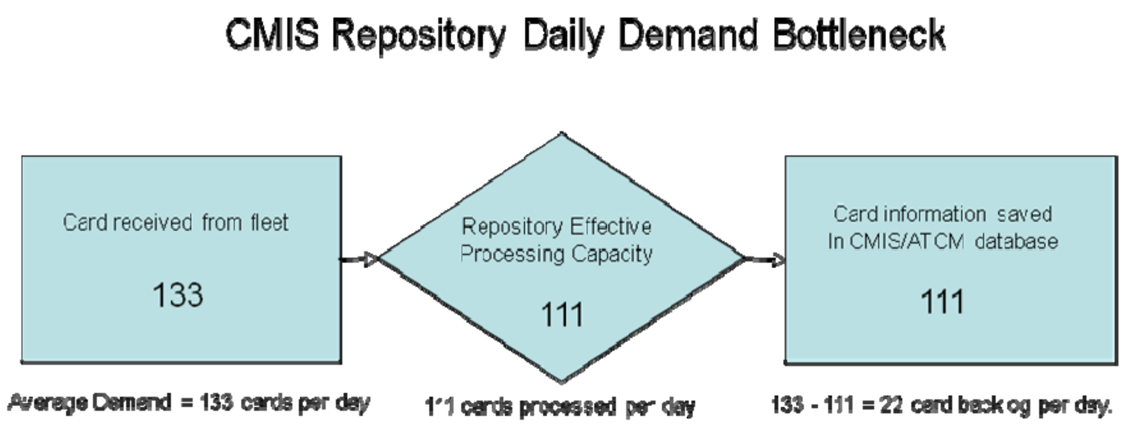
Required Processing Days = Yearly Demand/Daily Processing Capacity

33,250/111 = 300 processing days required to meet demand

**Figure 16. ATCM Required Number of Days to Meet Yearly Demand**

The processing capacity calculation did not include the estimated 7400 backlogged cards for March 2009 shown in Table 3 or the equivalent 67 days of backlogged data that is currently awaiting entry into the ATCM database, which only exacerbates the inefficiencies of the ATCM Repository's processing capacity.[23] The current backlog of data and the bottleneck shown in Figure 17 are the direct result of insufficient processing capacity. These delays have a direct impact on the timely update of the ATCM Repository database and, thus, affect the ability to provide a reliable and timely response to Fleet user requests for lifecycle data. Repository leadership provided an estimated three-day turnaround on the average Fleet request for lifecycle data. The additional three days of delay from the ATCM Repository were also reflected in our thesis team's Fleet survey data collected on the SRC-card process.

[23] 67 days is based on 7400 cards divided by an effective processing capacity of 111 cards/day.




The capacity in which the CMIS/ATCM Repository is able to process lifecycle data into the Repository database has created a bottleneck in the process, impacting the quality of support provided to Fleet customers. Lack of reliable and timely information can directly influence the cost of doing business as well as negatively impact Fleet readiness by delaying components for administrative discrepancies.

**Figure 17. CMIS/ATCM Repository Bottleneck**

## B. DYCOMTRAK Process Analysis

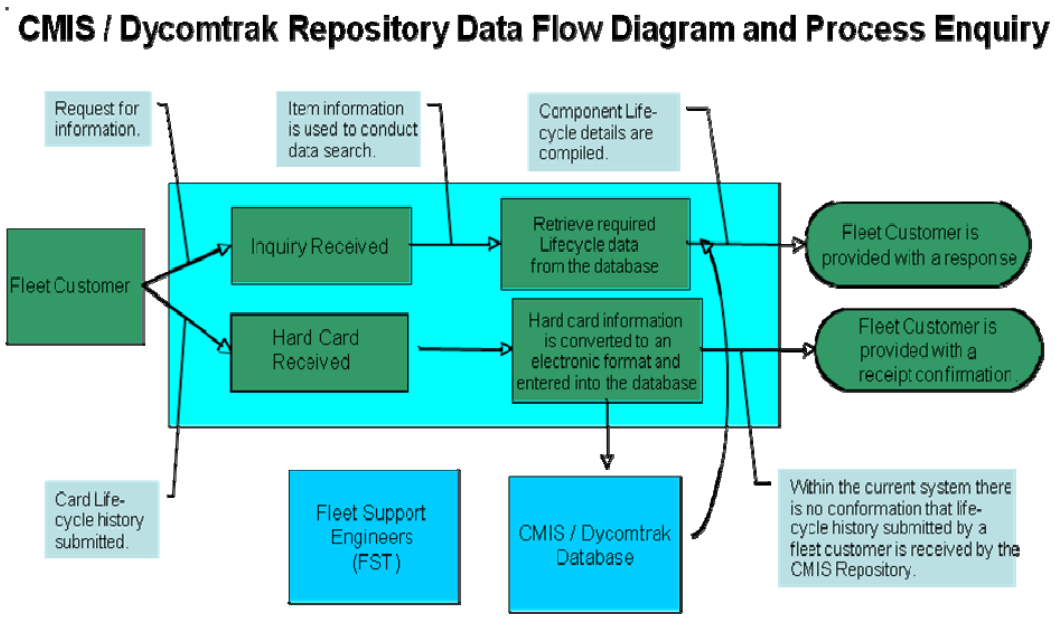
### 1. Hard-card Input

The primary method for the exchange of lifecycle data with Dycomtrak is through e-mail. Fleet activities rely on scanners to convert physical card information into an electronic PDF file and transmit the lifecycle data via email to Dycomtrak personnel. The use of e-mail allows for an informal confirmation, or a feedback loop that provides the Fleet submitter verification that the data was successfully sent and received by the Repository. In contrast, the ATCM Repository relies on a physical or traditional mail system of receiving card information from the Fleet and lacks any form of confirmation.

The ability to successfully integrate component-lifecycle data into its respective Repository database can have an impact on the success of future requests for historical data. If data is not received in a timely manner, then it may affect the ability to successfully retrieve critical lifecycle data when the Fleet needs it. Dycomtrak also uses periodic site visits to Fleet activities to gather copies of cards and screen them to ensure that their Repository database (COMTRAK) has the most up-to-date lifecycle data for the component.

When Dycomtrak personnel receive electronically formatted lifecycle data, they use the information to update the component's historical record, maintained in the COMTRAK database. Dycomtrak also focuses on data accuracy by screening the lifecycle information that is received from the Fleet. Dycomtrak processes lifecycle data for components that have variable operational life-limits based on the TMS aircraft they are installed in; therefore, they place an emphasis on ensuring correct usage data is reflected in the component's historical record.

When it comes to customer service and fulfilling Fleet requests for historical lifecycle data, Dycomtrak provides a similar product to that of the ATCM Repository. The telephone is the primary method for receiving part historical-data requests. When Dycomtrak personnel receive a request via the telephone, the Fleet customer will be asked to provide identifying component information such as nomenclature, part number, and serial number. Once sufficient information is gathered to identify the component, the Fleet customer will provide a return telephone number, or in most cases, a valid e-mail address where the lifecycle information can be forwarded. Dycomtrak personnel will then use the COMTRAK database and any other additional resources available to search for and locate a historical record for the component in question. Once the historical record for the component in question has been located, the information will be forwarded to the Fleet user, as seen in Figure 18.

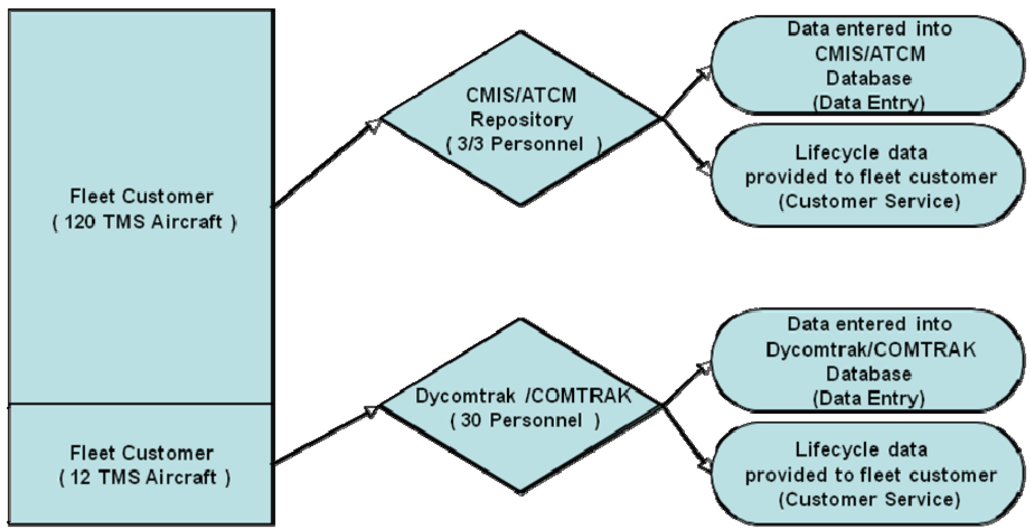



The current process for Fleet users to obtain lifecycle data is most commonly initiated via an email exchange, or phone-call to Repository personnel. Fleet activities are required to give identifying information to help Repository personnel conduct a search of historical records stored in the Repositories database. If historical records are not found within the active database, Repository personnel will contact Fleet Support Team (FST) engineers to assist them with the data search. If FST personnel are unsuccessful in locating up-to-date historical data, components receive a lifecycle-penalty or may even be stricken from the usable inventory. Fleet customers are then provided with direction to rebuild the lifecycle data hard-card and place the component into service, or they are directed to return the component to the supply system. Updating lifecycle data is informal at best, and the prescribed method in the 4790 (*NAMP*) is to mail the cards to the Repository. Once a Fleet activity places a card in the mail, it is assumed that the critical lifecycle data is eventually received.

**Figure 18. CMIS/Dycomtrak Repository Data Flow Diagram and Process Enquiry**

Although Dycomtrak utilizes a more reliable method than the CMIS Repository to receive lifecycle data from Fleet activities, it is still aware of the possibility that component-lifecycle data will not be successfully forwarded to the Dycomtrak Repository. Their site visits compensate for the poor process reliability of keeping critical lifecycle data on a piece of paper.

**High Level CMIS/ATCM/COMTRAK Repository Data Flow Diagram**




Both the CMIS/ATCM and Dycomtrak repositories process and store lifecycle data and provide Fleet activities with historical lifecycle data to rebuild lifecycle-data hard-cards when records are missing or illegible. Currently the CMIS/ATCM Repository has 3 dedicated Petty Officers that perform customer service, and 3 dedicated civilian employees that perform data entry for 120 TMS aircraft. Dycomtrak employs 30 personnel who perform both data entry and customer service functions in support of 12 TMS aircraft.

**Figure 19. High Level ATCM/COMTRAK Repository Data Flow**

### 2. Hard-card Processing

Comparing the 30 Dycomtrak personnel that maintain 12 TMS to the ATCM Repository that uses 3 personnel to provide customer support for 120 different TMS aircraft, as seen in Figure 19, it is not surprising to learn that Dycomtrak does not currently carry a backlog of cards, as noted in Figure 20. The Dycomtrak figures were calculated by only comparing the seven people assigned to provide support for the H-60 TMS aircraft against the total average demand for all 12 TMS aircraft supported by Dycomtrak. The Dycomtrak average demand of 125 cards per day is less than the ATCM daily average demand.[24]

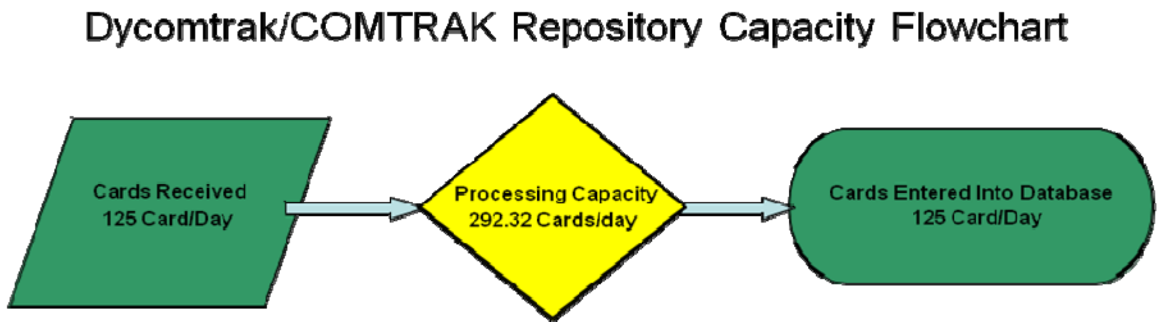
| |
|---|
| Calculations determined using 30 personnel that support the H-60 TMS Aircraft |
| (Estimated processing capacity of 6 cards per hour/employee, provided by Dycomtrak) |
| Annual Demand = Average Daily Demand * 250 days/yr |
| 125 * 250 = 31,250 Cards Per Year |
| Designed Capacity = (shift hrs/day) * (work days/wk) * (work wks/yr) * (number of workers) |
| 8 hrs/day * 5 days/wk * 50 wks/yr * 30 workers = 60,000 Designed Capacity Work hrs/yr |
| Allowance Rate = (1 – 0.13) assuming about 30 min for lunch and two 15-min break periods |
| Total Annual Effective Capacity = (Designed Capacity) * (Allowance Rate) |
| 60,000 * (1 – 0.13) = 52,200 Total Effective Capacity Work hrs/yr |
| Average Annual Utilization Rate = Annual Demand/ Annual Processing Capacity |
| 31,250 / 52,200 = .60 = 60% Utilization Rate |

**Figure 20. Dycomtrak Processing Capacity**

A sufficient processing capacity allows Dycomtrak personnel to focus on providing a timely and accurate response to Fleet requests for lifecycle-history data. With sufficient numbers of personnel to process lifecycle data into the Comtrak database, Dycomtrak is able to use its excess processing capacity to review and verify lifecycle data for accuracy. The result of having additional time to review the accuracy of data as it is being processed helps Dycomtrak maintain a more accurate and complete database. Although the Dycomtrak database is not 100% accurate, its increased reliability and robustness allow their staff to handle a heavy demand of Fleet requests.

---

[24] E-mail from Dycomtrak Program Manager (October 2, 2009) reported an average of 125 hard-cards received per day. This is based on 6 month period, 130 work-days and a 5-day workweek.




The Dycomtrak Repository Capacity Flowchart illustrates the flow of cards from Fleet activities to the Dycomtrak Repository. Once cards are received, they are manually entered into the COMTRAK Repository database. At the rate of inflow and given the excess processing capability of Dycomtrak personnel, there is currently no backlog of data awaiting entry into the COMTRAK Repository database. Dycomtrak has currently staffed its Repository with sufficient personnel numbers and the current configuration of resources more than meets the daily demand for processing hard-cards. The Dycomtrak Repository is able to provide Fleet customers with real-time or near real-time lifecycle-data support.

**Figure 21. The Dycomtrak/COMTRAK Repository Capacity**

Dycomtrak's monthly reports from June 2005–June 2006 show an estimated monthly average of 328 lost-card data requests and a monthly average of 144 request for data accuracy, as shown in Figure 22. Since the Dycomtrak database is up-to-date and free of backlogged data, Dycomtrak personnel are able to provide a much quicker turnaround time for lifecycle data requests, as shown in Figure 21. This allows Dycomtrak to fulfill Fleet needs in a matter of hours instead of days.

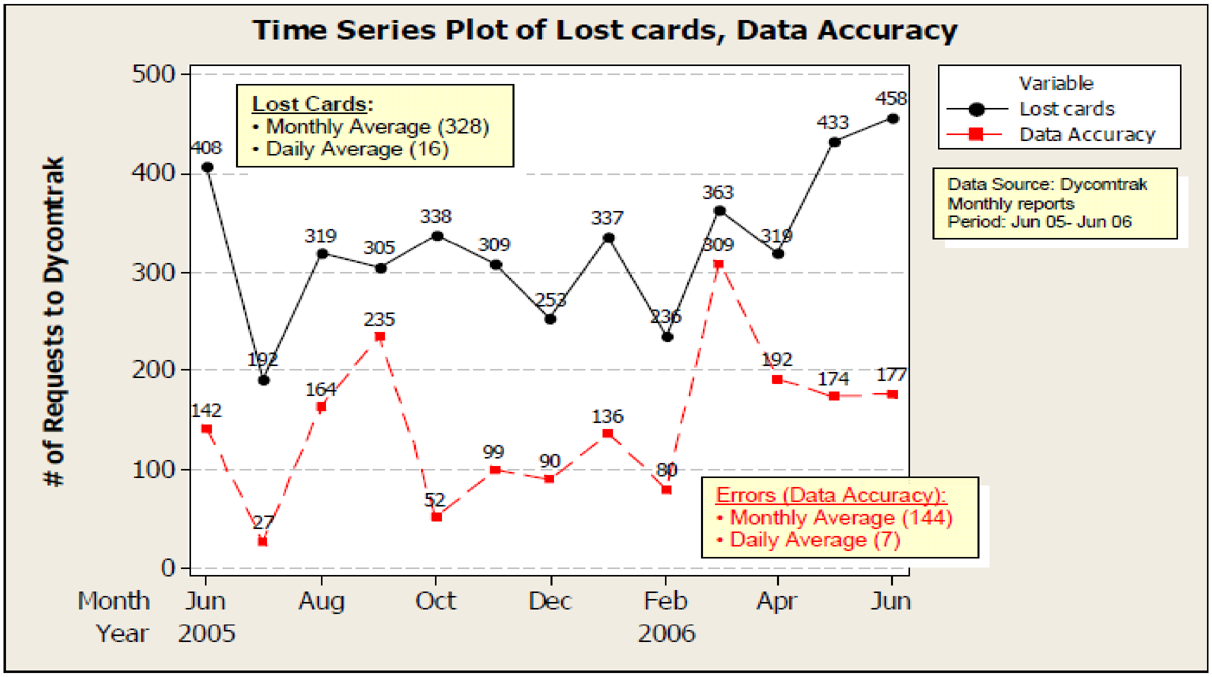



**Figure 22. DYCOMTRAK Historical Hard-card Requests**
(From Albright, 2006)

## C. Part-Lifecycle Financial Analysis

### 1. DYCOMTRAK Part-Lifecycle Financial Analysis

Appendix C displays the contractor's monthly platform status for H-60 dynamic components for the period of September 1 to September 30, 2009. As stated in the summary section of appendix C, the contract and status report are designed to provide analyses, technical studies, and reports relative to component time before overhaul, evaluate 3M reports, provide recommendations, and monitor the maintenance/logistics data collection and tracking systems/programs, including 3M and component tracking in support of the H-60 Helicopters. Using similar status reports for other platforms serviced by Dycomtrak, personnel are able to closely track many different metrics for each platform.

For 2009, the SH-60 community is on track to "lose" over $750,000 in part-related reconstruction penalties. Per an e-mail on August 21, 2009, from

Dycomtrak's Logistics Analyst, Thomas Stallings, he states "from January 2009 to the end of July 2009 the 'dollar lost' figure is $457,486.00. This is an average of $65,355.00 a month so far."[25] This eye-opening sum does not include labor, overhead, or any other type of cost that could be associated with the reconstruction efforts put forth in determining a part's historical usage. It also does not include the cost of buying new parts to replace those that have expired much earlier than anticipated. These losses are calculated by Dycomtrak based on penalties assessed by the H-60 Fleet Support Team (FST). For example, if the H-60 FST assesses a 100-hour penalty on a particular part, then Dycomtrak will look up the cost of a new part (assume $100,000), and divide the cost by the part's engineered or designed lifetime (assume 5,000 hours). That means the part costs $20/hour, which is then multiplied by the 100-hour penalty, for a total-realized loss of $2,000.

Internally, Dycomtrak only collects and maintains H-60 series losses. This is not required by any command or contract; rather, it is done on their own initiative. They use this data in conjunction with other past records to support lobbying for better and more efficient database systems. These realized costs are only for part penalties and do not include readiness effects, new parts purchased earlier than expected, logistics costs associated with re-sending parts that cannot be used for lack of adequate documentation, or overheads and civilian staffs needed to handle the large volume of paper products.

The cumulative savings calculated above is an eye-opening figure, especially considering it only covers January through September 2009 and only deals with the H-60 TMS. It is calculated in somewhat the same manner as part penalties, mentioned earlier. In this case, the actual savings calculation comes from the flight-hour difference between what Dycomtrak was able to establish as the actual part flight hours (using their database and other sources) and the part's flight-hour limit.

---

[25] Appendix C provides an example of Dycomtrak's monthly platform status report.

For example, a squadron calls Dycomtrak looking for part data because of a lost SRC-card. Dycomtrak researches the part history and finds that the part has 4,500 flight hours but would get scrapped at 6,000 flight hours. Dycomtrak takes the difference (1,500 hours) and multiplies that by the part cost/hour (a detailed example of this is shown in the next section). If the part in this case cost $50/hour, then the savings equals $75,000. Essentially, Dycomtrak is saying that if they weren't there to perform the service, the part would have been scrapped, resulting in a $75,000 part usage loss to the Navy.

One could argue that there really is no savings here because these are expected costs of this type of business, or that the way it is calculated isn't necessarily the best method to determine expected losses. However, it is important to remember that part-history research (Dycomtrak) exists almost only because of hard-card-process shortfalls. If the part-history system were a Web-accessible database, the hard-card process would be removed and, theoretically, would remove the entire research process. Again, this does not mean Dycomtrak would be completely removed from the process if a central database were in place. Verification tools and personnel support would certainly be needed, just as they are in any current commercial or military Web-based database.

Appendix C lists the following information shown in Table 5 for H-60 TMS:

**Table 5. Dycomtrak H-60 Monthly Savings**

| SAVINGS / BENEFITS | | | |
|---|---|---|---|
| **NUMBER DISCREPANCIES** | **TYPE OF DISCREPANCIES** | **BENEFITS** | **SAVINGS THIS MONTH** |
| 200 | Lost Cards/Rep | Savings | **$3,519,289.00** |
| 34 | **Lost Cards/Cons** | Savings | **$53,067.00** |
| 176 | **Data Accuracy** | Readiness | **$0** |
| 4 | **High Time** | Safety | **$0** |
| **CUMULATIVE (YEARLY) SAVINGS** | | | **$62,265,888.00** |

The $62 million is not an actual dollar amount that could be saved by fixing the hard-card process, but rather more of an indicator of how inefficient the hard-card process is. Here, the word "savings" is a non-tangible figure that helps to support and show the value of a Dycomtrak-type service, or better yet, a Product Lifecycle Support (PLCS) system. The PLCS model is rapidly becoming the buzzword in aviation communities around the world because of similar problems and costs faced by vendors and commercial airlines alike. Also, it is the foundation of the JSF program.

### 2. FST Part-lifecycle Financial Analysis

When the ATCM Repository and Dycomtrak are unable to reconstruct missing or lost information on an SRC card from their databases, FST assistance is requested. An e-mail from Mr. Bob Lindauer of Boeing's Hornet Support Network provides an OEM perspective:

> I am currently in the middle of a situation where a part went through an Engineering Investigation (EI) and was forwarded to our vendor for repair. No SRC card was available when inducted for the EI and hence, there was only

> the removal Maintenance Action Form (MAF) that indicated some number of hours at removal. In order to return this part to an RFI condition, I had to contact the Fleet Support (FST) Team at North Island that is responsible for the part. They will contact the Navy's data Repository for such info at North Island to determine if the process has been followed and there is a backup of the SRC card there. If not, the FST will do further research to see if they can account for the hours on the part. If they cannot determine the number of hours prior to removal or are uncomfortable with the information on the removal MAF, the part will be decremented by up to 50% of the lifetime on a new SRC card. Unfortunately, only about 50% of the time is there a hit on the database. (Lindauer, 2009)

For F/A-18's specifically, the FST has a dedicated team of a few engineers and one former-enlisted service member who have access to multiple aviation-related databases not typically available to other commands, including the Repository and Dycomtrak. Hoping to gain some insight on a part's history to prevent assessing part penalties, the North-Island-based FST developed a 10-step part-life reconstruction procedure that utilizes all these databases. If part history cannot be verified using this procedure, penalties are assessed to the part's life based on statistical flight data collected by the FST over the lifetime of an aircraft. This often leads to a pre-mature death of an otherwise usable part. FST engineers provided the following part-penalization assessment procedure:

1. Flight hour spreadsheets contain average flight hours, plus 1.5 times the standard deviation for the Fleet for a range of years. Penalization is Fleet average, plus 1.5 times the standard deviation. This is a command decision from AIR-4.3.3 (Barry Strugis), as of May 2009. It was mean plus 1 sigma previously.

2. Determine the range of dates for the missing data on the component.

3. Round to the nearest month, and use the monthly average flight hours to calculate the total penalty (see Figure 23 for example). Use 68.2 hours per month for all years before 1990, and use 60.5 for all years after 2008 (F/A-18A-D only).

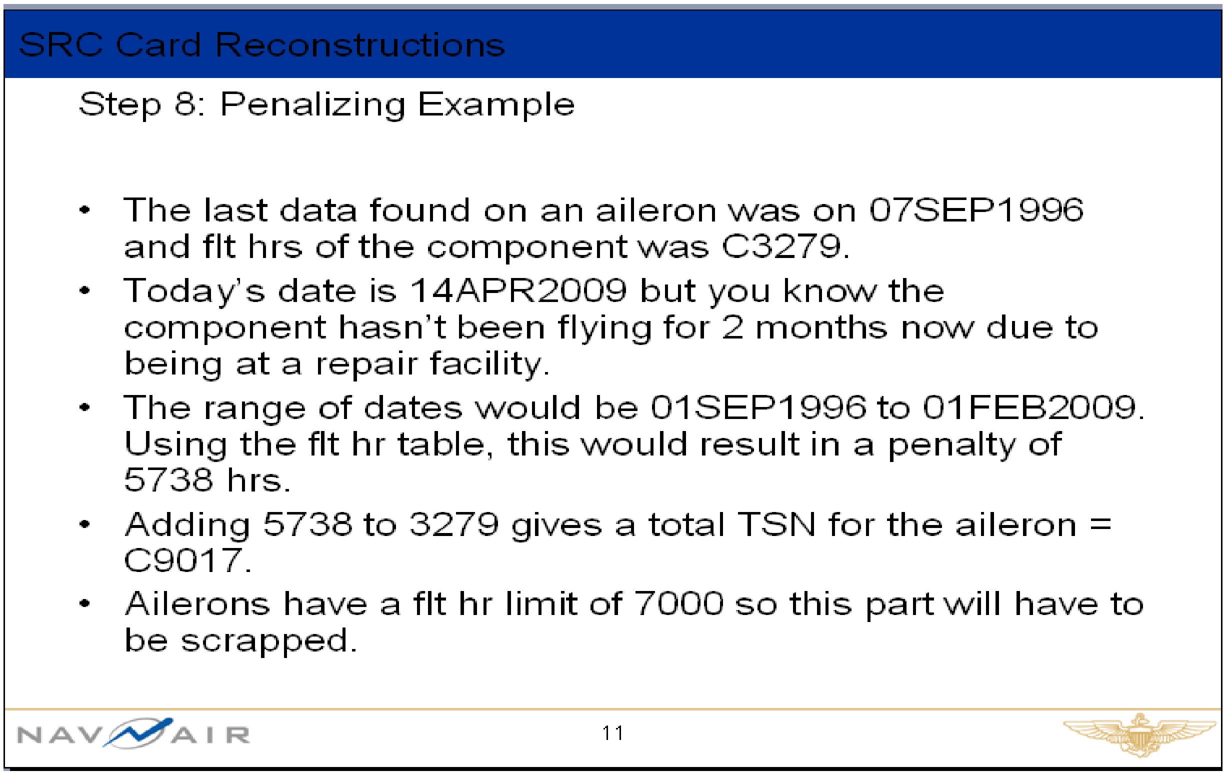



**Figure 23. FST Part-penalizing Example**
(From Saunders, 2009)

Figure 23 is slide 11 of a PowerPoint generated by Kurt Saunders at the FST. It provides an example of how parts are penalized when little to no data is available for the part. Summarized in Table 6, the FST provided a part-reconstruction spreadsheet, covering the period of January 2009 to June 1, 2009, for the F/A-18 A-Ds. The table shows how many parts were penalized per category and how many parts were scrapped as a result of penalties. The spreadsheet used to generate Table 6 only included 76 parts from the wings, flaps, rudder and horizontal stabilizer part categories.[26] Of those 76 parts, 42 (or 55.3%) received various flight-hour penalties that resulted in the loss of more than 52,000 hours of lost part-life. 24 of the 43 (55%) parts were scrapped for lack of data or because accessed penalties

[26] These components are considered to be in the aircraft-structure category but represent only a handful of the hundreds of parts covered by SRC-cards for the F-18 A-D and tracked by the FST.

(like the example in Figure 23) pushed the part over its life-limit. Ten out of 42 or 23.8% of parts penalized did not have an associated hour penalty because the FST engineers were unable to find exact penalty data. They knew the parts were penalized and, therefore, reported the data. These unknown penalties, therefore, support a conservative dollar-loss total, indicated in Table 6 because the losses would be higher if those penalties were known.

**Table 6. Part Penalty Assessments**

| F/A-18 A-D Part Penalties for Structures (Jan 7 - Jun 1, 2009) | | | | | |
|---|---|---|---|---|---|
| | **Total # of Part Inquiries** | **Total $ Penalized** | **Total Penalities** | **Actual Penalties (hrs)** | **Parts Scrapped** |
| **ILEF** | 7 | $22,169.93 | 3 | 213.5<br>611 | 3 |
| **OLEF** | 5 | $186,602.48 | 3 | 7000<br>698<br>3240 | 1 |
| **TEF** | 23 | $361,460.44 | 10 | 2092<br>2046<br>326<br>2744<br>1303<br>93<br>101 | 4 |
| **AIL** | 7 | $109,862.55 | 6 | 2745<br>3643 | 0 |
| **OWP** | 13 | $1,756,852.79 | 5 | 7000<br>7000<br>2050 | 4 |
| **Rudder** | 7 | $131,902.00 | 3 | 7000 | 1 |
| **Hor stab** | 8 | $37,661.94 | 7 | 241 | 6 |
| **Hor Stab Arm** | 6 | $12,390.56 | 5 | 1860 | 5 |
| **Totals** | **76** | **$2,618,902.69** | **42** | **52006.5** | **24** |

ILEF = Inboard Leading Edge Flaps
OLEF = Outboard Leading Edge Flaps
TEF = Trailing Edge Flaps
AIL = Aileron
OWP = Outer Wing Panel
Hor Stab = Horizontal Stabilizer
Hor Stab Arm = Horizontal Stabilizer Arm

Table 6 includes total-assessed-realized dollar losses associated with each category. The research team, using a simple dollar-per-hour cost idea, estimated these costs. This is the same method used by Dycomtrak and the ATCM Repository. Tables 7 and 8 show two examples of how these realized losses were calculated against part penalties for F-18 A-D structures only; again, this is exactly the same way H-60 FST and Dycomtrak determine part losses. Table 7 is for Trailing Edge Flaps (TEF) and Table 8 is for Outer Wing Panels (OWP). Despite the large losses indicated in Table 8, it is most likely an outlier group of data, based on discussions with the FST, Dycomtrak and ATCM Repository. Two of the three penalized OWP parts were penalized for their entire life (8,000+ hours) because no data was found for past part usage. This helps demonstrate the overwhelming effects that can and do result from the current hard-card process.

**Table 7. Part Penalty Assessments for TEF**

| **Penalties:** | Unit Cost | Part Flight hour limit | Cost per Hour | Penalty Assessed (hrs) | Flt hr losses converted to |
|---|---|---|---|---|---|
| 1 | $337,104 | 7000 | $48.16 | 2092 | $100,745.94 |
| 2 | $148,810 | 7000 | $21.26 | 2046 | $43,495.04 |
| 3 | $337,104 | 7000 | $48.16 | 326 | $15,699.41 |
| 4 | $337,104 | 7000 | $48.16 | 2744 | $132,144.77 |
| 5 | $148,810 | 7000 | $21.26 | 101 | $2,147.12 |
| 6 | $337,104 | 7000 | $48.16 | 1303 | $62,749.50 |
| 7 | $337,104 | 7000 | $48.16 | 93 | $4,478.67 |
| Total | | | | | $361,460.44 |

**Table 8. Part Penalty Assessments for OWP**

| Penalties: | Unit Cost | Part Flight hour limit* | Cost per Hour | Penalty Assessed (hrs) | Flt hr losses converted to $ |
|---|---|---|---|---|---|
| 1 | $680,173 | 8000 | $85.02 | 7839 | $666,484.52 |
| 2 | $680,173 | 8000 | $85.02 | 10866 | $923,844.98 |
| 3 | $649,847 | 8000 | $81.23 | 2050 | $166,523.29 |
| Total | | | | | $1,756,852.79 |

***Note:** Part Flight hour limit can actually go beyond 8000 hrs if the part passes the high flight hour bulletin.

THIS PAGE INTENTIONALLY LEFT BLANK

# V. Conclusions

## A. Necessary Short-Term Changes

The analysis chapter of this research paper discussed SRC-card reconstruction costs for parts in 6 of the 120 different TMS operated by the U.S. Navy. The reconstruction costs were obtained from the F-18 FST and Dycomtrak. This data clearly shows a tremendous dollar loss being absorbed by the U.S. Navy on a daily basis. The dollar-to-part loss assessments discussed in this paper only include about 7-8% of all TMS. Surprisingly, none of this information appears to be tracked, monitored, or briefed to anyone in NAVAIR or any other upper echelon, yet it strikes at the very core of the NAE and AIR*Speed* objectives. Earlier calculations for F/A-18's and H-60's alone show that over $3 million dollars in unrealized part-lifecycle losses have been incurred bi-annually, but it appears that nobody is paying attention.[27] If we assume similar losses for each of the other TMS, the losses could be in the tens of millions.

This paper focused directly on the root cause of early part deaths (SRC-card process) in an effort to address the oversights that are occurring. As mentioned earlier, this is not just a U.S. Navy problem. It is a worldwide aviation problem, experienced by both military and civilian aviation entities. Some inexpensive logical short- and long-term solutions are discussed throughout the paper in order to provide a starting platform from which this issue can be addressed. The software and hardware needed (Oracle 10g) to create a Product Lifecycle Support (PLCS) system (which is being implemented by militaries, airlines and manufacturers around the world) are somewhat already in place at CMIS/ATCM.

[27] Penalized part costs were considered unrealized in this paper because they are not required to be tracked or reported to any component of naval aviation. FSTs, Dycomtrak and the CMIS Repository have the ability to track these penalties and costs, but there is no standard method promulgated for actual cost determination or tracking.

### 1. NAMP

Sometimes, the quickest and most valuable way to affect a process of any kind is to look for possible changes in the administrative process. For the SRC-card issue in particular, administrative changes to the *NAMP* (detailed in the analysis chapter) would provide an immediate increase in process efficiency at no cost. *COMNAVAIRFOR Instruction 4790.2A* Change 1, dated February 15, 2009, states the following: “The NAMP was established by the CNO to provide an integrated, disciplined system for performing aeronautical equipment maintenance and related support functions. Because of the dynamic nature of the NAMP, it has been periodically revised to incorporate improved maintenance and data collection methods and techniques” (COMNAVAIRFOR, 2009). These periodic revisions normally originate from Fleet recommendations to correct administrative discrepancies, recommendations to change polices or procedures, and/or requests to deviate from *NAMP* policies, procedures or responsibilities. The revisions help meet the *NAMP* objective of improving aviation material readiness and safety standards through optimum use of manpower, material, facilities, and funds.

According to the NAE, the objective of *NAMP* modifications is to increase readiness and reduce cost, which is ultimately evaluated using a single metric known as ready-for-tasking (RFT). Every month, each individual TMS must achieve a pre-designated RFT number based on their current Fleet Response Plan (FRP) month. The pre-designation comes from Commander Naval Air Force Atlantic (Readiness, Standards and Policy) in close coordination with Echelon Two commands. RFT is the requirement for a certain number of aircraft in a squadron to be “ready-for-tasking” on any given month of an FRP.[28] RFT aircraft are counted by

[28] FRPs for most carrier-based aircraft are based on a 27-month cycle. Within each of the 27 months, a squadron must maintain a set number of aircraft in an RFT status. RFT is essentially a fully mission capable airplane. Using an F/A-18E squadron consisting of 12 aircraft, that particular squadron must have at least 9 RFT aircraft available during each month of deployment but can have an RFT requirement of between 4.5 and 5.6 aircraft during other FRP months of the 27-month cycle.

a squadron each day and then averaged over a month to achieve a required monthly RFT number. Squadrons that do not achieve their monthly RFT requirement must have an explanation. Many times the reason for RFT shortfalls centers on part unavailability, leading to unusable or "downed" aircraft. Some of the unavailable or unusable parts can be tied directly to the inadequate SRC-card process, discussed in earlier chapters.

### 2. NAVAIR 6.0 Web Site

*NAMP* Chapter 5, section 5.2.1.30.1.5, directs all squadrons needing SRC-card data to contact the ATCM Repository or use the listed Web site link. It also lists options such as sending the request by U.S. mail and/or official message traffic. The electronic form for Historical Data Request located on the CMIS Web site is preferable because it matches the query format needed by the ATCM staff to quickly navigate their database. According to the ATCM staff, the Historical Data Request Form greatly minimizes the time often wasted on the phone talking about what is needed for query.

Unfortunately, after talking with numerous staff members around the Fleet and comparing their responses to personal Fleet experiences, it was evident that the ATCM Web site is not well known. In fact, just over 50% of survey respondents have visited the Web site. Per the ATCM staff, the Historical Data Request Form available at http://www.navair.navy.mil/logistics/atcm/REQUEST.CFM allows for easier and more efficient data query.

### 3. Increased Manning at the CMIS/ATCM Repository

Currently, only three people at the ATCM Repository respond to phone and Web site requests of 120 different TMS, meaning there could be a large time delay before a Fleet user is able to talk with the ATCM staff. This is especially troublesome when calling from an aircraft carrier since phone lines are not always available and are commonly victim to bad connections. Even worse, when a phone line is available, the deployed squadron is now competing with a vast majority of personnel around the Fleet needing similar information from the ATCM staff.

The simple answer is to increase the number of ATCM staff members on the phones or increase their working hours. But there is no money for the employment of extra staff members or for authorized overtime or holiday workdays, and there is no manning priority identified by NAVAIR to add enlisted service members beyond the three already working there. Without any type of short-term staffing or funding increase, our analysis shows that it is impossible for the ATCM staff to overcome the current hard-card backlog that has been present for well over a year. If the enlisted customer-service providers were cross-trained in data entry and card processing and entered hard-card information when not answering phone request, then this could have a significant impact on the data-entry backlog. By comparison, Dycomtrak, which is responsible for only about 10% of the 120 different TMS, has anywhere between three to seven or more staffers per TMS. It would cost very little for the Navy to achieve the same performance delivered by Dycomtrak; it suffices to increase the number of staff members at ATCM.

## B. Long-Term Changes Needed

Long-term changes center around the establishment of an online-accessible database that inherently removes the need for hard-cards—an innovation that senior leadership at both DYCOMTRAK and the ATCM Repository endorse. This type of collaborative medium has been researched, experimented with, and documented with great success by businesses around the globe, including NAVAIR.

### 1. 24/7 Web Site Access

Since the ATCM staff only works Monday through Friday, 8–4 p.m. EST, the Fleet is without service on weekends, holidays, and 16 hours of each day because the ATCM database does not administratively allow outside user interface, although the database software does have the ability. The ATCM database is also UID compliant, meaning the DoD-mandated technology can be used to query the database from anywhere in the world. However, not everyone is equipped and trained for the use of UID technology, so database query by part number, serial number, and cage would have to be the default search method until commands are equipped to take advantage of UID technology.

Although it may be asked why the database is not already accessible to the Fleet, the answer is relatively simple: training, accuracy and validation. If Aviation Administrative Personnel (AZs) were granted full database access, then the data going into the database may become inaccurate without some sort of quality-assurance process. As it stands now, AZs can request an account to view data but, if approved, would not have permission for record modifications. With a CMIS/ATCM-developed Standard Operation Procedure (SOP) and mandatory training for Fleet AZs, the system could eventually allow modifications from users. This would eventually lead to a Fleet-wide paperless hard-card process at minimal cost when compared to the almost $50 million price tag presented by SPAWAR to NAVAIR for NALCOMIS changes. NALCOMIS certainly needs updating but it is not necessary to make the SRC-card process paperless.

More importantly, squadrons would have access to accurate information at any time of day or location. With an average information delay of three days or more currently plaguing the part data-request process, it is easy to see how a real-time data Web site could greatly increase Fleet readiness—a core AIRSpeed initiative that cannot continue to be overlooked. The need to obtain, update, and track critical aviation part information is a multi-national requirement that is being implemented by governments and businesses around the globe.

### 2. SPAWAR and NAVAIR

SPAWAR's 2007 paperless SRC-card project was a valid effort at trying to wrap the naval aviation's arms around avoidable dollar losses that are occurring on a daily basis. Unfortunately, the black-belt project was shelved by NAVAIR for undisclosed reasons. SPAWAR's $48.5-$52.3 million NALCOMIS proposal price tag was most likely the reason it was cancelled. Despite the justification, NAVAIR and SPAWAR missed a great opportunity to stop the hemorrhage of money from the hard-card process. The SPAWAR project would have allowed SRC cards to go paperless at almost all levels, something certainly needed (but it did not attack the heart of the system: the Repository). The paperless SRC-card research conducted by SPAWAR and a black-belt team at NAVAIR was certainly warranted, but somehow never got implemented.

Using dollar-lost figures obtained from DYCOMTRAK, the F/A-18 FST, and ATCM Repository as well as multiple interviews from each entity, it could be argued that dollar losses from part penalties are costing naval aviation over $10 million each year. These controllable and avoidable losses articulated in the analysis section suggest a need for further investigation by NAVAIR in the spirit of AIR*Speed*. If this dollar figure is not enough to inspire awareness, Dycomtrak also recognized 54 "safeties" over a recent six month period directly attributable to a high level of staffing and capacity to manage each TMS with precession. Safeties stop unknowing squadrons from flying over-timed parts - a risk no one can afford to take. How many of these safeties go undiscovered by the ATCM Repository because of being understaffed?

Eventually, NAVAIR and SPAWAR will need to design a NALCOMIS with the ability to collaborate with a common ATCM Repository and COMTRAK database(s): a one-stop-shopping database that is already available. The Oracle 10g server, located in the ATCM Repository building has many of the capabilities needed in a common database or PLCS-type system, including UID capabilities. An implementation plan that includes Fleet-to-database rules of engagement—or an SOP—Fleet training, and an update to the *NAMP* should move the Fleet towards a reliable system for maintaining lifecycle history.

A central Web site and database (similar to CMIS) that is accessible by any command at anytime is the future of part lifecycle management. Commercial and military aviation communities around the world are implementing similar systems because they provide accurate and immediate access to crucial and interoperable lifecycle information. Efficiencies gained in reduced labor and lifecycle research times will yield new levels of Fleet readiness and returns on investment as costs are dramatically reduced. Immediate access to lifecycle information also provides an intrinsic training value for personnel who will work with future platforms such as the JSF, which is designed to take advantage of real-time interoperable lifecycle information. JSF is not just about the airplane but about a centralized database that promises to be virtually paperless, available 24/7, and logistically smart-ordering by delivering the right part, at the right time, anywhere in the world. Implementing and using a central database system now will, therefore, pay dividends in the future as aviation maintenance professionals become accustomed and efficient in a collaborated and desired environment.

## C. UID Implementation

### 1. NAVAIR PLCS Study

In 2007, a successful study of PLCS was conducted by NAVAIR. The results of the study determined that using PLCS data entry methods in NALCOMIS OOMA made the data-entry process significantly more efficient than conventional methods. PLCS is a software- architecture model accepted worldwide that is a means of giving aircraft-component- information visibility to end-users. PLCS allows users of the system, through a central database, visibility of a component's history and lifecycle data.

Since both OOMA and the Oracle 10g database software used by the Repository already have the capacity to accept UID information and since the DoD mandates manufacturers to incorporate UID technology, PLCS provides an off-the-shelf idea that NAVAIR can explore and potentially utilize. Perhaps SPAWAR could also study the software architecture of PLCS systems and develop a similar software architecture that can make NALCOMIS, OOMA, and the ATCM database compatible.

### 2. Complications with Continued Use of Part and Serial Numbers

It is common practice to query databases by part, serial, and cage number, but these days are numbered. As the number of vendors for common aircraft parts increase, part and serial numbers are sometimes duplicated on different parts. This can result in the ordering of an incorrect part based on correct part numbers. UIDs are being implemented to address that problem. Part UIDs are synonymous with a social security number. They are exclusively designated for a particular part, which is then registered in a master DoD file. Each vendor that does business with the DoD now has to obtain a UID number from the master UID database to ensure no part in the DoD can be confused with another part.

# VI. Recommendations

## A. NAVAIR

### 1. PLCS

In 2007, the NAE, through Navy Air System Command (NAVAIR), completed a PLCS pilot project using basic aircraft delivery data from an SH-60. In minutes, PLCS completed a NALCOMIS OOMA data-entry task that normally takes two weeks using five fulltime-employed personnel (Finley, 2007). Deputy Under Secretary of Defense for Acquisition and Technology, James Finley, went on to say, “The successful pilot compelled us to extend the tool to a more robust production effort that can readily proliferate to other DoD and contractor users. A data exchange standard based on PLCS was developed and used to transfer delivery, maintenance, and configuration data among maintenance management systems.” Using these results, the NAE could investigate, test, and implement PLCS technologies to improve the SRC-card process. This would drive the SRC-card process toward a single process of ownership, enhance cost-wise readiness, provide improved materiel management, and ensure higher availability through faster turnaround times. In this case, the common DEX (data exchange) environment inherent to PLCS systems would provide a secondary DoD benefit, Total Asset Visibility (TAV).

### 2. The NAE

There are several recommendations for the NAE. The NAE should implement an AIR*Speed* ideology into the Repository system to take advantage of the many inefficiencies that currently exist. The NAE should also look into increasing the staffing level at the ATCM Repository in order to ensure incoming hard-card processing demands can be met by the ATCM staff. A re-examination of past black-belt projects, such as the one completed in late 2006 by CDR Jon

Albright and Jim McGilloway, would offer further insight to the current problem and what has already been done to address the issue at hand.

Further part-penalty research with other FSTs will most likely identify dollar losses similar to the losses identified during this research. Those additional recognized dollar losses will help drive support for an automated ATCM and COMTRAK database that will eventually allow fulltime access to the history of a part's lifecycle. And since UID capabilities already exist in the Oracle 10g database, use of the current database server in combination with squadron use of UID technology will provide two advantages: compliance with the DoD's UID mandate and dramatic increases in process efficiencies and accuracies in part information Fleet wide.

Another suggestion is to recommend that a new AIR*Speed* project be initiated in the Repository process of handling SRC cards and related items. The current backlog of SRC and other hard-card items that need to be entered into the ATCM database suggests that that there is an opportunity for improvement in the current process. An AIRSpeed *DMAIC* (Define, Measure, Analyze, Improve, and Control) model could be used to redefine the problem as well as determine possible solutions to reduce the backlog and process incoming cards more efficiently.

At the organizational level, squadrons should implement training that identifies the proper procedures for SRC-card reporting. Some TMS have dual reporting requirements regarding SRC-related items, and administrative persons must adhere to the local PMIC for reporting instructions. We recommend specific SRC-card training for incorporation into the already-established organizational training syllabus.

### 3. DYCOMTRAK

Dycomtrak personnel need to continue the push for COMTRAK to become Web accessible. It will most likely need support from research groups at the Naval

Postgraduate School since there are numerous PLCS systems available in the commercial world. An NPS study that focuses on the problem, the systems available to address the problem, and cost-efficient ways of implementing such a system would be extremely beneficial and inexpensive.

Dycomtrak has been included in the *NAMP* change recommendations because some TMS activities report hard-card items to both Dycomtrak and the ATCM Repository. Dycomtrak performs essentially the same services as the ATCM Repository, with the additional function of hour validation/conversion of components. Not every squadron has records that are tracked by Dycomtrak. The squadron's Periodic Maintenance Information Cards (PMIC) will direct the proper procedures for submitting hard-cards.

#### 4. NAMP and the CMIS/ATCM Repository

The current Web site link for the Historical Data Request Form needs to be updated in Section 5.2.1.30.1.5 to http://www.navair.navy.mil/logistics/atcm/overview.cfm. The link should also include a note that says something to the effect of "This is the preferred method of requesting part data." The Historical Data Request Form is the ATCM staff's preferred method for part lifecycle requests because the form matches database query requirements, making the part data search more efficient. It minimizes the non-value-added work inherent to phone calls between the ATCM Repository staff and Fleet users.

The Fleet may not be aware of CMIS/ATCM query requirements, which may result in wasted time on the phone as the ATCM staff try to help the Fleet requestor find the necessary query information of a part. If the Fleet understood the part information required by the ATCM staff and had this information when contacting the Repository, then these earned-time efficiencies could be applied to other functions of the ATCM staff such as data entry and sorting of newly received hard-cards. The current *NAMP* Web link does not lead directly to the Historical Data Request Form nor is the form easy to find using the link provided. This updated link will take the customer directly to the Historical Data Request Form Webpage.

The second short-term fix includes multiple similar changes and additions to several chapters of the *NAMP*. In chapters 3, 5, 6, 7, 9, 10, 12, and 15, the following sentence should be added: "If an AESR, ASR, EHR, MSR, or SRC card is missing or contains incorrect or insufficient information, then refer to 5.2.1.30.1.5 for contacting the ATCM Repository or Dycomtrak based on TMS and PMIC requirements." This change would add efficiency to the *NAMP* by allowing the user to quickly access Repository and Dycomtrak point-of-contact information located elsewhere in the *NAMP* and not readily available in any of these sections.

Additionally, in chapter 5 Section 5.2.1.30.1.4, the following should be added after the ATCM Repository address: “In addition, send information to Dycomtrak if directed by local PMIC.” On multiple site visits, administrative personnel of TMS supported by Dycomtrak were unaware of the dual reporting criteria, as outlined by the *NAMP*. This will help eliminate the stovepipe that currently exists in platforms served by only Dycomtrak. Finally, in Section 5.2.1.30.1.5, the following changes are recommended: add the ATCM Repository fax number (301) 757-8451, and change part (a) by adding “if directed by local PMIC” to the end of the sentence.

The last change is to establish a general e-mail account within the Repository to take full advantage of the many benefits e-mail provides. It would facilitate a faster collection of SRC cards normally mailed in (which can take several weeks to arrive from deployed squadrons) and provide a more efficient sorting system for cards received. E-mail correspondence would establish a means of electronically sorting unprocessed data (backlogs) in contrast to the current physical card-stacking method while providing a quick retrieval of hard-card data awaiting entry into the ATCM database. Additionally, it would provide an accurate inventory of received, processed, and backlogged cards.

A general e-mail account would develop and promote a more reliable communication path between the Fleet and the Repository by providing a means to overcome phone and internet connectivity problems often encountered by deployed squadrons. The path will act to establish a mutually beneficial communication behavior pattern between the Repository and the Fleet while silently promoting the need for a future "e-mail direct-to-database" capability. A capability of that nature would lead to a negligible hard-card backlog, provide the most accurate part-lifecycle database possible, and dramatically reduce the millions of dollars lost each year to scrapped parts. The general e-mail address could read TMS@respository.com, where TMS is replaced by actual platform nomenclature (i.e., FA18@Repository.com, E2@Repository.com, EA6@Repository.com, T45@Repository.com, etc.).

Since all aforementioned modifications to the *NAMP* should expedite the SRC-card data-transfer process between the ATCM Repository and the Fleet, we drafted a*NAMP* change request and sent it to the Program Manager, Pat Montgomery, for review. With his concurrence, the team co-authored the official *NAMP* change request IAW NAMP Chapter 1 submittal procedures.[29]

As discussed in earlier chapters, the CMIS/ATCM database has the capability to be accessed by the Fleet at any time, but it is currently limited to administration only, for good reasons. If it is decided that the full capabilities of the Oracle 10g server are to be used, CMIS would need to develop an SOP for all ATCM and COMTRAK users. Limited database access should initially be allowed as training is provided to supervisors and those of the AZ rating. Navy Knowledge Online NKO may be a great tool for this training as well as AZ school. Completion of this type of

---

[29] The *NAMP* provides examples for formal submissions based on whether a correction, change, or deviation is thought to be needed. Once approved, *NAMP* modifications are immediately addressed to the Fleet using official message traffic and are than incorporated into the *NAMP* as a hardcopy upon release of an updated revision, which may be several years from any given accepted change.

training could lead to the requirements by the Repository for database access. If full capabilities are deemed undesired because of data integrity or data risk considerations, then the ATCM must be funded for greater staffing, similar to the staffing of Dycomtrak.

## B. SPAWAR

### 1. Paperless SRC-card OOMA Project

A Paperless SRC-card OOMA Project was conducted in 2007; however, the project was not adopted by NAVAIR. The $48.5–$52.3 million NALCOMIS proposal price tag may have been the reason for cancellation of a paperless SRC Card, but perhaps the NAVAIR black-belt team could implement another black-belt project to explore other alternatives to achieve a paperless card process.

The paperless card process is not a new concept. NAVAIR has been introduced to several conceptual paperless card programs that have not been adopted. A paperless SRC-card process would not only provide quicker Fleet response to needed data but also would give the end user an easier way of transmitting information. It would save the Fleet man-hours and costs associated with physically mailing a card to the Repository or Dycomtrak. Currently, there is no feedback process that tells the Fleet personnel that the card was received. This is another issue in the Repository process that needs to be addressed. If the process were electronic, perhaps an electronic form of acknowledgement that a card was received could be provided to the Fleet administration person.

### 2. OOMA Update to Include UID Technology and Communication Link to Repository and DYCOMTRAK

OOMA is UID capable. The technology for UID utilization at the organizational level is not in place; however, OOMA can recognize UID information. If there were a way to effectively implement UID with SRC-carded components and capture that data in OOMA, this would eliminate the necessity of the paper SRC card.  If the SRC data in OOMA could be sent electronically to the ATCM Repository, this would eliminate the human interface of having to maintain a paper copy of an SRC card.  In addition, the man-hours spent in sending a paper copy of the SRC card would be saved as well as the cost of shipping.  We recommend NAVAIR continue to explore and adopt an automated system that would allow the user to access SRC information instantly, instead of the current process that can take days for a response.

### 3. Design NALCOMIS' Software to Collaborate with CMIS/ATCM and COMTRAK

We recommend a type of shareware that can be incorporated and that will allow NALCOMIS data to be sent to or incorporated into the ATCM and Comtrak database.  Having real-time information sent to the Repository would eliminate the steps of having administrative personnel produce a copy of a hard-card, send it to the Repository, and have the Repository input that data into the ATCM database.  If an administrative person at the organizational level could establish a more direct line of communication with the Repository, this would eliminate multiple unnecessary steps in the current reporting process.

If SPAWAR could implement a password-protected, user-friendly database or interface that would allow the user to input NALCOMIS software data into a CMIS/ATCM database that would have the up-to-date information about that specific component, then it would be a tremendous asset to the Fleet.

### 4. Repository Chat Room

Over the past five years, chat services (such as Yahoo Messenger or Google Talk) have become a primary means of instant messaging in the computer world. The military, in particular, does a tremendous amount of chatting, using products such as MIRC and Microsoft Chat on both classified and unclassified networks. These extremely powerful real-time communication vehicles are widely available at no cost and would provide instant access to Repository staff from anywhere in the world, at any time.

Developing a chat room for the Repository would also provide the added benefit of allowing Fleet maintenance personnel to converse with Repository staff more quickly than both Web site and e-mail services, which is particularly important, and may compensate for the limited availability of telephone access while at sea. If developed and implemented, a Fleet-wide message would need to be promulgated to ensure chat room benefits are immediately recognized and enjoyed. A *NAMP* change similar to what was submitted with this thesis will also be necessary to illustrate official endorsement.

## C. Commander Naval Education and Training (CNET)

### 1. Develop and Implement Hard-card Training at Administrativeman "A" School

During our site visits to different air stations, our research team found that Aviation Administration men (AZ) personnel had different interpretations of what the proper procedures were in the event of a lost or missing SRC card, or if the card contained possibly wrong information. One junior AZ noted that the curriculum for the AZ "A" school, which is the initial training for an aviation administration person, was entirely computer-based and that the procedures for missing or lost SRC cards were not covered.

We recommend that enhanced SRC-card procedures be implemented in the AZ "A" school training curriculum to better educate AZs in their initial training. Perhaps a scenario-based training module could be used to reflect situations in which an SRC card must be reconstructed or further information is needed about an SRC-carded item—in which case, the Repository may need to be contacted. For an AZ that may report to a TMS activity that has a dual reporting responsibility, Dycomtrak reporting procedures also need to be incorporated in the training.

Currently, administrative personnel send thousands of EHR cards to the ATCM every month. In e-mails from Repository personnel, it was identified that these EHR cards are collected but not maintained in a database by the Repository. In contrast, EHR cards are being received and tracked at Dycomtrak. These EHR cards provide data on the history of a part that Dycomtrak and FSTs can use to identify failure trends, help define root causes, and determine Fleet-wide technical maintenance problems. EHRs also provide another means of acquiring data on the history of a part when rebuilding SRC cards. For these reasons, EHR cards should be maintained, but as mentioned earlier, the Repository is not staffed adequately to handle the large numbers that are received each month. Adopting a PLCS system will allow this information, along with all other hard-cards, to be processed electronically in a collaborative architecture that will greatly enhance maintenance management at all levels, thereby contributing and increasing readiness around the Fleet.

THIS PAGE INTENTIONALLY LEFT BLANK

# Appendix A: Survey Questions

1. How familiar are you with the Scheduled Removal Card (SRC) process?

    a. Very Familiar b. Somewhat Familiar c. Not really

    d. What is an SRC?

2. When was your experience with the SRC process?

    FROM________________________ TO__________________________

3. Which job title most closely describes your experience with the SRC process?

    a. MMCO b. AZ c. SK d. Maintenance Chief

    e. Maintenance Tech f. __________________________

4. Where do you have the most experience in dealing with SRC cards?

    a. Sea Duty O-level b. Sea Duty I-level c. Shore Duty O-Level

    d. Shore Duty I-Level e. Supply Command ashore

    f. Supply Command at sea

5. Have you ever received a part from the supply system that did not contain an SRC **but** required one?

    Yes b. No

6. If so, approximately how many times in your career has this happened?

    _______________________________

7. Have you ever used the NAVAIR 6.0 central CMIS Repository "Historical Data Request Form" for parts missing their respective SRC? (http://www.navair.navy.mil/logistics/atcm/REQUEST.CFM)

    a. Yes b. No

8. How much time, on average, did it take to remedy the missing SRC issue so that the applicable part could be flown on an aircraft?

a. ________________________________________

9. How did you remedy the problem? Contacted:

a. CMIS Repository b. Supply c. AIMD/FRC d. Generated New SRC e. ______________________________

10. At any time, did the missing SRC(s) lead to a flight delay or cancellation?

a. Yes b. No

11. Did the missing SRC(s) lead to the unplanned cannibalization of another aircraft or "borrowing" parts from a nearby squadron to maintain squadron readiness?

a. Yes b. No

12. After transferring an SRC item, how long did you maintain a copy of the original?

a. Don't keep one b. __________months c. Never discarded.

13. After you transferred the SRC item, what method did you use to send the SRC data to the CMIS Repository?

a. Email b. WEBSALTS c. U.S. Postal or courier

d. did not send a copy

14. Feel free to write any additional comments about your experience with the SRC process.

______________________________________________________________

______________________________________________________________

We appreciate your cooperation. Please return this survey to astaffie@nps.edu.

# Appendix B: Submitted Official *NAMP* Change Request

**DEPARTMENT OF THE NAVY**
Commander Naval Air Systems Command
Patuxent River, MD

From: Program Manager, Repository CMIS/ATCM

To: Commander, Naval Air Systems Command (AIR-6.7.2.1)
Via: Commander Naval Air Force, U.S. Pacific Fleet

Subj: CHANGE RECOMMENDATION TO COMNAVAIRFORINST 4790.2

Ref: (a) COMNAVAIRFORINST 4790.2

1. Recommend adding the following sentence to the 4790 references below: "If an AESR, ASR, EHR, MSR, or SRC Card is missing, contains incorrect or insufficient information refer to 5.2.1.30.1.5 for contacting the CMIS Repository or Dycomtrak based on TMS and PMIC requirements."

**3.2.2.9.6.5**, at the end of paragraph c,
**3.2.2.13.2**, between …EHRs. and O-level…,
**3.2.2.13.3**, after …guns,
**3.5.2.2**, at the end of paragraph f. (7),
**3.5.6.3**, at the end of paragraph c,
**5.1.1.5.1.9**, between …inspected. and At the completion…,
**5.1.1.5.6.8.2**, after …Aircrew Systems Record.,
**5.1.1.5.6.9.2**, after …Aircrew Systems Record,
**5.1.1.10**, at the end of paragraph, after … Explorer,
**5.1.1.13.2**, at the end of paragraph d,
**5.1.3.3.1**, paragraph d, remove sentence "If the appropriate record or card is not available…" and inserting recommended sentence.
**5.1.3.3.2**, at the end of paragraph a,
**5.1.3.4.6.1**, at end of paragraph,
**5.2.1.1.2**, at the end of paragraph d,
**5.2.1.10.2**, at the end of paragraph e,
**5.2.1.16.1.3**, at end of paragraph,
**5.2.1.20.1.5**, at end of paragraph,
**5.2.1.25.1.7**, at end of paragraph e,
**6.1.1.1.2.4**, first paragraph, after "each engine AESR or CM ALS AESR."
**7.1.8.1.5.3,** at the end of paragraph a.
**9.1.27.2,** at the end of paragraph (1) section c**,**

**10.3.3.1.1**, at the end of paragraph,
**10.3.3.2**, at the end of paragraph e,
**10.9.3.4.2**, at the end of paragraph g,
**10.10.3.5**, in addition to the NOTE,
**10.10.5.3.1.3**, at the end of paragraph,
**10.10.5.3.1.4**, at the end of paragraph,
**10.10.5.3.1.6.2**, at the end of paragraph,
**10.10.5.3.1.9**, in addition to the NOTE,
**10.10.5.3.1.11**, at the end of paragraph,
**10.10.5.3.3**, block 6, end of paragraph,
**10.10.5.3.3**, block 7, end of paragraph,
**10.10.5.3.4**, block 6, end of paragraph,
**10.10.5.3.4**, block 7, end of paragraph,
**10.10.5.4.8**, at the end of paragraph,
**12.3.3.5.4**, at the end of paragraph,
**12.3.12.1.3.2**, at the end of paragraph g,
**12.3.12.4.4**, in addition to the NOTE,
**12.3.12.9.4**, at the end of paragraph b,
**15.2.4.1.5**, at the end of paragraph, create NOTE: and add recommended sentence,
**15.2.4.1.12.1**, at end of paragraph,
**15.2.11.10**, in addition to the NOTE.

2. This change adds efficiency to the NAMP by allowing the user to quickly access Repository and Dycomtrak point of contact information that is located elsewhere in the NAMP and is not readily available in any of these sections. NAMP Chapter 5, section 5.2.1.30.1.5, directs all activities requesting SRC Card data, to call the CMIS Repository or use the listed Web site link. It also lists options such as sending the request by U.S. Postal mail and/or official message traffic.

3. Recommend adding the following to Chapter 5 Section **5.2.1.30.1.4** after CMIS Repository address: "In addition, send information to Dycomtrak if directed by local PMIC."

4. A study conducted by a research team from the Naval Postgraduate School found that some administrative personnel of TMS supported by Dycomtrak were unaware of the dual reporting criteria as outlined by the 4790. This will help eliminate the stovepipe that currently exists in platforms served by only Dycomtrak and give the CMIS Repository more accurate information.

5. Recommend adding the following information to **5.2.1.30.1.5:** after “COMM (301) 757-8883,” insert “FAX (301)757-8451”. Also, remove “http://www.navair.navy.mil/logistics” and replace with “http://www.navair.navy.mil/logistics/atcm/index.cfm”.

6. The Fleet user may be unaware of CMIS/ATCM query requirements. The current NAMP Web link does not lead directly to the Historical Data Request Form nor is the form easy to find from the link provided. Per the CMIS staff, the Historical Data Request Form available through http://www.navair.navy.mil/logistics/atcm/index.cfm which allows for easier and more efficient data query of the CMIS/ATCM database and can save a significant amount of time. This updated link will take the customer directly to the Historical Data Request Form Web page.

7. Point of contact is Pat Montgomery, DSN 757-2311 email Patrick.Montgomery@navy.mil.

THIS PAGE INTENTIONALLY LEFT BLANK

# Appendix C: H-60 Helicopter/Dynamic Component Tracking

**Contractor's Monthly Platform Status**

**For the period 1 September to 30 September 2009**

## 10.2.1 Summary

In accordance with the 3.2 Maintenance Planning and Design Interface contract, *Serco North America* will provide analyses, technical studies and reports relative to Component Time Before Overhaul, evaluate 3M Reports and provide recommendations and monitor of Maintenance/Logistics data collection and Tracking Systems/Programs including 3M and component tracking in support of the H-60 Helicopters.

**CONTRACT NUMBER**: N000421-01-D-0101

**DATE OF REPORT**: 15 October 2009

**SERIAL NUMBER OF REPORT**: A003-10

10.2.2.1 Milestone/Task Status

**A.** **Schedule**: To date General Task 3.2.2.2 has been complied with.

**B.** **Baseline Comparison:** N/A

**C.** **Period Accomplishments:** H60 processed 1,138 documents, answered 414 Fleet Requests for data, completed 58 A/C Logbooks from NAS Norfolk, VA and Hawaii, and processed 3M for the month of August 2009.

**D.** **Key Dates:** N/A

**E.** **Design Completed:** N/A

**F.** **Previous Problem/Resolution:** N/A

**G.** **New Problem Areas Encountered or Anticipated:** N/A

**H.** **Significant Results of Conference, Trips, or directives:** Screened and copied fifty-eight Aircraft logbooks from Norfolk, VA and Hawaii.

**I.** **Significant Information Resulting In Program Schedule Change:** None

**Future Plans:** Continue to update database through the receipt of FE's, mail-ins, SRC Cards from the Fleet activities and Rework activities. Provide logistic support as requested. Monitor tracking systems and associated programs.

**Itemized Costs and Man-hours:** N/A

**Contract Delivery Status:** There is no backlog at this time.

**Report Prepared By**: Paul D. Allen (252) 447-0391

## SH60-B/-F/-H/-R/-S DYCOMTRAK STATUS

**Reporting Period: September 1 – September 30, 2009**

## I. TASK STATUS:

1. **DATABASE**

| | | |
|---|---|---|
| A. | Number of aircraft on Master file - | 426 |
| B. | Number of aircraft not loaded - | 0 |
| C. | Number of new aircraft loaded - | 5 |
| D. | Number of components tracked per aircraft - | 148 |
| E. | Number of components in the Master file - | 113,404 |
| F. | Number of aircraft inducted into SDLM/Rework - | 0 |
| G. | Number of aircraft completed SDLM/Rework - | 0 |
| H. | Number of aircraft in SDLM/Rework - | 0 |

2. **PARM FILE CHANGE REQUEST:** 81 Parm File changes

3. Loaded 16650, 166551, 166522,167836 and 167837 into database.

4. Deleted 162137 from database.

## II. CURRENT MONTH'S ACTIVITY:

**TOTAL AIRCRAFT UPDATED THIS MONTH** 418

### 1. MAIL-IN PROGRAM:

**DOCUMENTS RECEIVED:**

| SEPTEMBER | TOTAL FOR YEAR |
|---|---|
| 1,138 | 21,103 |

### 2. DATA CALL SUBMISSIONS:

| SEPTEMBER | TOTAL FOR YEAR |
|---|---|
| 414 | 3,786 |

### 3. SAVINGS/BENEFITS:

| NUMBER DISCREPANCIES | TYPE OF DISCREPANCIES | BENEFITS | SAVINGS THIS MONTH |
|---|---|---|---|
| 200 | Lost Cards/Rep | Savings | $3,519,289.00 |
| 34 | Lost Cards/Cons | Savings | $53,067.00 |
| 176 | Data Accuracy | Readiness | 0 |
| 4 | High Time | Safety | 0 |

| | |
|---|---|
| **CUMULATIVE SAVINGS:** | $62,265,888.00 |
| **CUMULATIVE READINESS:** | 1258 |
| **CUMULATIVE SAFETY:** | 28 |

### 4. DOLLAR LOSS DUE TO PENALTY APPLICATION:

| PART NUMBER | QTY | DOLLAR LOSS |
|---|---|---|
| 96250-32107-041 | 1 | $907.00 |
| 70400-08110-060 | 1 | $115.00 |
| 70400-08110-061 | 1 | $40.00 |
| 70400-08162-042 | 4 | $19,748.00 |
| 70410-26520-042 | 1 | $3,230.00 |
| 70400-06701-042 | 1 | $84.00 |
| 70107-08404-045 | 1 | $4,394.00 |
| 70108-28103-041 | 1 | $3,802.00 |
| 70106-28004-041 | 1 | $733.00 |
| 70102-11101-042 | 2 | $8,904.00 |
| 70410-02500-046 | 5 | $10,900.00 |
| **TOTALS** | 19 | $52,857.00 |

### 5. AV3M/FLIGHT SUMMARY UPDATE:

A. 3M data for August 2009 was processed.

3,740 Documents Processed by the 3M Edit Program
2,162 COMTRAK Related Documents
2,147 Documents in the Master file
408 Documents which had to be corrected in the Master file
794 Documents deleted as completed
0 Documents were initially correct
945 Documents not corrected due to invalid data
15 Documents in the "Work" and "CFAA" Files

| | |
|---|---|
| 0 | Documents were corrected |
| 10 | Documents not corrected due to invalid data |
| 5 | Documents deleted as previously completed |
| 1,578 | Documents in the "Discard File" |
| 0 | Documents were researched and corrected |
| 1,578 | Documents researched and found not related to COMTRAK due to WUC's not tracked, or invalid S/N's |
| 408 | Documents were submitted to update the COMTRAK Program |

B. Flight Summary for the Month of August 2009 was completed.

6. **SPECIAL REPORTS:** Provided 400 report and cards for 166313 Flight Control System and Drive Transmission System to FST Engineers. Provided Main Module Access database converted to Excel Spreadsheet to FST Engineer. Also provided removal data on Main Modules that were removed for high time to FST Engineer.

# List of References


Addams, C. (2003, April 15). *A world of service for the Boeing 737*. Press release. Retrieved July 14, 2009, from http://www.boeing.com

Albright, J. (2006, October 18). *Lean six sigma: Improving the aircraft component history record process*. Unpublished PowerPoint presentation.

Allen, P. (2009, August 19). Interview with researchers.

Barber, T. (2007, March 15). NALCOMIS optimized organizational maintenance activity: NALCOMIS, the next generation. [PowerPoint presentation]. Retrieved June 5, 2009, from http://www.southernmarylandsole.com/documents/MAROOMASoleBrief.ppt#723,1,Slide 1.

Blake, R. *NALCOMIS optimized organizational maintenance activity.* [PDF format].

Retrieved from email of Mr. Pat Montgomery to Mr. James Mcgilloway on January 24, 2007.

Buckner, R. (2003, December 9-10). *Apache CMB part marking: DoD part marking AIT forum*. [PDF format]. Retrieved July 30, 2009, from http://www.avioninc.com/services/programs/amats_ait.html

CIMdata. (2009, May 21). *CIMdata: Global leaders in PLM consulting*. Retrieved June 5, 2009, from http://www.cimdata.com/publications/commentaries.html

CIMdata. (2009, May). *Jotne EPM's EDMmodelServer™(PLCS)—Using PLCS to harmonize product development and support environments*. Retrieved July 14, 2009, from http://www.cimdata.com/publications/commentaries.html

Commander Naval Air Forces (COMNAVAIRFOR). (2009). *The Naval Aviation Maintenance Program Instruction. (NAMP)* (Commander Naval Air Forces Instruction 4790.2A). (Chapters 1-17). San Diego, CA

Davis, D. (2009, January 15). *ALGS Data Quality & Integration Management (DQIM)*.Unpublished PowerPoint presentation.

Defense Acquisition University. (2008). *Item Unique Identification (IUID)—Basic training*. Retrieved June 14, 2009, from http://www.dau.mil

Department of the Navy. (2009, Feburary 15). *Aviation maintenance administration basic- aviation theories and other practices* (OPNAVINST 4790.2). Retrieved June 5, 2009, from http://www.tpub.com/content/aviation/14292/index.htm

Durant, R.W., & Andreson, J. (2007). The Concept of Operations for IUID-enabled maintenance in support of DoD materiel readiness (revision 1). Washington, DC.

Eurostep and the UK Ministry of Defence Product Data Standards Team. (2008). *Product lifecycle support*. Retrieved May 15, 2009, from http://www.plcs-resources.org/index.html.

Finley, J. (2007, May-June). Making a difference for asset visibility, management, and accountability. *Defense AT&L*, *36*(3), 8-12.

Foster, B. (2007, June 22). *OOMA Installation Optimization LSS Project, OOMA executive brief* (PMW-150). PowerPoint presentation and brief. Building OT-3, CIPO Conference Room (2915) San Diego, CA, OOMA Standdown Meeting.

Jahadi, M., & Mason, H. (2008, December). *Computer-aided Enterprise Solutions*. Retrieved May 17, 2009, from http://img1.custompublish.com/getfile.php/862950.861.fwfbyfeuwd/PLCS-EDIG-200902.pdf?return=www.jotne.com

Kaarlela, M. (2004, January-February). F-35 Joint Strike Fighter and Unique Identification (UID). *Defense AT&L*, *33*(1), 12–15.

Lahiri, S. (2005). *RFID sourcebook*. Upper Saddle River, NJ: Pearson PLC.

Lindauer, B. (2009, August 27). [E-mail correspondence with researchers].

Lockheed Martin. (2007, August). *Support system 101*. Unpublished PowerPoint presention.

MacDougall, C., & Pompa, J. (2009, May). *IUID gateway service*. Unpublished PowerPoint presentation.

MacSema, Inc. (2009, August 28). *Buttonmemory Product Catalog*. Retrieved August 30, 2009, from http://www.macsema.com/pdf/Button_Catalog.pdf

Mason, H. (2008a, July 5). *Jotne EPM technology*. Retrieved May 16, 2009, from http://www.epmtech.jotne.com/why-plcs.4496614-109293.html

Mason, H. (2008b, July 5). *Why PLCS?* Retrieved June 7, 2009, from http://www.epmtech.jotne.com/index.php?id=4496614&cat=109293&printable+1

Montgomery, P. (2009, June 12). Interview with researchers.

Naval Enterprise. (2009). *What is Navy Enterprise?* Retrieved November 7, 2009, from http://www.navyenterprise.navy.mil.

Naval Air System Command. (2009a). *NAVAIR 6.0 logistics and industrial operations*. Retrieved August 27, 2009, from http://www.navair.navy.mil/logistics/atcm/overview.cfm

Naval Air System Command. (2009b). *Serialized Item Management (SIM) appendix (draft)*. Patuxent River, MD: Naval Aviation Enterprise.

Navy Supply Systems Command (NAVSUP). (2006, June). *Automatic Information Technology (AIT) implementation manual*. Mechanicsburg, PA: Navy AIT Program Office.

Saunders, K., & Steckman, T. (2009, June 11). *F-18 SRC card reconstructions*. Unpublished PowerPoint presentation.

Stallings, T. (2009, August 24). [E-mail correspondence with researchers].

Under Secretary of Defense (AT&L). (2007, March 23). Unique Identification (UID) standards for a net-centric Department of Defense. (Directive 8320.03). Washington, DC.

THIS PAGE INTENTIONALLY LEFT BLANK

# 2003 - 2009 Sponsored Research Topics

## Acquisition Management

- Acquiring Combat Capability via Public-Private Partnerships (PPPs)
- BCA: Contractor vs. Organic Growth
- Defense Industry Consolidation
- EU-US Defense Industrial Relationships
- Knowledge Value Added (KVA) + Real Options (RO) Applied to Shipyard Planning Processes
- Managing the Services Supply Chain
- MOSA Contracting Implications
- Portfolio Optimization via KVA + RO
- Private Military Sector
- Software Requirements for OA
- Spiral Development
- Strategy for Defense Acquisition Research
- The Software, Hardware Asset Reuse Enterprise (SHARE) repository

## Contract Management

- Commodity Sourcing Strategies
- Contracting Government Procurement Functions
- Contractors in 21st-century Combat Zone
- Joint Contingency Contracting
- Model for Optimizing Contingency Contracting, Planning and Execution
- Navy Contract Writing Guide
- Past Performance in Source Selection
- Strategic Contingency Contracting
- Transforming DoD Contract Closeout
- USAF Energy Savings Performance Contracts
- USAF IT Commodity Council
- USMC Contingency Contracting

## Financial Management

- Acquisitions via Leasing: MPS case
- Budget Scoring
- Budgeting for Capabilities-based Planning
- Capital Budgeting for the DoD
- Energy Saving Contracts/DoD Mobile Assets
- Financing DoD Budget via PPPs
- Lessons from Private Sector Capital Budgeting for DoD Acquisition Budgeting Reform
- PPPs and Government Financing
- ROI of Information Warfare Systems
- Special Termination Liability in MDAPs
- Strategic Sourcing
- Transaction Cost Economics (TCE) to Improve Cost Estimates

## Human Resources

- Indefinite Reenlistment
- Individual Augmentation
- Learning Management Systems
- Moral Conduct Waivers and First-tem Attrition
- Retention
- The Navy's Selective Reenlistment Bonus (SRB) Management System
- Tuition Assistance

## Logistics Management

- Analysis of LAV Depot Maintenance
- Army LOG MOD
- ASDS Product Support Analysis
- Cold-chain Logistics
- Contractors Supporting Military Operations
- Diffusion/Variability on Vendor Performance Evaluation
- Evolutionary Acquisition

- Lean Six Sigma to Reduce Costs and Improve Readiness
- Naval Aviation Maintenance and Process Improvement (2)
- Optimizing CIWS Lifecycle Support (LCS)
- Outsourcing the Pearl Harbor MK-48 Intermediate Maintenance Activity
- Pallet Management System
- PBL (4)
- Privatization-NOSL/NAWCI
- RFID (6)
- Risk Analysis for Performance-based Logistics
- R-TOC AEGIS Microwave Power Tubes
- Sense-and-Respond Logistics Network
- Strategic Sourcing

## Program Management

- Building Collaborative Capacity
- Business Process Reengineering (BPR) for LCS Mission Module Acquisition
- Collaborative IT Tools Leveraging Competence
- Contractor vs. Organic Support
- Knowledge, Responsibilities and Decision Rights in MDAPs
- KVA Applied to AEGIS and SSDS
- Managing the Service Supply Chain
- Measuring Uncertainty in Earned Value
- Organizational Modeling and Simulation
- Public-Private Partnership
- Terminating Your Own Program
- Utilizing Collaborative and Three-dimensional Imaging Technology

A complete listing and electronic copies of published research are available on our website: www.acquisitionresearch.org

THIS PAGE INTENTIONALLY LEFT BLANK

ACQUISITION RESEARCH PROGRAM
GRADUATE SCHOOL OF BUSINESS & PUBLIC POLICY
NAVAL POSTGRADUATE SCHOOL
555 DYER ROAD, INGERSOLL HALL
MONTEREY, CALIFORNIA 93943

www.acquisitionresearch.org