



## COMNAV AIR FORCES (CNAF) MACHINERY CONDITION ANALYSIS (MCA) PROGRAM

# FY2004 MCA PROGRAM BENEFIT TO COST STUDY

## 1.0 INTRODUCTION

### 1.1 Executive Summary:

The aircraft carrier continues to be the centerpiece of the forces necessary for forward presence. Whenever there has been a crisis, the first question has been: "Where are the carriers?" Carriers support and operate aircraft that engage in attacks on airborne, afloat, and ashore targets that threaten free use of the sea; and engage in sustained operations in support of other forces.

Aircraft carriers are deployed worldwide in support of U.S. interests and commitments. They can respond to global crises in ways ranging from peacetime presence to full-scale war. Together with their on-board air wings, the carriers have vital roles across the full spectrum of conflict. Because of their importance, the fleet must always be prepared to engage upon its mission with little or no advance notice. As well, an operating ship, must give high priority to ship material readiness to ensure that it can perform its mission at its full capacity. The aircraft carrier **Machinery Condition Analysis (MCA) program is a critical component in maintaining the Navy's high standard of fleet operational readiness.**

Aircraft carrier maintenance planners have used information from the MCA program to define availability work packages since 1970. Azima DLI has been the government's contractor for MCA since 1975 and Ship's Force Machine Vibration Analysis (SFMVA) since 1988. Information on the specific condition of over 400 pieces of rotating machinery on each ship is determined and tracked for use in deciding if the machine should be repaired or overhauled, or if scheduled time-based work can be deferred. This information has made the maintenance and repair planning process more accurate and cost effective, and has reduced the incidence of failures and emergent industrial work for these machines.

### 1.2 Benefit to Cost Results:

The MCA Program conducted 9 surveys during FY 2004. 2,639 non-nuclear cognizant machines were tested, averaging 295 machines per survey. There were also 3,020 machines tested by SFMVA during the year, for a total count of 5,659 non-nuclear cognizant machine tests.

SFMVA recommendations can be redundant and are not counted in this study. However, non-nuclear cognizant MCA reports made the following number of recommendations:

Class and Priority	Desirable	Important	Mandatory
Class B overhaul component	15	10	10
Class C repair specific item	100	71	13
Class D inspect or monitor component	Not considered in this study		

The program costs were \$913,431 including contractor costs and administration by the Carrier Planning Activity (CPA), but excluding nuclear cognizant work. Consequently, the cost of conducting MCA and SFMVA was \$161 per machine test.

The program savings, as defined and calculated in this study, were \$11,274,850, for a **Benefit / Cost ratio of 12.3 / 1**. This is a conservative calculation. Section 2.0 lists several areas of program savings, most of which are difficult to accurately quantify and are not included in this study.

This benefit/cost study was done, considering current planning practices and machinery repair costs. Eight previous benefit cost studies were completed, using criteria relevant to the planning processes and costs in those years. Some of those benefit cost ratios were:

Year	1977	1988	2000	2001	2002	2003	2004*
B / C	18.8 / 1	19.0 / 1	19.5 / 1	20.0 / 1	20.9 / 1	23.0 / 1	12.3 / 1

\*2004's ratio is low because there were only two CVN68 Class surveys, prior to DPIAs, where notional work packages could be reduced to gain benefit savings. See Section 2.2.

## 1.3 Background:

### 1.3.1 Pre-Availability MCA Surveys:

Approximately 6 months before a major availability, a 2 or 3 man, contractor team goes onboard the ship and works with the SFMVA team to complete an MCA survey on approximately 330 machines. Visual inspections are accomplished and operator input is obtained. A preliminary MCA report is issued onboard and a final MCA report and maintenance action forms (OPNAV 4790-2K) are distributed by CPA within 15 days.

CPA maintenance planners and the TYCOMs use the pre-availability MCA report, during or following the WDC, to define the scope of the machinery portion of the work package.

### 1.3.2 Post-Availability MCA Surveys:

Often (following at least 30% of the availabilities), a post-availability survey is conducted by a team from the contractor. This survey supplements the shipyard and ship's force QA of the repairs performed, confirms new machinery configurations, and documents machinery readiness following the availability.

### 1.3.3 SFMVA Surveys:

Ship's force is annually trained and provided with data collectors to test their own machinery. The Ship's Force Machinery Vibration Analysis (SFMVA) data is analyzed onboard and the results are used to schedule Condition Based Maintenance (CBM). These results are sent to the contractor for review and inclusion in statistical studies.

## **2.0 Program Benefits:**

Listed below are descriptions of eight benefits provided by the MCA program, where each item generates repair cost savings and other benefits. Items 1 and 2, but not 3, are used in this study. The remaining five benefits are positive, but difficult to objectively quantify.

### **2.1 Benefit #1 - Prevention of progressive machine damage through early detection of problems.**

Correcting problems found during the MCA surveys prevents subsequent machine deterioration and failure. Casualties and damage, which may affect operations or safety, are prevented, as well as an emergent overhaul or major repair. **Cost savings realized were \$1,674,550.**

### **2.2 Benefit #2 - Improved selection of machines for overhaul during PIA industrial periods.**

There is never enough money to overhaul all machinery, so any information providing guidance in deciding which machines, if any, should be overhauled, is valuable. The MCA report provides specific repair recommendations to be accomplished during the Planned Incremental Availability (PIA). This information is objective and improves the accuracy of overhaul selection, as well as providing a financial benefit for CVN68 Class ships, by eliminating a number of Incremental Maintenance Plan (IMP) overhauls listed in the notional work package. An additional benefit is the elimination of unjustified work listed in the Current Ship's Maintenance Project (CSMP). **Cost savings realized were \$9,600,300.**

### **2.3 Benefit #3 - Improved selection of machines for overhaul during COH or RCOH industrial periods.**

Although in-plant machines are always overhauled, some in-plant and auxiliary machines listed in the notional work package can be eliminated.

### **2.4 Benefit #4 - Identification of specific repairs needed, in lieu of a complete overhaul.**

Considerable cost savings are realized by reducing the number of complete unit overhauls and only accomplishing the recommended specific repairs. The MCA program supports this approach by addressing components and only recommending unit overhauls when they are clearly necessary. Limiting the scope of repair often allows ship's force the option of doing the work.

### **2.5 Benefit #5 - Reduction in post-availability repairs by using machine vibration data for quality assurance during and after industrial periods.**

Post-repair vibration surveys are performed by the shipyard, ship's force, and/or the contractor. All tests use vibration acceptance criteria established by the MCA program. It is well known that the initial failure rate (infant mortality) of newly overhauled machines is high. Problems inadvertently caused during the overhaul can be discovered and corrected under warranty. Full surveys will find problems with other machines, not screened for repair, which developed immediately before or during the availability.

### **2.6 Benefit #6 - Prioritization of machinery operation and reduction in ship's force workload.**

The MCA team presents a report to the Reactor, Engineering, and Air Officers before departing the ship. The report lists machinery condition and all recommended repairs (Class B, C and D). The report allows

the ship to prioritize machinery operating hours and to follow condition based maintenance (CBM), only doing repairs that are within their capability. CBM extends machinery life and ultimately reduces the ship's workload. This benefit is always onboard through ship's force machinery vibration analysis (SFMVA).

### **2.7 Benefit #7 - Reduction of long-term maintenance costs by identifying recurring problems that may be permanently solved.**

The MCA History Report for each aircraft carrier reveals recurring and common faults over the previous 5 to 6 years. Machine class problems, or fundamental, systemic problems, are identified and quantified. Starting with this data, the operational, maintenance and cost benefits over the remaining life of the ship can be predicted. Planners can decide whether to repair the fault or to replace entire suites of machines.

### **2.8 Benefit #8 - Support of repair parts procurement and manpower scheduling prior to the industrial period.**

When an aircraft carrier enters a period of availability, regardless of the length of time it will be there, prior knowledge of which machines will be worked on, and what work will be done, greatly improves efficiency. Having the correct parts and workers on hand greatly improves the ability to finish on time and within budget.

~End~