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NAVY AIR-LAUNCHED MISSILE OPERATING
AND SUPPORT COST ESTIMATING MODEL

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Prepared for
Office of the Chief of Naval Operations
Advisor for Resource Analysis (OP-96D)
The Pentagon
Washington, D.C. 20350

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ABSTRACT

On August 31, 1977, the Cost Analysis Improvement Group (CAIG), which is responsible for policy and guidance for cost analysis in the Department of Defense (DOD), issued a memorandum which contained an operating and support (O&S) cost element structure (CES) for tactical air-launched missiles, to be used in all Defense System Acquisition Review Council (DSARC) reviews and other missile cost analyses. Accordingly, the Resource Analysis Group (Op-96D), which is responsible for independent cost analysis within the Navy, tasked Administrative Sciences Corporation to undertake a study and accomplish the following objectives:

1. develop and coordinate a Navy air-launched missile operating and support cost element structure,
2. discover data sources and gather available data,
3. develop cost-estimating relationships, and
4. document the effort in a report that can be used as a handbook or guide for Navy air-launched missile O&S cost analyses.

The CES which was developed contains sixteen cost elements which define and encompass the same activities described in the CAIG memorandum. Each cost element is discussed in detail in the body of this report, including the following information:

1. a definition;
2. a discussion of the activity, points of contact, historical data, and sources for planning data;
3. a cost-estimating relationship (CER) including computational procedures; and,
4. an example calculation.

All pertinent data which was collected during the study is included ~~in this~~ report, as well as examples of Navy documents which can be used for cost estimating in the future. Each source is identified by a point of contact and a DOD telephone number. All explanatory variables which were employed in the study, whether used in a CER or not, are also included. These data should be helpful for future CER development.

I. EXECUTIVE SUMMARY

This report presents the work done by Administrative Sciences Corporation for the Resource Analysis Staff (Op-96D) under contract N00014-77-C-0180, in the area of Navy air-launched tactical missile operating and support (O&S) costs. The objectives of the effort were to:

- 1) develop a Navy air-launched missile operating and support cost element structure (CES),
- 2) discover data sources and gather available data,
- 3) develop cost-estimating relationships and,
- 4) document the effort in a report that can be used as a handbook or guide for Navy air-launched missile O&S cost analyses.

The CES which is shown in Exhibit I-1 captures exactly those costs defined by the Cost Analysis Improvement Group (CAIG). It was coordinated with the Air Force and is identical at the major topic level with the Air Force tactical air-launched missile CES. Each element is discussed in detail in the body of the report including the identification and discussion of data sources. The raw data is contained in Appendix C. Cost estimating relationships were developed for every cost element for which the data were amenable. For other cost elements, cost factors and/or examples of recent cost history are provided. The factors from the Navy Resource Model (NARM) Program Factors Manual are included to provide an estimating methodology for the elements which are of an indirect nature; e.g., Base Operating Support, Personnel Support.

Cost elements which usually comprise the bulk of O&S costs and the associated "cost drivers" are accorded special emphasis in the discussion, the data and the CER's. In the case of depot maintenance, two different CER's are

EXHIBIT I-1
NAVY OPERATING AND SUPPORT COST ELEMENT
STRUCTURE FOR AIR-LAUNCHED MISSILES

	<u>Appropriation</u>	<u>Budget Category¹</u>	<u>Claimant²</u>	<u>Accounting Visibility³</u>
o <u>Operations</u>				
1. Handling and Inspection	MPN		CINC	A
2. Operational Training	MPN, O&MN		CINC, NAVAIR NAVSEA	A, D/A
o <u>Below-Depot Maintenance</u>				
3. Organizational/AIMD Maint.	MPN, O&MN		OP-01, NAVAIR	A
4. Intermediate Maintenance	O&MN	7/A/2	NAVAIR 4104	D
o <u>Installations Support</u>				
5. Base Operating Support	MPN, O&MN		CINC, NAVAIR NAVSEA	I
o <u>Depot Maintenance</u>				
6. Depot Maintenance	O&MN	7/A/2	NAVAIR 4104	D
o <u>Depot Supply and Technical Support</u>				
7. Supply Depot Ops	O&MN	7/E/1,2,3	NAVSUP	A/I
8. Technical Support				
Fleet Support	O&MN	7/A/2	NAVAIR 4104	D
Engineering Support	O&MN	7/A/2	NAVAIR 4104	D
Quality Evaluation	O&MN	7/A/4	NAVAIR 4104	D
Program Management	MPN, O&MN		NAVAIR	D/A
o <u>Second Destination Transportation</u>				
9. Transportation	O&MN	7/E/3	NAVSUP	A
10. Receipt, Segregation, Storage & Issue	O&MN, MPN	7/B/1	NAVSEA 04J	A
o <u>Personnel Support Training</u>				
11. Replacement Training	MPN, O&MN	8/A/2,2/E	CNET	A/I
12. Health Care	MPN, O&MN		BUMED	I
13. Personnel Support	MPN, O&MN		OP-01	I
o <u>Sustaining Investments</u>				
14. Replenishment Spares	WPN	2	NAVAIR 412	D/A
15. Modifications	WPN, O&MN	2,7/A/2	NAVAIR 412	D
16. Replenishment Ground Support Equipment	WPN		NAVAIR 4104	A

¹7/A/2 refers to Budget Program 7, Budget Activity A, Budget Project 2

²Claimants: CINC - the Commander-in-chiefs of the Naval Fleets
NAVAIR - Naval Air Systems Command
NAVSEA - Naval Sea Systems Command
CNET - Chief of Naval Education and Training
NAVSUP - Naval Supply Systems Command
BUMED - Bureau of Medicine and Surgery
OP-01 - DCNO Manpower Personnel and Training

³D = Direct Cost with individual weapon system visibility

A = Direct Cost without individual weapon system visibility; must be allocated

I = Indirect

provided from which the user may pick the appropriate one. Program data are also provided, and an example calculation is made for every element. The reader, however, is cautioned in Section II regarding the necessity of confirming all program and operational data with knowledgeable fleet personnel.

The report is written in handbook form so that it can be used both as an educational tool for a new analyst and an estimating model for the experienced analyst. Appendix E is designed to serve as a user's guide for both experience levels. The new analyst can refer to Table E-1 which lists all the variables required by the equations in this report. These variables are organized by source in Table E-2; i.e., all the data which should be obtained from the program office, or from the assistant project manager for logistics (APML), or from the OpNAV sponsor (Op-506), etc., are grouped together. The new analyst therefore can satisfy all data requirements from a particular source with a single request.

For the experienced analyst, Table E-3 provides a listing of the cost elements, a brief definition for each, the computation procedure including cost-estimating relationships, and a reference which identifies the major data source and tells where additional background information can be found. Once the analyst digests the information in this report and obtains a working knowledge of missile O&S, he need refer only to the summary of the CER's contained in this table. Finally, Table E-4 contains the cost element structure with the appropriation, claimant and point of contact for each. This provides the reader with an easy guide for gathering data in the future.

II. INTRODUCTION

Since the decision to buy a new weapon system commits the Navy to operate and support it over its operating life, it is important that the operating and support (O&S) costs, as well as research and development (R&D) and procurement costs, be understood and analyzed during the acquisition process. This has become increasingly important in the last decade as O&S costs have exceeded the sum of R&D and procurement costs for many systems. The basic tasks involved in managing and controlling O&S costs are as follows:

- 1) estimate O&S costs during the acquisition process;
- 2) observe and record O&S costs throughout the life of the system in the fleet;
- 3) learn what operating and maintenance policies and procedures drive O&S costs; and
- 4) feed back information to the industrial community so that the designs of future systems incorporate O&S cost savings.

The Cost Analysis Improvement Group (CAIG) has taken the lead in stressing the importance of O&S cost analyses especially relating to Task 1. On August 31, 1977, the CAIG issued a memorandum which contained a cost element structure (CES) for tactical air-launched missiles, including definitions. The memorandum, the missile CES, and definitions, all of which are included in this report as Appendix A, are important because they establish the ground rules for performing missile O&S analyses for all services -- what to include, what not to include.

Appendix B contains the Navy tactical air-launched missile CES developed during this effort, complete with definitions and the funding appropriation and claimant. The CES was prepared to capture exactly those costs defined in the CAIG memo, and at the same time, reflect the uniqueness of the Navy organization, mission, and support concepts. It was also coordinated with Air Force cost analysts and is identical to the CES developed by the Air Force at the major heading level (Operations, Below-Depot Maintenance, Depot Maintenance, etc.) The material is organized as a single section to permit it, when excerpted from this report, to serve as initial guidance for a Navy Program Manager or Study Director in preparing an O&S analysis for a Navy tactical air-launched missile.

Section III of the report contains information for each cost element consisting of a definition of the element, a discussion of the data sources, the computational procedure including a CER, and an example calculation. Since the CES contains several cost elements (Base Operating Support, Personnel Support, Health Care, etc.) which are general in nature and for which no weapon-specific data is collected, the methodology from the Navy Resource Model (NARM) Program Factors Manual is utilized to generate cost estimates. Simply speaking, the methodology consists of the identification of certain support resources (dollars and personnel) from the budget and allocation of these resources back to weapon systems on the basis of some proxy variable or variables (usually the number of direct personnel) which are chosen to approximate the weapon systems' demand for support. This methodology, although indirect, has many advantages. It provides a consistent, logical procedure for estimating costs which would

otherwise be extremely difficult to estimate; it is well recognized and accepted; and, it provides consistency with the other analyses supported by the NARM. A complete discussion of the methodology can be found in Section III in each section where the methodology is utilized.

Section IV of this report provides a listing of the data base which supported the regression analysis used to develop the CER's contained in this report, and a brief discussion of some of the data problems. This is included to facilitate future CER development.

Appendix C contains the raw data and program information collected during this study which were used to develop the CER data base described in Section IV. Appendix D contains a metric conversion chart. Since current DOD contracts require the use of metric measures in all reports, this chart is included to facilitate comparison/conversion of this data, which is entirely metric, to other previously developed data. Appendix E is a user's guide and provides simple instructions on the preparation of a missile O&S analysis using this report. Table E-2 groups all the variables defined in the report according to the most likely sources. This provides the uninitiated analyst with directions about where to go and what information to seek. Tables E-3 and E-4 contain a summary of the CER's and points of contact respectively.

Finally, it should be emphasized in the strongest possible terms that the "rules of thumb" and other descriptive type information contained in this report are for the purpose of providing background information and facilitating the education of the reader. They are valid only for the time period during which this report was prepared and, IN NO WAY DOES THE PRESENCE OF THIS INFORMATION ALLEVIATE THE ANALYST OF THE RESPONSIBILITY OF RECONFIRMING ALL OF THE INFORMATION WITH THE FLEETS AND THE SUPPORTING COMMANDS DURING EACH SUBSEQUENT ANALYSIS.

III. COST ELEMENT DISCUSSION AND ESTIMATION

The purpose of this section is to provide a definition, a discussion of the supporting data, and a methodology for developing a cost estimate for each of the cost elements listed in Table III-1. In many cases the methodology will take the form of a statistical cost-estimating relationship (CER). In such cases the equation will be given with t-statistics followed by the adjusted coefficient of determination, the standard error of the estimate, the determinant of $X'X$, the F Statistic, definitions of all variables and the data base. In instances where a CER is not provided, enough information will be provided to support a rudimentary cost estimate; and, an example calculation will be made. This calculation is intended to be a benchmark based on general knowledge which will provide the analyst an example of a reasonable value for each variable and for the total cost. The example calculation should not supplant detailed analysis, but rather it should serve as an indication of the order of magnitude of the cost one could expect for a particular cost element.

Escalation was based on the August 1977 memorandum from the Office of the Secretary of Defense (OSD). The O&MN escalation rates are given below:

	<u>75</u>	<u>76</u>	<u>TQ</u>	<u>77</u>	<u>78</u>	<u>79</u>	<u>80</u>
O&MN	0.755	0.817	0.868	0.878	0.940	1.000	1.080

The missiles discussed in this report and used to develop the CER's are those currently in the Navy inventory or under development. Their names and official designations are as follows:

NAVY MISSILES

<u>Name</u>	<u>Designation</u>
Sidewinder	AIM-9
Sparrow	AIM-7
Walleye I	GW-MK1
Walleye II	GW-MK5
Shrike	AGM-45
Standard Arm	AGM-78
Phoenix	AIM-54
Harpoon	AGM/RGM/UGM-84
Harm	AGM-88

EXHIBIT III-1
NAVY OPERATING AND SUPPORT COST ELEMENT
STRUCTURE FOR AIR-LAUNCHED MISSILES

	<u>Appropriation</u>	<u>Budget Category¹</u>	<u>Claimant²</u>	<u>Accounting Visibility³</u>
o <u>Operations</u>				
1. Handling and Inspection	MPN		CINC	A
2. Operational Training	MPN, O&MN		CINC, NAVAIR NAVSEA	A, D/A
o <u>Below-Depot Maintenance</u>				
3. Organizational/AIMD Maint.	MPN, O&MN		OP-01, NAVAIR	A
4. Intermediate Maintenance	O&MN	7/A/2	NAVAIR 4104	D
o <u>Installations Support</u>				
5. Base Operating Support	MPN, O&MN		CINC, NAVAIR NAVSEA	I
o <u>Depot Maintenance</u>				
6. Depot Maintenance	O&MN	7/A/2	NAVAIR 4104	D
o <u>Depot Supply and Technical Support</u>				
7. Supply Depot Ops	O&MN	7/E/1,2,3	NAVSUP	A/I
8. Technical Support				
Fleet Support	O&MN	7/A/2	NAVAIR 4104	D
Engineering Support	O&MN	7/A/2	NAVAIR 4104	D
Quality Evaluation	O&MN	7/A/4	NAVAIR 4104	D
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9. Transportation	O&MN	7/E/3	NAVSUP	A
10. Receipt, Segregation, Storage & Issue	O&MN, MPN	7/B/1	NAVSEA 04J	A
o <u>Personnel Support Training</u>				
11. Replacement Training	MPN, O&MN	8/A/2,2/E	CNET	A/I
12. Health Care	MPN, O&MN		BUMED	I
13. Personnel Support	MPN, O&MN		OP-01	I
o <u>Sustaining Investments</u>				
14. Replenishment Spares	WPN	2	NAVAIR 412	D/A
15. Modifications	WPN, O&MN	2,7/A/2	NAVAIR 412	D
16. Replenishment Ground Support Equipment	WPN		NAVAIR 4104	A

¹7/A/2 refers to Budget Program 7, Budget Activity A, Budget Project 2

²Claimants: CINC - the Commander-in-chiefs of the Naval Fleets
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NAVSUP - Naval Supply Systems Command
BUMED - Bureau of Medicine and Surgery
OP-01 - DCNO Manpower Personnel and Training

³D = Direct Cost with individual weapon system visibility

A = Direct Cost without individual weapon system visibility; must be allocated

I = Indirect

1. HANDLING AND INSPECTION

1a. Definition - This is the cost of personnel and consumable material needed to handle and operate the missile and missile system equipment at the organizational level. Examples of handling and inspection tasks are: removing the missile from organizational storage; missile inspection; missile assembly (usually limited to the attachment of wings and fins); transporting missiles to the aircraft; missile uploading; and missile check-out and arming prior to a captive flight or firing. This cost also includes a similar series of tasks to download the missile and return it to storage if it is not fired. It is important to note that there is some variation in missile handling procedures; e.g., some missiles require minor assembly, others do not; some missiles undergo the missile-on-aircraft-test (MOAT) before takeoff, others after takeoff.

1b. Discussion - Some missile systems have a contingent of organizational personnel who are dedicated to the operation and maintenance of the missile system and therefore easy to identify and cost. Other systems have no dedicated personnel and the analyst must compute an equivalent manpower figure by summing the total annual organizational level manhours required for support of the missile system. There are several ways to obtain an estimate of the required handling and inspection manpower. One is to discuss organizational missile operations with Naval personnel who have had experience in that area. Another method is to refer to the Maintenance Engineering Analysis (MEA). A MEA is usually prepared for each missile system and is available through the respective program

offices (see section 8.4, page 57 for a list of the program offices).

Contained in the MEA is the following information:

- 1) maintenance requirements for each assembled missile and each subassembly;
- 2) required maintenance tasks;
- 3) a recommended maintenance level for each maintenance requirement;
- 4) required support equipment for each task; and
- 5) task times and personnel requirements by number and type.

As an example, a sample of the worksheets taken from the AIM-7F MEA, which pertain to organizational handling and inspection, are shown as Table C-1 of Appendix C. The work sheets describe each task, the number of men required, their rating and skill level, the time required, and the required support equipment. Based on those engineering estimates found in the MEA, one can compute the average manpower required for one upload/download cycle for an AIM-7F to be two and one-half (2.5) manhours. As a general rule, lighter missiles would probably require less labor, while heavier ones would require more.

In addition to the unit labor requirement, one must also know the number of captive flights in order to compute the total labor required for handling and inspection tasks. Planning data on the captive carry rates for missiles can usually be obtained from the program offices. For the purpose of providing background information, the HARM program office was using the rate of one captive carry, with two missiles per deployed aircraft per month. Captive carry rates for air-to-air missiles such as Sidewinder (AIM-9), Sparrow (AIM-7) and Phoenix (AIM-54) are usually higher. Again, for the purpose of providing background information, one can assume that on the average five or six

carriers are active at all times, each with two attack squadrons (twelve aircraft each) and two fighter squadrons (twelve aircraft each). This computes to an average of 120 to 144 attack and 120 to 144 fighter aircraft deployed at any one time. The analyst is cautioned that although this information is representative, actual experience may vary, sometimes greatly. It is incumbent upon the analyst to check with the program office of the particular missile under review and/or with a representative of the fleet to determine what the current or planned captive carry rates are.

Actual data on captive flight activity of missiles already in the inventory is contained in the maintenance data collection system (MDCS) for air-launched missiles, which is maintained at the Fleet Analysis Center (FLTAC) in Corona, California. This information, however, is not part of FLTAC's Performance Monitoring System (PMS), a conversational system which provides users with ready access to the most frequently requested data, and therefore would require a special run. The charge for this run is estimated by FLTAC to be two to four thousand dollars. Captive flight information for Phoenix and Sparrow, however, is currently available in a series of reports known as deployment reports. A deployment report is prepared after each deployment for the assistant project manager for logistics (APML) in NAVAIR 4104 and the Pacific Missile Test Center (PMTTC). These reports contain the following information for each missile uploaded on the carrier:

- the number of captive flights, if any;
- the bureau number of the carrying aircraft;
- the duration of each captive flight;
- the ordnance station on the aircraft on which the missile was carried;

- the number of failures; and,
- many other items of information.

FLTAC has a request pending to prepare these deployment reports, which cost approximately ten thousand dollars annually per weapon, for all air-launched missiles. This information is useful in estimating future captive carry rates of missiles under development in two ways:

1. It gives historical data on missile systems which may be forerunners to other systems under development (e.g. AIM-7E, AIM-7F).
2. It serves to give the analyst an idea of the accuracy of planning estimates vis-a-vis actual data from the fleet.

Although the definition for Handling and Inspection includes the cost of consumable material, this cost is negligible or non-existent for current Navy air-launched missiles.

1c. Cost-Estimating Relationship - The analytical representation of the computation of Handling and Inspection costs is given below:

$$HI = DE \times EPR + DO \times OPR + CM$$

$$DE = \frac{LU}{1440} \times NM \times CF$$

where,

HI = the annual cost of handling and inspection of air-launched tactical missiles. (FY79\$K)

DE = the number of equivalent direct enlisted manyears required for handling and inspection tasks.

EPR = the annual enlisted pay rate.* (FY79\$K = 9.517)

*Pay is defined here and throughout this report as the average annual pay rate by categories (officer, enlisted, cadet and trainee) found in the Five Year Defense Program (FYDP) for military pay and allowances. The rates are obtained by dividing total military pay and allowances for each category by the average annual military strength in each category, and are readily available through the Navy Resource Model (NARM) Program Factors Manual prepared by Op-901 (X-55038). FY79 rates are \$22,141 for officers and \$9,517 for enlisted.

- DO = the number of direct officer manyears (if any) required for handling and inspection tasks.
- OPR = the annual officer pay rate. (FY79\$K = 22.141)
- CM = the annual cost of consumable material required for handling and inspection tasks.¹
- LU = the number of manhours required to successfully upload and download a missile.
- NM = the number of missiles carried per captive flight.
- CF = the annual number of captive flights.

The variable LU which is given in manhours is divided by 1440 productive manhours per manyear to transform it into manyears. This factor is commonly used in manpower planning to determine personnel requirements. If it is felt that a different factor is more appropriate for a particular circumstance, it may be substituted in lieu of 1440. Also note, that the variables DE and DO (in addition to similar variables in Cost Element 3 - Organizational/AIWD Maintenance) are measures of the equivalent direct manpower necessary to operate and maintain the weapon system and are used as proxy variables to compute other costs. This will be discussed in detail later in this chapter and is mentioned here only to place proper emphasis on the variables DE and DO.

1d. Example Calculation

Assume:

LU = 2.5 manhours

NM = 2.0 missiles per aircraft

¹The cost of consumable material for air-launched missiles currently in the fleet is negligible.

CF = (5 carriers with weapons x 24 aircraft/carrier x 1 captive flight/aircraft/month + 2 Naval Air Stations x 10 captive flights/month) x 12 mos./yr. = 1680 annual captive flights

CM = 0

EPR = 9.5 (FY79\$K)

DO = 0

$$DE = \frac{2.5}{1,440} \times 2 \times 1,680 = 5.8$$

$$HI = 5.8 \times 9.5 + 0 \times 22.1 + 0 = \$55.1 \text{ (FY79\$K)}$$

2. OPERATIONAL TRAINING

2a. Definition - This is the cost of operational training to attain missile system proficiency and consists primarily of two types of training - pilot training on the Advanced Combat Maneuvering Range (ACMR) and operational firings of live missiles. The former is an instrumented air space where pilots fly through attacks, dogfights, etc., and are able to replay the entire scenario in a classroom environment and discuss their performance and weapons proficiency. The latter type of training, operational firings, consists of the costs involved in expending a live round. These costs generally fall into three areas, range costs, threat simulation, and post flight analysis support. Range costs are the costs associated with opening, clearing, operating and closing the range for a firing exercise, equipping the range with any special telemetry, radar or photography equipment, and any other general software support required by the exercise. Threat simulation costs are the costs associated with presenting a target complete with augmentation or whatever other support is required to create a realistic threat environment. Finally, the post flight analysis support is the engineering effort required to ascertain the performance of the missile and pilot.

2b. Discussion - Costs for use of the ACMR are currently averaging approximately eight hundred dollars (\$800) per hour, with an average exercise consisting of two 45 minute sessions. Costs are variable since up to four aircraft may train at any one time. Also, there are plans for several more of these facilities in the future which may drive down the cost per hour. For more information on the ACMR contact Mr. R. Crangle, NAVAIR-06E (X-27785).

To estimate the cost of range services, threat simulation, and post flight analysis is difficult because the charges for these services vary so significantly that one must actually prepare the specifications for the operational test firing before costs can be estimated with any accuracy. For instance, the charge for range costs at the twenty-six fleet training ranges may vary from over two thousand dollars per hour to nothing. In the case of the Atlantic fleet Weapons Training Facility (AFWTF) where no charge is made, it is obvious that costs are incurred despite the fact the user is not charged, but to pick out these costs from the operating budgets of the fleet would not be a cost effective effort at this time. Target costs and post flight analysis costs also vary drastically depending on the requirements of the particular shot.

Despite this variability, a list of representative costs shown in Exhibit III-2 has been obtained from various sources and may be used to generate baseline estimates of operational firing costs if specific information is not available. Further information on these costs can be obtained from Mr. H. Kollshegg, NAVAIR-06 (X-27675) and/or Mr. F. Belen, NAVSEA-06N (X-27748).

The number of missiles fired annually depends on a number of factors such as inventory levels, training requirements, tactics evaluation requirements, funding and others. By far the most important of these factors is the inventory consideration. Information on the planned operational firing rates can be obtained from the OPNAV program sponsors (Op-506). The specific individuals are identified below:

<u>Title</u>	<u>Code</u>	<u>Name</u>	<u>Telephone</u>
Air Weapon Systems	Op-506F/506F2	CAPT R.J. Johnson	X-51985
Air-Surface Guided			
Weapons Coordinator	Op-506F1	LtCMDR J.W. Prueher	X-51985
Air-Air Guided Weapons			
Coordinator	Op-506F3	CMDR R.C. Allen	X-51985

EXHIBIT III-2
REPRESENTATIVE OPERATIONAL FIRING COSTS

1. Range Costs

This cost varies from range to range. A charge of \$1,000 per hour is representative but it should be remembered that a series of firing exercises will usually be conducted when an operational unit comes to a range. The range costs therefore must be allocated.

2. Threat Simulation

<u>Land Targets</u>	<u>Approximate Procurement Cost (FY79\$K)</u>	<u>Reuse</u>
Bunker	0	Infinite
Moving Vehicle	10	1-5 Times ¹
<u>Sea Targets</u>		
Moored Hulk	0	5-10 Times
Moving Vessel (Septar)	100	2-5 Times
<u>Air Target (Subsonic)</u>		
MQM-74C	80	2-5 Times ²
BQM-34 A/S	250	2-5 Times ²
TOW	8	2-5 Times
<u>Air Target (Supersonic)</u>		
AQM-37A	40	No
BQM-34 E/T	450	2-5 Times ²
CQM-10B	75	No

Target augmentation costs may range from 0-\$35K depending on what is required. For example, HARM would require a radiating target, Harpoon would require augmentation of a Septar to simulate the larger profile of a surface combatant.

3. Post flight analysis also varies with the amount of equipment used and data collected. Currently, a representative effort is 2-3 manweeks, costing \$60-70K per manyear depending on which Naval engineering activity performs the work.

¹Costs are for special purpose, light target vehicles. If a fully armored, droned tank is required, costs may run to \$200K or higher for target vehicle.

²Add \$3-4K for consumable material and preparation for each reuse. All reuse estimates are approximations. Actual experience may vary, sometimes greatly.

2c. Cost-Estimating Relationship - A general representation of the cost calculation is as follows:

$$OT = 0.80 \times ACMRT + NLF \times UCLF$$

where,

OT = the annual cost of operational training. (FY79\$K)

ACMRT = the total annual time spent training on the Advanced Combat Maneuvering Range. (hours)

NLF = the annual number of live firings.

UCLF = the unit cost of a live firing including range costs, target simulation and post flight analysis support. (FY79\$K)

2d. Example Calculation

Assume:

238 (17 squadrons x 14 pilots/sqn.) go through 1.5 hours of ACMR training annually

NLF = 10 per year

UCLF = 10K

range costs = 4K (4hrs. @ 1K/hr.)

target costs = 4K (TOW-assume 2 flights/target)

post flight anal. = 2K (2 manweeks @ \$60K/year)

OT = $0.80 \times 357 + 10 \times 10$

= 385.6 (FY79\$K)

3. ORGANIZATIONAL/AIRCRAFT INTERMEDIATE MAINTENANCE DEPARTMENT (AIMD) MAINTENANCE

3a. Definition - This is the cost of labor and consumable material required at the Squadron and the CVA/NAS Aircraft Intermediate Maintenance Department (AIMD) to perform maintenance on the missile and its associated equipment.

The concept of the all-up-round (AUR) precludes this type of maintenance on the missile itself, but organizational and intermediate level maintenance is required on missile-dedicated aircraft equipment.

3b. Discussion - The current maintenance concept of Navy air-launched missiles is that of the all-up-round (AUR). What this means is that no maintenance is performed on the missile at the organizational level. If a missile fails a visual inspection or a built-in-test (BIT), it is packaged and returned to the Naval Weapons Station (NWS) for repair. No attempt is made to repair the missile on a carrier or at a Naval Air Station (NAS).

Costs do accrue to this element, however, when maintenance is required for missile system-dedicated hardware on the aircraft. Both the HARM and Harpoon systems require missile system-dedicated hardware on the launching aircraft. When such maintenance occurs, it can entail organizational labor and consumable materials to remove and replace the faulty equipment, and labor and consumable materials to repair the faulty equipment at the Aircraft Intermediate Maintenance Department (AIMD) aboard the carrier or at the NAS.

Data on missile system-dedicated aircraft hardware currently in the inventory can be obtained from the Maintenance and Material Management (3-M) System. The Fleet Weapon System Reliability and Maintainability Statistical Summary (MSOD 4790.A2142-01) contains data on mean-time-between-failure (MTBF)

and mean-time-to-repair (MTTR) by work unit code (WUC) for each aircraft type/model/series (t/m/s) aircraft. This report can be obtained from the Maintenance Support Office Department (MSOD) Mechanicsburg, PA, or by contacting Mr. R. Schanamann (X-28781) of NAVMAT 0415.

Information regarding equipment not in the inventory can be obtained from the weapon system Reliability Prediction Reports which are prepared for each missile and contain projections for missiles and missile equipment reliability. The reports can be obtained from Mr. F. Norton (X-27596) of NAVAIR 5205.

The estimation of aircraft operating and support costs is a rather involved topic. The reader can get considerably more detail on this subject by referring to "Naval Aircraft Operating and Support Cost Model - FY76 Revision," ASC R-116, March 1978.

3c. Cost-Estimating Relationship - The analytical representation of the computation of Organizational/AIMD Maintenance costs is given below:

$$OMC = OME \times EPR + CMA$$

$$OME = NA \times FHY/MTBF \times MTTR/1440$$

where,

OMC = the annual cost of organizational/AIMD maintenance. (FY79\$K)

OME = the number of equivalent enlisted man-years required for organizational/AIMD maintenance of missile system equipment.

EPR = the annual enlisted pay rate. (FY79\$K = 9.517)

CMA = the annual cost of consumable material for missile-dedicated aircraft equipment maintenance. (FY79\$K)

NA = the number of aircraft carrying the missile-dedicated equipment.

FHY = the annual flying hours per aircraft.

MTBF = the mean-time-between-failure of the missile-dedicated equipment. (hours)

MTTR = the mean-time-to-repair the missile-dedicated equipment (hours).

It is again noted that the OME variable represents direct manpower at the organizational level. This variable, when summed with DE and DO (if other than zero) from Cost Element 1 - Handling and Inspection, is used to estimate Base Operating Support Costs and in turn, Replacement Training, Health Care and Personnel Support. This will be discussed in detail in each of the respective sections.

3d. Example Calculation

Case 1 - Aircraft contains missile-dedicated equipment.

Assume:

EPR = 9.5 (FY79\$K)

CMA = 0

NA = 204 aircraft

FHY = 240 hours per year

MTBF = 270 hours

MTTR = 1.0 hour

OME = $204 \times 240 / 270 \times 1 / 1440$

= 0.13

OMC = $0.13 \times 9.5 + 0 = 1.2$ (FY79\$K)

Case 2 - Aircraft does not contain missile-dedicated equipment.

OMC = 0

4. INTERMEDIATE MAINTENANCE

4a. Definition - Intermediate or Naval Weapons Station (NWS) maintenance is the cost of personnel, consumable material and station overhead required to perform missile and missile component checkout and repair at the Naval Weapons Stations. This includes such procedures as the functional test of the assembled round, fault isolation of the failed round, removal and replacement of faulty major subgroups such as the flight control group of the guidance section, and fault confirmation and other support from the Weapons Quality Evaluation Center (WQEC). Exhibit III-3 taken from the AIM-7F MEA provides a graphic depiction of the intermediate maintenance functions required for the AIM-7F.

4b. Discussion - The Maintenance Data Collection System (MDCS) for air-launched missiles is maintained at the Fleet Analysis Center (FLTAC) in Corona, California and tentative workload and budget data for NWS maintenance is available through their Performance Monitoring System; but since it is only planning data, a better source is Naval Air Systems Command, Operations, Navy, Budget Justification Material. This material, which is prepared for each budget request by NAVAIR 4104, contains detailed information about the unit cost and quantity of each type missile processed at the NWS. This data from the FY77, FY78, and FY79 submissions is shown in Tables C-2 through C-5 of Appendix C.

In general, a missile requires NWS maintenance when one of three events occur:

1. It is determined to have failed;
2. It has reached its afloat storage time limit or maintenance due date (MDD); or,
3. It has reached its shore storage time limit or maintenance due date (MDD).

EXHIBIT III-3
MAINTENANCE BLOCK DIAGRAM OF AIM-7F MISSILE
INTERMEDIATE LEVEL (NWS)

A missile failure can be ascertained in several ways. The most frequent method is via the avionics check of an uploaded missile, usually referred to as the BIT (built-in-test) or MOAT (missile-on-aircraft-test). A second method for determining failures is through visual inspection which may reveal missing or damaged parts. A final method of determining a failure is through some breach of maintenance or operational procedures. An example of this would be a missile that had been dropped or one that contained seawater in its sealed container.

The second source for NWS maintenance is when a missile reaches its MDD for afloat storage. When a carrier receives a shipfill of missiles for a deployment, a portion of the missiles is kept containerized in what is called deep storage. A missile is removed only when it is needed to replace a failed missile. The remainder of the missiles may remain in deep storage until a specific time limit is reached. When that occurs, the missiles must be returned to the NWS for test and recertification.

The third source for NWS maintenance is when a missile reaches its MDD for shore storage. Missiles in deep storage ashore are not subject to the ravages of salt air and sea motion and are therefore assumed to have better survival rates than those stored afloat. Therefore they are sometimes afforded a longer interval between recertification.

It should be noted that for some missiles the current policy also imposes a limit on the number of captive flights or captive flight hours, but this policy is under review. The replacement policy is one of "fly until die" or continue to captive fly a missile until a failure is observed. Table C-6 of Appendix C, contains the current maintenance due policy for air-launched weapons.

Captive flight reliability data can be obtained from the FLTAC deployment reports mentioned in Section 1. For a missile not yet operational, a prediction of this reliability can be found in the Decision Coordinating Paper (DCP) which can be obtained from the program office. The DCP usually contains the proposed maintenance due policies, but if not, the program office can provide that information.

4c. Cost-Estimating Relationship - The NWS unit cost data found in Table C-5 of Appendix C was used to develop the following CER:

$$\begin{aligned} \text{NWS} &= 0.312 + 2.561\text{IRR} + 0.004\text{LWO} \\ &\quad (1.18) \quad (3.17) \\ \bar{R}^2 &= 0.731 \\ \text{S.E.E.} &= 0.436 \\ \text{Det. of X'X} &= 0.728 \\ F &= 10.510 \end{aligned}$$

where,

NWS = the unit cost of NWS maintenance. (FY79\$K)

IRR = the intermediate reject ratio, i.e., the percentage of missiles processed by the NWS which are determined to be failures and are sent to the depot for repair.

LWO = the launch weight of the missile less the ordnance weight. (kilograms)

DATA BASE			
<u>Missile</u>	<u>NWS</u> <u>(FY79\$K)</u>	<u>IRR</u>	<u>LWO</u> <u>(KG)</u>
Sidewinder	1.07	0.13	77.00
Sparrow (AIR)	1.84	0.30	200.00
Walleye I	1.15	0.07	225.00
Walleye II	1.34	0.09	182.00
Shrike	1.36	0.22	137.00
Standard Arm	3.48	0.30	548.00
Phoenix	1.77	0.25	421.00
Harpoon	2.67	0.19	375.00

The use of the intermediate reject ratio as an explanatory variable for estimating unit intermediate maintenance costs may, at first, seem recursive, but it makes sense not only statistically, but intuitively as well, once the details of NWS funding are understood. Simply speaking, the Naval Weapons Stations negotiate a unit fixed price with NAVAIR for the repair of each type missile. Funding then amounts to the unit price times the number processed. Since the unit price is applicable both to missiles which pass initial tests and are recertified after minimal maintenance, and to missiles which fail initial tests, require retest, disassembly, fault isolation, etc., it is obvious that the greater the percentage of failures, the higher the unit price will eventually be.

To compute the intermediate reject ratio requires the computation of each of the various sources of maintenance requirements - observed failures, maintenance due for afloat storage, and maintenance due for shore storage, each having its own failure rate or reject rate. The analytical representation is:

$$IRR = \frac{AF \times AFRR + MDSA \times MDSARR + MDSS \times MDSSRR}{NWSWL}$$

where,

IRR = the intermediate reject ratio, i.e., the percentage of missiles processed by the NWS which are determined to be failures and are sent to the depot for repair.

AF = the annual NWS workload resulting from missile failures, determined by BIT check and visual inspection.

AFRR = the failure rate at the NWS of missiles which were returned to the NWS as observed failures in the fleet.

MDSA = the annual NWS workload resulting from missiles stored afloat which reach their maintenance due date.

MDSARR = the failure rate at the NWS of missiles which were returned to the NWS because the afloat storage maintenance due date had been reached.

MDSS = the annual NWS workload resulting from missiles stored ashore which reach the maintenance due date.

MDSSRR = the failure rate at the NWS of missiles which were returned to the NWS because the shore storage maintenance due date had been reached.

NWSWL = the annual NWS workload; i.e., the number of missiles of a particular type which undergo NWS maintenance in a year.

Data for the three failure rates is usually contained in the DCP and/or the Reliability Prediction Report for each missile under development. NWS reject rates for missiles in the fleet are recorded by the FLTAC Performance Monitoring System (PMS) and can be requested through Mr. Koniak of NAVAIR 4104. Table C-7 of Appendix C contains the most recently available reject ratio data.

The degree of sophistication used to estimate the NWS workload can vary greatly. If feasible, one can employ a simulation in which every missile is tracked and failures are determined stochastically with predetermined failure rates and in accordance with one or more assumed operational scenarios involving deployment schedules, cross-decking policies, captive carry rates and many other factors. On the other hand, the analyst can simply obtain an estimate by analogy using the NWS workload data in Tables C-2, C-3, and C-4 of Appendix C.

One methodology, which is a compromise between the two previously mentioned, is to estimate the workload resulting from each of the three sources mentioned earlier. An analytical representation of this methodology is as follows:

$$NWSWL = AF + MDSA + MDSS$$

$$AF = CF \times NM \times CFD/CFR$$

$$\text{MDSA} = (\text{ANSA} - \text{AF}) \times \frac{1}{\text{ASR}}$$

$$\text{MDSS} = \text{ANSS} \times \frac{1}{\text{SSR}}$$

where,

NWSWL = the annual NWS workload; i.e., the number of missiles of a particular type which undergo NWS maintenance in a year.

AF = the annual NWS workload resulting from missile failures, determined by BIT check and visual inspection.

MDSA = the annual NWS workload resulting from missiles stored afloat which reach their maintenance due date.

MDSS = the annual NWS workload resulting from missiles stored ashore which reach the maintenance due date.

CF = the total annual number of captive flights (also used in Element 1).

NM = the number of missiles per captive flight.

CFD = the average captive flight duration (in hours).

CFFR = the captive flight failure rate (MTBF in hours).

ANSA = the average number of missiles stored afloat.

ASR = the afloat storage recertification time (maintenance due date - in years).

ANSS = the average number of missiles stored ashore.

SRR = the shore storage recertification time (maintenance due date - in years).

Therefore, the NWS cost can be estimated as the workload multiplied by the unit cost.

$$\text{TNWS} = \text{NWS} \times \text{NWSWL}$$

where,

TNWS = the total NWS maintenance cost. (FY79\$K)

NWS = the unit cost of NWS maintenance. (FY79\$K)

NWSWL = the annual NWS workload; i.e., the number of missiles of a particular type which undergo NWS maintenance in a year.

4d. Example Calculation

Unit Cost:

Assume a missile with the following characteristics:

LWO = 150kg

IRR = 0.12

NWS = $0.312 + 2.561(0.12) + 0.004(150)$

= 1.22 (FY79\$K)

Workload:

Assume:

ANSA = 600 (5 carriers x 120 shipfill) missiles

ANSS = 3400 missiles

CF = 1680 (as computed in Element 1)

NM = 1

ASR = 1.75 years

SSR = 4 years

CFFR = 300 hours

CFD = 2.5 hours

AF = $1680 \times 2.5/300 = 14$ missiles

MDSA = $(600 - 14)/1.75 = 335$ missiles

MDSS = $3400/4 = 850$ missiles

NWSWL = $14 + 335 + 850 = 1199$ missiles per year

Total NWS cost = $1199 \times 1.22 = \$1462.8$ (FY79\$K)

5. BASE OPERATING SUPPORT

5a. Definition - Base Operating Support (BOS) is the cost of installation personnel and material necessary to directly support missile handling and inspection personnel. Examples of installation functions which directly support the unit include food services, custodial services, supply, motor pool, payroll, ADP and communication operations. It also includes a proportional share of work center costs such as real property maintenance, etc.

5b. Discussion - Since it is often difficult to determine the variable impacts on base operating support costs of the addition or deletion of a force unit such as a missile or an entire missile system, the methodology used in the Navy Resource Model (NARM) Program Factors Manual¹ was adopted to provide an estimate for Base Operating Support costs as well as several other subsequent elements which are similarly general in nature. A simplified explanation of the NARM methodology is that it identifies total support resources (O&M funds and manpower) of a specific type from the Navy budget and allocates those resources back to the force units based on some proxy variable or variables which are chosen to approximate that force unit's demand for support. The usual proxy variable is direct manpower (in the case of missiles, Handling and Inspection and Organizational/AIMD Maintenance manpower). In each succeeding case where NARM methodology is used to estimate costs, it is identified and the methodology, factors and proxy variables are given.

¹Navy Program Factors Manual, (OPNAV-90P-02A), Volumes I and II, 31 August 1977.

For BOS the computation is done in the following manner. The annual costs and manpower allowances found in the Navy budget, which are contained in program elements 24611N, 24612N, 24613N, 24614N, 24615N, 24617N, 24618N and 72827N are summed and divided by three, because only one-third of the total BOS resources are considered variable with the forces. The one-third of the resources which is to be allocated is done so based on the number of direct operating personnel associated with each system, i.e., the more personnel required to operate and support a weapon system, the more base services are required. BOS services consist of officer personnel, enlisted personnel and O&MN funds. The factors used to make this allocation are not found explicitly in the Factors Manual. Those factors used in the most recent edition, 31 August 1977, are given in this report, and subsequent revisions can be obtained from Ms. Ruth, Op-901, (X-55038).

5c. Cost-Estimating Relationship - The computation is as follows:

$$\begin{aligned} \text{BO} &= 0.0014\text{TDP} \\ \text{BE} &= 0.0178\text{TDP} \\ \text{BOM} &= 0.4946\text{TDP} \\ \text{BOS} &= (\text{BO} \times \text{OPR}) + (\text{BE} \times \text{EPR}) + \text{BOM} \end{aligned}$$

where,

- BO = the number of base operating officers necessary to provide BOS services to missile system personnel.
- TDP = the number of total direct personnel (officers and enlisted) involved in operating and supporting the missile system. This is usually an equivalent number of personnel, (e.g., two officers half-time equal one officer) required in Element 1 - Handling and Inspection, and Element 3 - Organizational/AIMD Maintenance and is equal to the sum of DE and DO (from Element 1) and OME (from Element 3, Section 3, 3c.)
- BE = the number of base operating enlisted personnel necessary to provide BOS services to missile system personnel.

BOM = the O&M funds required to provide BOS services to missile system personnel. (FY79\$K)

BOS = the total cost (O&MN and MPN) of base operating support. (FY79\$K)

OPR = the officer pay rate. (FY79\$K = 22.141)

EPR = the enlisted pay rate. (FY79\$K = 9.517)

It is important to make note here of three important variables - the number of direct enlisted (DE + OME) plus base operating enlisted (BE), hereafter referred to as direct and base operating enlisted (DBE); the number of direct officers (DO) plus base operating officers (BO), hereafter referred to as direct plus base operating officers (DBO); and the total of the two, hereafter referred to as direct and base operating total (DBT). These variables are required by the NARM methodology and are used to compute costs for Elements 11 - Replacement Training, 12 - Health Care, and 13 - Personnel Support.

The equations are given below:

DBE = DE + OME + BE

DBO = DO + BO

DBT = DBE + DBO

where,

DBE = the total number of enlisted personnel, direct plus base operating, required to operate and provide base support to the missile system.

DE = the number of equivalent direct enlisted required for handling and inspection tasks (from Element 1, Section III, 1c.)

OME = the number of equivalent enlisted required for Organizational/AIMD Maintenance of missile system equipment.

BE = the number of base operating enlisted personnel necessary to provide base operating support services to missile system personnel.

- DBO = the total number of officer personnel, direct plus base operating, required to operate and provide base support to the missile system.
- DO = the number of equivalent direct officers required for handling and inspection tasks.
- BO = the number of base operating officers necessary to provide base operating support services to missile system personnel.
- DBT = the total number of personnel, officers and enlisted, direct plus base operating required to operate and provide base support to the missile system.

5d. Example Calculation

Assume:

- DE = 5.8 (from Element 1, Section III, 1d.)
- DO = 0 (from Element 1, Section III, 1d.)
- OME = 0.1 (from Element 1, Section III, 1d.)
- TDP = 5.9
- BO = $0.0014(5.9) = 0.0$ officers
- BE = $0.0178(5.9) = 0.1$ enlisted
- BOM = $0.495(5.9) = 2.9$ O&M (FY79\$K)
- BOS = $0 \times 22.1 + 0.1 \times 9.5 + 2.9 = 3.9$ (FY79\$K)

also:

- DBE = $5.8 + 0.1 + 0.1$
 = 6.0 enlisted
- DBO = $0 + 0$
 = 0 officers
- DBT = $6.0 + 0 = 6.0$ total personnel

6. DEPOT MAINTENANCE

6a. Definition - Depot Maintenance is the cost of manpower, material, and overhead needed to perform missile, missile component and support equipment maintenance at Navy and Contractor repair facilities. Exhibit III-4 taken from the AIM-7F MEA provides a graphic depiction of the depot maintenance functions for the AIM-7F missile. In addition to maintenance of missiles, depot maintenance funding pays for a number of types of support other than repair of missile sections such as:

1. Mobile Missile Maintenance Unit (MMMU) operations,
2. repair of missile containers, (material denoted by Aviation Supply Office (ASO) cognizance code-2E),
3. repair of missile explosive devices (material denoted by ASO cognizance code-4E),
4. repair of air-launched missile repairable components (material denoted by ASO cognizance code-6E),
5. repair and calibration of test equipment and other GSE.

6b. Discussion - Data for depot repair costs of air-launched missiles and missile equipment is available from several sources. The first source, FLTAC air-launched missile MDCS, contains a large amount of logistic information such as depot level parts replacement rates for the flight control and seeker sections, klystron replacement rates, analysis of age sensitive components, and many other details. The second source, Industrial Performance Summary of the Naval Air Rework Facilities provides complete data on the rework of the missiles at the

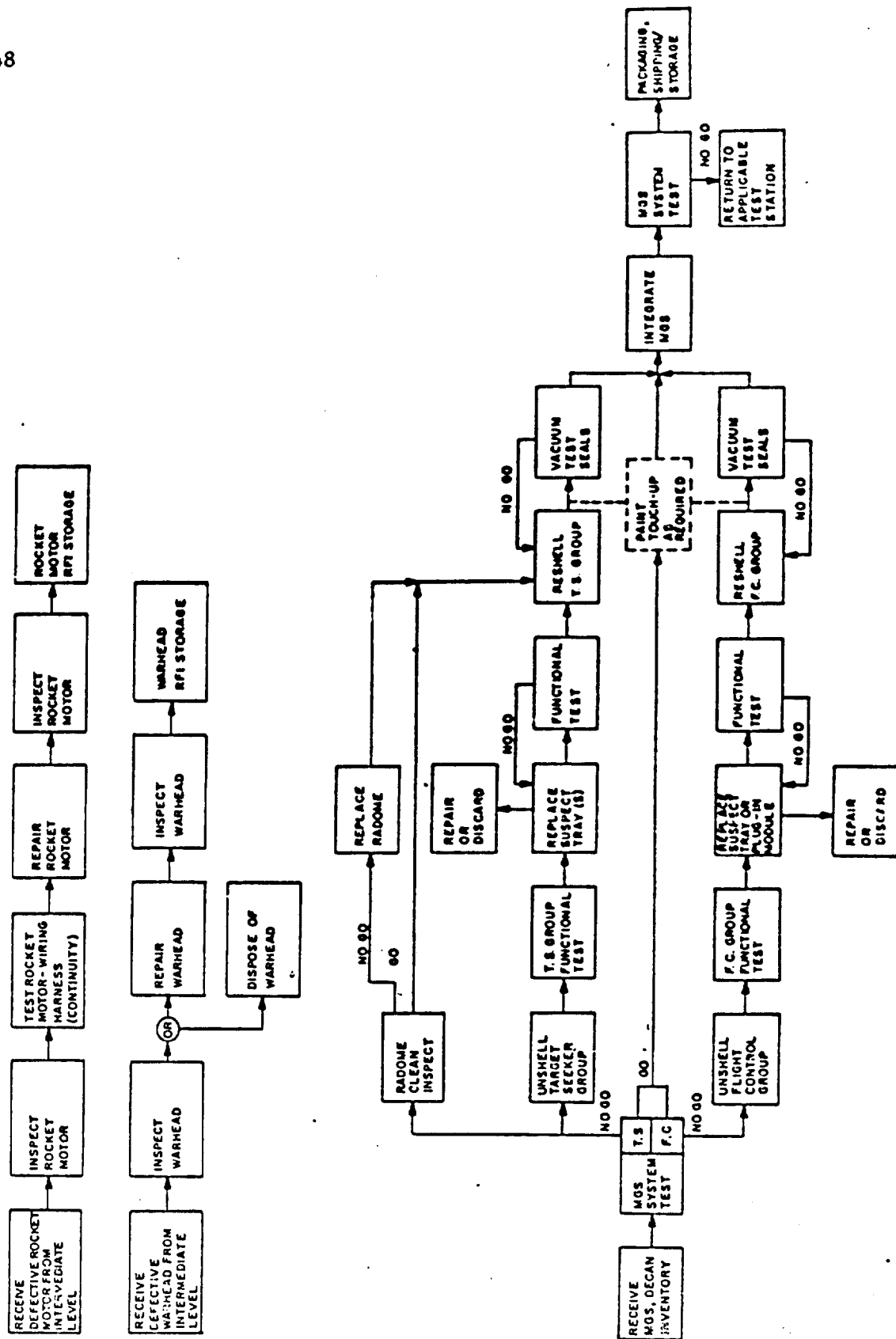


EXHIBIT III-4

MAINTENANCE BLOCK DIAGRAM OF THE AIM-7F MISSILE - DEPOT LEVEL

Naval Air Rework Facilities (NARF's). Neither of these sources however, provides complete depot costs since neither addresses the miscellaneous rework previously mentioned or the rework of rocket motors. In order to obtain this information, one must go to the third source, the Budget Justification Material prepared by NAVAIR 4104, obtainable from Mr. Koniak (X-29773). Since NAVAIR 4104 budgets for, and funds all depot rework for air-launched missile systems, the budget back-up provides a complete funding profile of all depot costs. Tables C-8 through C-18 of Appendix C contain copies of the depot maintenance budget back-up sheets from the FY77, FY78 and FY79 submissions. Each table contains the data for one fiscal year (or transition quarter) as it appeared in the budget submission. Table C-19 contains a history of total depot costs expressed as a unit cost based on the guidance and control (G&C) section workload. This is done to facilitate cost estimating by maintaining compatibility with the NWS reject ratio. Table C-20 contains the depot unit cost of repair of the G&C section. In the cases (Shrike and Phoenix) where there are actually two separate sections (a guidance and a control section), the unit cost is expressed on the basis of the guidance section workload. Table C-21 contains the depot manhours required to repair a G&C section for those missiles reworked at the NARF's. It also contains the NARF labor rates for the missile work centers. Table C-22 contains unit costs for depot (NOS Indianhead) repair of rocket motors, commercial depot level repair cost and other depot costs. Other depot costs consist of repair of repairables, container repair, ground support equipment repair and Mobile Missile Maintenance Unit (MMMU) operations. Although the specific breakdown of these components is not available, it was learned from

NAVAIR that repair of repairables comprised 70% of other depot costs in FY78, 38% in FY77 and 42% in FY76.

Historical depot workload data is also contained in Tables C-8 through C-18 of Appendix C. The estimation of future depot workloads can be easily accomplished by taking the three sources of NWS workload (from Element 4) and multiplying each by its respective NWS failure rate (also from Element 4). This provides an estimate of the number of sections requiring depot repair. It should be pointed out that this estimate is not technically precise since it is possible that a rejection at the NWS may produce two or more sections which require depot repair and the currently available data does not permit one to track an occurrence of this kind. Fortunately, this problem is not of a magnitude sufficient to affect cost estimating significantly and is mentioned only for the background knowledge of the reader.

6c. Cost-Estimating Relationship - Two CER's were developed for estimating depot costs - the first estimates the total depot unit cost, while the second estimates only the G&C unit repair cost. The CER for total depot cost is as follows:

$$DC = DUC \times WL$$

$$WL = NWSWL \times IRR$$

$$DUC = 1.251 + 0.324MS + 0.013CAC_{1000}$$

(1.52) (4.99)

$$\bar{R}^2 = 0.834$$

$$S.E.E. = 0.890$$

$$\text{Det. of } X'X = 0.949$$

$$F = 16.131$$

where

- DC = the total annual depot cost. (FY79\$K)
- DUC = the total depot unit cost for a particular type missile (FY79\$K)
- WL = the depot workload; i.e., the number of G&C sections processed.
- NWSWL = the annual NWS workload; i.e., the number of missiles of a particular type which undergo NWS maintenance in a year.
- IRR = the intermediate reject ratio; i.e., the number of missiles failed by the NWS and forwarded to the depot for repair divided by the total number processed by the NWS.
- MS = the maximum speed of the missile in free flight. (mach)
- CAC₁₀₀₀ = the cumulative average hardware cost of the first one thousand missiles procured. (FY79\$K)

<u>Missile</u>	DATA BASE		
	<u>DUC</u> (FY79\$K)	<u>MS</u> (mach)	<u>CAC₁₀₀₀</u> (FY79\$K)
Sidewinder	3.54	4.0	35.4
Sparrow (AIR)	3.97	2.5	129.6
Walleye I	2.19	1.0	47.3
Walleye II	2.85	1.0	56.1
Shrike	1.12	2.0	48.7
Phoenix	6.90	5.0	335.2
Harpoon	5.94	0.8	340.9

The Standard ARM observation was removed from the data base because it was felt that the extremely low volume of depot repair was resulting in an unusually high unit cost.

If one wishes to estimate only the unit cost of repair of the G&C section, the following CER may be used:

$$DGC = -0.728 + 0.018LWO \\ (5.43)$$

$$\bar{R}^2 = 0.803$$

$$S.L.E. = 1.404$$

$$\text{Det. of } X'X = 1.000$$

$$F = 29.486$$

where,

DGC = the depot unit cost of rework of a missile G&C section.
(This does not include repair of G&C repairables.) (FY79\$K)

LWO = the launch weight of the missile less the ordnance weight.
(kilograms)

DATA BASE

<u>Missile</u>	<u>DGC</u> <u>(FY79\$K)</u>	<u>LWO</u> <u>(kg)</u>
Sidewinder	2.1	85.0
Sparrow	3.1	200.0
Walleye I	1.8	225.0
Walleye II	2.5	182.0
Shrike	1.3	137.0
Standard Arm	9.4	548.0
Pheonix	8.7	421.0
Harpoon	4.1	375.0

This CER would also be improved by omitting the Sidewinder observation, but the improvement is only slight since most of the unexplained variation is in the depot rocket motor and depot other categories. If this equation is utilized, the analyst must explicitly treat the other depot costs - repair of rocket motors, repairable material, containers and other costs. This may be done by analogy using Table C-22.

6d. Example Calculation

Assume:

$$MS = 4.5 \text{ mach}$$

$$CAC_{1000} = 145 \text{ (FY79$K)}$$

$$\text{NWSWL} = 1,199$$

$$\text{IRR} = 0.12$$

$$\text{WL} = \text{NWSWL} \times \text{IRR} = 144$$

$$\text{DUC} = 1.251 + 0.324(4.5) + 0.013(145)$$

$$= 4.6 \text{ (FY79\$K)}$$

$$\text{DC} = 4.6 \times 144 = 662.4 \text{ (FY79\$K)}$$

7. SUPPLY DEPOT OPERATIONS

7a. Definition - This is the cost of manpower and material needed to buy, store, package, manage and control supplies, spares and repair parts used in operating and maintaining missiles, missile components and support equipment. When a new missile system is introduced into the force, spare parts are procured to sustain missile operations. These parts are introduced into the supply system and resources are expended to manage, store, distribute, package and crate both the spares inventory and other common supply items which support missile system personnel.

7b. Discussion - This cost is computed for the Navy Resource Model Program Factors Manual by taking the costs contained in program element 71111N - Supply Depot Operations of the budget and allocating to force units on the basis of direct requirements of manpower and operating funds, i.e., MPN, O&MN, and WPN.

7c. Cost-Estimating Relationship - The equation for estimating Supply Depot Operations is:

$$SDO = 0.025DR$$

where,

SDO = the annual cost of Supply Depot Operations required to support a weapon system. (FY79\$K)

DR = the direct requirements of manpower and operating funds represented by the total cost of Elements 1, 3, 4 and 6. (FY79\$K) (HI + OMC + NWS + DC)

7d. Example Calculation

Assume:

HI = 55.1 (total cost - Element 1, Section III 1d.)

OMC = 1.2 (total cost - Element 3, Section III 3d.)

NWS = 1487.8 (total cost - Element 4, Section III, 4d.)

DC = 662.4 (total cost - Element 6, Section III, 6d.)

DR = $55.1 + 1.2 + 1462.8 + 662.4 = 2181.5$

SDO = 0.025×2181.5

= 54.5 (FY79\$K)

8. TECHNICAL SUPPORT

Technical Support is the cost of a number technically oriented programs usually centrally managed by the Systems Command or one of its field activities. Each of the programs, which are listed below, will be identified and discussed separately.

8.1 Fleet Support

8.2 Engineering Support

8.3 Quality Evaluation

8.4 Program Management

8.1 FLEET SUPPORT

8.1a. Definition - Fleet Support is the cost of on-site technical personnel (Navy civilians) who provide technical advice and assistance in the operation and maintenance of the weapon system. These "tech. reps." deploy with the units and serve as advisors and liaison for maintenance, configuration, training and many other problem areas.

8.1b. Discussion - Fleet Support is budgeted and funded by NAVAIR 4104 and Mr. Koniak (X-29773) is the responsible individual. Cost data for Fleet Support are found in the Budget Justification Material prepared by NAVAIR 4104 and are presented in Table C-23 of Appendix C.

8.1c. Cost-Estimating Relationship - The data from Table C-23 was used to develop this CER for Fleet Support costs:

$$FS = 64.307 + 3.119PI + 113.530AAD$$

(2.83) (4.25)

$$\bar{R}^2 = 0.800$$

$$S.E.E. = 36.231$$

$$\text{Det. of } X \text{ } K = 0.980$$

$$F = 14.995$$

Where,

FS = the annual cost of Fleet Support for a particular missile type (FY79\$K)

PI = the percentage of the air launched missile inventory represented by the missile

AAD = a dummy variable which takes the following values:

0, if the missile is an air-to-surface missile

1, if the missile is an air-to-air missile

DATA BASE

<u>Missile</u>	<u>FS</u> <u>(FY79\$K)</u>	<u>PI¹</u> <u>%</u> <u>(FY79 Base)</u>	<u>AAD</u>
Sidewinder	271	17.6	1
Sparrow	271	17.3	1
Walleye I	117	22.5	0
Walleye II	52	3.6	0
Shrike	192	25.4	0
Standard Arm	107	2.5	0
Phoenix	170	7.3	1
Harpoon	98	3.8	0

The data used in this CER is the average of FY76 from the FY78 submission plus the three years (FY77-79) contained in the FY79 submission.

8.1d. Example Calculation

Assume:

PI = 20%

AAD = 1

$$\begin{aligned} \text{FS} &= 64.317 + 4.229(20) + 113.530(1) \\ &+ 262.4 \text{ (FY79$K)} \end{aligned}$$

¹The variable PI has been adjusted from the values shown in Exhibit IV-1 to reflect only those missiles that have Fleet Support funding in FY1979.

8.2 ENGINEERING SUPPORT

8.2a Definition - The cost of Engineering Support is comprised of two major areas - maintenance engineering and design engineering. The former consists of efforts at the various Naval engineering activities in support of the missile maintenance system and is funded through NAVAIR 410, while the latter is concerned with engineering for the missile itself, i.e., design and configuration matters, and is funded by the NAVAIR 510. These engineering functions include revisions and additions to the Integrated Logistics Support Plan (ILSP) necessitated by configuration changes, revisions to the maintenance concept, or any other change instituted to correct a problem in the fleet. In other words, Engineering Support funding pays for follow-on Integrated Logistics Support (ILS).

8.2b Discussion - The NAVAIR 410 portion is printed in the Budget Justification Material and is summarized in Table C-24 of Appendix C. The NAVAIR 510 portion is not specifically identified in the budget but was obtained from NAVAIR 510, and is shown in Table C-25 of Appendix C. For further information contact Mr. Koniak (X-29773) for the NAVAIR 410 portion and Captain Glunt (X-28571) or Mr. Cooper (X-28620) for the NAVAIR 510 portion.

8.2c Cost-Estimating Relationship - The following CER can be used to estimate the total cost of Engineering Support:

$$ES = 80.950 + 4.306FS \\ (3.96)$$

$$\bar{R}^2 = 0.677$$

$$S.E.E. = 233$$

$$\text{Det. of } X'X = 1.000$$

$$F = 15.649$$

where,

- ES = the annual cost of Engineering Support (design engineering and maintenance engineering). (FY79\$K)
- FS = the annual cost of Fleet Support for a particular missile type (FY79\$K).

DATA BASE

<u>Missile</u>	<u>ES</u> <u>(FY79\$K)</u>	<u>FS</u> <u>(FY79\$K)</u>
Sidewinder	1,431	271
Sparrow	1,241	271
Walleye I	347	117
Walleye II	181	52
Shrike	657	192
Standard Arm	709	107
Phoenix	747	170
Harpoon	857	98

The data show above is the sum of the four-year average funding level (FY76-FY79) for NAVAIR 410 and NAVAIR 510 Engineering Support.

8.2d Example Calculation

Assume:

$$\begin{aligned}
 FS &= 262.4 \text{ (from Element 8.1, Section III, 8.1d.)} \\
 ES &= 80.950 + 4.306(262.4) \\
 &= 1210.8 \text{ (FY79$K)}
 \end{aligned}$$

8.3 QUALITY EVALUATION

8.3a Definition - Quality Evaluation is the cost of the Navy Weapons Quality Program whose purpose is to monitor the status and condition of the air-launched weapons stockpile. Principal activities include maintenance/reliability/performance trend analysis, calibration of test equipment, destructive testing of missile sections, certification of NWS failures and related data collection and analysis.

8.3b Discussion - Data for Quality Evaluation (QE) were received from Mr. Sanders, NAVAIR 4104 (X-29828) and are shown in Table C-26 of Appendix C. The data were adjusted per Mr. Sanders instructions to include the cost of the Special Interface Gauges Program. Quality Evaluation funds were also used to support the development of the air-launched weapons reporting system at FLTAC, Corona, California, but this was not factored into the data since it is not a recurring function.

8.3c Cost-Estimating Relationship - The estimating equation for Quality Evaluation is as follows:

$$QE = 109.559 + 6.785PI + 171.660AAD$$

$$\bar{R}^2 = 0.605$$

$$S.E.E. = 85.768$$

$$\text{Det of } X'X = 0.98$$

$$F = 6.369$$

Where,

QE = the annual cost of Quality Evaluation (FY79\$K)

PI = the percentage of air-launched missile inventory represented by the missile

AAD = A dummy variable which takes the following values:

0, if the missile is an air-to-surface missile.

1, if the missile is an air-to-air missile.

DATA BASE

<u>Missile</u>	<u>QE</u> <u>(FY79\$K)</u>	<u>PI¹</u> <u>%</u> <u>(FY79Base)</u>	<u>AAD</u>
Sidewinder	465	17.6	1
Sparrow	397	17.3	1
Walleye I	176	22.5	0
Walleye II	88	3.6	0
Shrike	324	25.4	0
Standard Arm	90	2.5	0
Phoenix	268	7.3	1
Harpoon	262	3.8	0

One might note that since Quality Evaluation is estimated with the same independent variables as Fleet Support, the two might be strongly correlated. This is in fact, true and to express QE as a function of FS makes sense not only analytically but logically. If the fleets are requiring a lot of on-site support (FS) for a missile, it obviously follows that many of those problems will be studied in the QE centers. The relationship is:

¹The variable PI has been adjusted from the values shown in Exhibit IV-1 to reflect only those missiles that have Quality Evaluation Funding.

$$QE = 10.30 + 1.05 FS$$

$$(7.36)$$

$$\bar{R}^2 = 0.883$$

$$S.E.E. = 51.450$$

$$\text{Det of } X'X = 1.000$$

$$F = 54.20$$

Where,

QE = the annual cost of Quality Evaluation (FY79\$K).

FS = the annual cost of Fleet Support for a particular missile type (FY79\$K).

DATA BASE

<u>Missile</u>	<u>QE</u> <u>FY79\$K)</u>	<u>FS</u> <u>(FY79\$K)</u>
Sidewinder	465	271
Sparrow	397	271
Walleye I	176	117
Walleye II	88	52
Shrike	324	192
Standard Arm	90	107
Phoenix	268	170
Harpoon	262	98

8.3d Example Calculation

Assume:

$$AAD = 1$$

$$PI = 20\%$$

$$QE = 109.569 + 6.785(20 + 171.660 (1))$$

$$= 417.0 \text{ (FY79$K)}$$

8.4 PROGRAM MANAGEMENT

8.4a Definition - Program Management is the O&S cost of missile-specific project management both at Systems Command level and below.

8.4b Discussion - Since the bulk of Program Management costs reside in the procurement phase of life cycle costing, it is important that costs shown in this element refer only to system activities of an operating or support nature. These costs are not routinely collected but can usually be estimated from discussions with program office personnel. A list of the missile program offices is given below:

MISSILE PROJECT OFFICES

<u>Number</u>	<u>Title</u>	<u>Missile</u>	<u>Telephone</u>
PMA 241	F14/Phoenix	Phoenix	28283
PMA 242	Defense Suppression Systems	Shrike, Standard ARM, HARM, Wall-eye I & II	23352
PMA 258	Harpoon	Harpoon	23340
PMA 259	Infrared Missiles	Sidewinder	20914
PMA 252	Sparrow III	Sparrow	28228
PM 3	Tomahawk	Tomahawk	28025

8.4c Cost-Estimating Relationship - Program Management costs are computed in the following manner:

$$PM = \sum NMP_1 \times CP_1$$

where,

- PM = the annual cost of Program Management (FY79\$K).
- NPM_1 = the number of program management personnel in the 1th pay grade
- CP_1 = the annual cost of paying one person in the 1th pay grade (FY79\$K).

It should be noted that the above equation relates only to direct pay and allowances of the manpower and has no provision for the overhead or "support tail." It would be possible to include the manpower with the Handling and Inspection, Organizational/AIMD Maintenance and Base Operating Support manpower and use the NARM factors to compute the general support costs. But since Program Management personnel are not in the fleet, the NARM factors, which are based on support of personnel in the fleet, are not appropriate. Just how to properly define and compute the total cost of manpower (especially headquarters manpower) is a subject that is currently being widely discussed and studied. In the meantime the analyst can estimate this cost heuristically or include only direct pay and allowances. The sensitivity of total O&S costs to this topic is very slight.

Direct pay and allowance can be computed by determining how many individuals of each rank/grade/step, etc. are involved in O&S activities and multiplying by the respective rates from a current pay schedule. Typically, a civilian professional in a project office would hold a grade approximating a GS 12, Step 5, while a clerical worker would hold a grade approximating a GS 6, Step 3.

8.4d Example Calculation

Assume the following personnel are concerned with O&S program management activities:

1 Military Officer	\$22.1
2 Civilian Professional	\$24.8
1 Civilian Clerical	\$11.8

$$\begin{aligned} \text{PM} &= 1 \times 22.1 + 2 \times 24.8 + 1 \times 11.8 \\ &= 83.5 \text{ (FY79\$K)} \end{aligned}$$

9. TRANSPORTATION

9a. Definition - This is the cost of Second Destination Transportation which consists primarily of commercial transportation of missiles or missile sections from the Naval Weapons Stations to the depots and back. There are also other reasons which require the transporting of missiles. For example, the current environment in which certain missile types are in short supply often causes imbalances between loadout requirements and inventory. These imbalances are solved by transshipping available missiles to the site where they are required.

9b. Discussion - Current plans call for the transferring of the missile depot repair capability of NARF Norfolk to NARF Alameda at the end of FY1979. This will make NARF Alameda the single site for depot repair of air-launched missile guidance and control sections and will significantly add to the cost of transportation. Unfortunately, the process required to precisely determine commercial transportation costs of missiles and missile sections is quite complicated. Rates vary with the distance traveled, the type of cargo (explosive components cost more), the number of hundredweight to be shipped, the level of security required, the routing of the shipment, and many other considerations. The situation is further complicated by the fact that in some situations (usually short hauls) sections are not transported commercially, but by organic Navy vehicles.

It is obvious that an exact representation of how transportation costs are incurred is much too involved and tedious for the purposes of this model; therefore, a sample of rates, which have been chosen as representative, are presented. In addition, factors representing the average cost of inland

commercial cargo transportation in the FY77 Budget Justification Material is given to use in situations where transportation costs need not be estimated with such precision. The analyst should realize that this is a very generalized factor and is comprised of mostly INERT material. The factor, \$0.1297 per kilogram transported (FY79\$K), is taken from Table C-27 of Appendix C, which shows a cost of \$42,226 (FY77\$K) for transportation of 408,802 short-tons of material. This results in the previously mentioned factor when escalated to FY79\$ and adjusted to metric weight. In addition other generalized factors based specifically on air-launched missile transportation costs are given later in this section.

For exercises which require a more detailed analysis of transportation costs, the reader can refer to Tables C-28 through C-37 of Appendix C. Each table contains transportation costs quotes from the Military Traffic Management Command (MTMC) Bayonne, New Jersey. Mr. Norman Roberts of NAVAIR 412 (X-20028) who is the NAVAIR contact for transportation costs was extremely helpful in obtaining the rate quotes from MTMC and in interpreting them.

Generally speaking, rate quotes were requested for four different types of material, for one-way trips involving ten combinations of origins and destinations, and for a number of different load sizes. Information regarding other charges involved in transporting missiles was also requested. The four types of material with simplified definitions are given below:

- Class A Explosive - Explosive material causing maximum hazard such as a missile warhead or all-up-round.
- Class B Explosive - Material which is typified by rapid combustion rather than detonation such as a missile rocket motor.
- Class C Explosive - Devices that contain Class A or Class B explosive material but in restricted quantities. The Sidewinder guidance and control unit falls into this class.
- INERT - No explosive material. The Sparrow guidance and control unit falls into this class.

The routes which were chosen and the tables which contain the rate quotes for those routes are given below:

<u>Table</u>	<u>Origin</u>	<u>Destination</u>
C-28	NWS Concord, CA	NOS Indianhead, MD
C-29	NWS Concord, CA	NWS Earle, NJ
C-30	NARF Alameda, CA	NWSC Crane, IN
C-31	NARF Alameda, CA	NWS Yorktown, VA
C-32	NARF Alameda, CA	NAS Miramar, CA
C-33	NARF Alameda, CA	NWS Seal Beach, CA
C-34	NWS Charleston, SC	NARF Alameda, CA
C-35	NWS Yorktown, VA	NARF Alameda, CA
C-36	NWS Yorktown, VA	NOS Indianhead, MD
C-37	NWS Yorktown, VA	NWS Charleston, SC

The routes were chosen to represent as large a portion of actual traffic as feasible and still demonstrate the many complexities of the rate structure. Several cross country routes were given (Tables C-28, C-29, C-31, C-34 and C-35) and the rates are somewhat puzzling. Although the distances were virtually the same, the truckload rate for 38,000 pounds varies more than 40 percent from the low rate \$10.32 per cwt. to the high rate \$14.75 per cwt. If one wishes to consider NWS Concord, CA to NWSC Crane, IN, a cross country route (2,255 miles) then the rate drops to \$5.44 per cwt. Four short routes were included, two intra-state (C-32 and C-33) and two interstate (C-36 and C-37). The shorter routes seem to offer a greater variety of rates and those rates also vary significantly. For example, a truckload of Class A Explosive material going from NARF Alameda to NWS Seal Beach (417 miles) costs \$0.95 per cwt., while a slightly larger truckload going from NWS Yorktown to NOS Indianhead (170 miles) costs \$2.18 per cwt. The rates, which may be affected

by intrastate vs. interstate considerations or possibly by east coast vs. west coast considerations do not adhere to a consistent pattern. One might infer that the volume of traffic is an important factor since shipments to the Navy Propellant Plant (C-35) seem to enjoy a favorable rate. One route was requested twice, once with the origin and destination reversed (C-31 and C-35) to see if that affected the rates. Generally speaking, it did not, although there is one difference in the truckload rates for INERT material. It had been learned in discussions with NAVAIR personnel that in some cases rates do vary over the same routes, when different origins are considered. Two final examples of puzzling data are contained in Table C-35 where the quoted truckload (TL) rate was higher than the less truckload (LTL) rate; and in Table C-28 where the rate for INERT material was higher than for Class A Explosive material.

In summary, it appears that the primary cost influence on transportation is the size of the shipment, followed by the distance shipped, the type of material and security required. Obviously, local competitive factors as well as many other considerations cause aberrations in the data, some of which are quite significant. The level of security (Signature Security, Dual Driver Protective Service) is determined by the asset managers and also can be an important cost consideration. It is up to the user of this manual to select certain rates as representative for each analysis and use them as estimates. The analyst is cautioned that the variations in the rate structures have caused variations in format in the ten tables (C-28 through C-37) and the reader should exercise caution in extracting data from them. One final technical

note is that these tables on transportation (C-28 through C-37) are given in non-metric units while the rest of the report is metric. The exception was made in order to avoid confusion in a subject area which is already quite complicated. Since the Navy and the trucking industry do not use the metric system in computing or discussing rates, it was not used in this section. Metric conversion factors are given at the bottom of each of the tables containing transportation rates.

Based on Tables C-28 through C-37, other generalized factors were developed specifically for use with air-launched missiles. The factors are based on the four and one quarter years data contained in this report. Over this time span, it was determined that the three Weapons Stations were processing missiles in the following proportions:

<u>Weapon Station</u>	<u>Workload</u>	<u>Percent</u>
NWS Yorktown	13,595	50.0%
NWS Concord	5,571	20.5%
NWS Seal Beach	<u>8,002</u>	29.5%
	27,168	

Workloads for the depots and NOS Indianhead for the same time period were 5,658 and 3,770 respectively. Assuming that the future flow of missiles from the Weapon Stations is the same as in the past, except that all missile G&C sections will go to Alameda, there are basically six routes involved in the computation of this factor.

Pricing Reference

Yorktown to Alameda	Table C-35
Concord to Alameda	Organic Navy
Seal Beach to Alameda	Table C-33
Yorktown to Indianhead	Table C-36
Concord to Indianhead	Table C-28
Seal Beach to Indianhead	Table C-28

It is assumed that organic Navy vehicles will provide the transportation from Concord to Alameda (a distance of 10 miles) and that the rates from Concord to Indianhead are suitable analogs for the Seal Beach to Indianhead route. No charge is made for the former. Costs were computed using the cheapest truckload rate for Class A Explosive Material with Dual Driver Protective Service. The factor is computed as follows:

		TL					
<u>Origin</u>		<u>%</u>	<u>\$/cwt</u>	<u>Min. Weight</u> <u>(thous. of lbs)</u>	<u>Security</u> <u>(\$/cwt)</u>	<u>Rate</u> <u>(\$/cwt)</u>	<u>Factor</u> <u>(\$/cwt)</u>
G&C	NWS Yorktown	50.0	14.73	42	1.30	16.03	8.02
	NWS Concord	20.5	0	--	--		0
	NWS Seal Beach	29.5	0.95	40	0.63	1.58	<u>0.47</u>
							8.49
RM	NWS Yorktown	50.0	1.46	40	0.35	1.82	0.91
	NWS Concord	20.5	10.32	38	1.36	11.68	2.39
	NWS Seal Beach	29.5	10.32	38	1.36	11.68	<u>3.45</u>
							6.75

The two resulting factors expressed on a per pound basis are \$0.0849 for a G&C section and \$0.0675 for a Rocket Motor. In the former case this is the average cost of a one-way trip from a NWS to NARF Alameda; in the latter, a one-way trip from a NWS to NOS Indianhead.

If the analyst wishes to tie this to the reject ratio of G&C sections at the NWS, it can be expressed as costing \$0.260 per pound (FY79\$) in transportation costs for each G&C failure detected at the NWS.

Factor #1 Derivation

G&C		\$0.0849
Rocket Motor	$0.666^1 \times 0.0675$	<u>0.0450</u>
		0.1299
Return Trip		<u>0.1299</u>
Total		\$0.260/lb./G&C failure

The second factor is given in order to demonstrate effect on the rates of shipping in less than truck load (LTL) rates. A situation which frequently occurs due to the practical pressures of managing the missile inventory. This factor is calculated in the same manner as the previous one, except that half of the missile poundage is shipped in dromedary units. All routes are calculated with Dual Driver Protective Service.

		Dromedary					
	Origin	%	Rate (\$/cwt)	Min. Wt. (thous. of lbs)	Security (\$/cwt.)	Rate (\$/cwt)	Factor (\$/cwt)
G&C	NWS Yorktown	50.0	38.63	2,500	21.84	60.47	30.24
	NWS Concord	20.5	—	—	—	—	0
	NWS Seal Beach	29.5	10.80	2,500	10.09	20.89	<u>6.16</u>
							36.40
RM	NWS Yorktown	50.0	12.18	2,500	5.72	17.90	8.95
	NWS Concord	20.5	36.71	2,500	20.65	57.36	11.76
	NWS Seal Beach	29.5	36.71	2,500	20.65	57.36	<u>16.92</u>
							37.63

¹0.666 is a ratio of containerized rocket motor weight to containerized G&C weight of air-launched missiles shipped from IMA's to Depots as shown in budget back-up material for the period FY76-78.

The preceding calculation refers only to the rates for the poundage shipped in dromedary units. To complete the computation each factor must be averaged with the corresponding rate from the truckload computation, i.e., the G&C rate would be $(0.0849 + 0.3640) \div 2$, or 0.2245 per pound and the RM rate would be $(0.0675 + 0.3763) \div 2$, or 0.2219 per pound. To complete the example, the calculations are as follows:

Factor Derivation (2)

G&C	\$0.2245
Rocket Motor 0.666×0.2219	<u>0.1478</u>
	0.3723
Return Trip	<u>0.3723</u>
Total	\$0.7446/lb/G&C failure

All of the preceding discussion refers to transportation by commercial motor freight. Although that is the way the vast majority of missiles and missile components are currently transported, it is nevertheless possible to ship by air. The Navy Material Transportation Office, Norfolk, VA, manages contract air transportation called QUICKTRANS for the Navy, but there are several reasons why it is less preferred than surface transportation. First, air transportation of Class A and Class B explosives cannot be accomplished without a waiver of Federal Aviation Administration regulations. As a practical matter, this is seldom worth the effort. Class C material can be air-lifted in restricted quantities. A second problem is the routing of air transportation. Getting a shipment to and from a QUICKTRANS location can often completely offset the time savings of shipping by air. Finally, the cost of shipping by air is also a barrier. Mrs. Swindeck provided a rate of \$42.16 per hundredweight for QUICKTRANS from Norfolk to the West Coast. This is compared to \$10.82 for a less truckload (LTL) of INERT material from MWS Yorktown to NARF Alameda (Table C-36 of Appendix C).

Despite this, it has been recently learned that authorization has been given to ship virtually all G&C units from NWS Yorktown to NARF Alameda by air (QUICKTRANS). Therefore, a third factor is computed which is similar to the second one except the G&C rate is computed entirely at the QUICKTRANS rate for the Yorktown to Alameda route. All others are half-TL and half-LTL.

	<u>Origin</u>	<u>%</u>	<u>Rate (\$/cwt)</u>	<u>Security (\$/cwt)</u>	<u>Rate (\$/cwt)</u>	<u>Factor (\$/cwt)</u>
G&C	NWS Yorktown	50.0	42.16	-	42.16	21.08
	NWS Concord	20.5	-	-	-	0
	NWS Seal Beach	29.5	5.88	5.36	11.24	<u>3.32</u>
						24.40
Rocket Motor		(Same as Factor #2)				22.19

Factor #3 Derivation

G&C		\$0.02440/lb
Rocket Motor	0.666 x 0.2219	<u>0.1478</u>
		0.3918
Return Trip		<u>0.3918</u>
Total		\$0.7836/lb/G&C failure

These factors which are applied to the number of pounds of G&C units (containerized) detected as failures at the NWS and sent to the depot, estimate the cost of transportation associated with those sections. They are, of course, only three of an infinite variety of factor calculations that can be made from the data in this section. The analyst is free to tailor the assumptions to each new situation.

There is, however, another requirement for transportation - the transshipment of missile and missile sections to meet load-out requirements and for a number of other reasons. It would be extremely difficult to obtain data on this type transportation and even more difficult to estimate future requirements. However, discussions with Mrs. Swindeck (Au8-963-4721) of the NWS Yorktown Supply Department indicate that the cost of transshipping missiles is approximately as great as that of shipping sections to the repair facilities. Accordingly, each of the three previous factors should be multiplied by a factor to account for transshipment costs. Assuming the factor 2 is used, the previous factors are modified as follows:

<u>FACTOR</u>	<u>ASSUMPTION</u>	<u>REVISED FACTOR</u>
1	All TL rates	\$0.520/lb/G&C failure
2	One-half TL, One-half LTL (Dromedary)	1.4892/lb/G&C failure
3	Yorktown to Alameda, QUICKTRANS All other, same as Factor #2	1.5672/lb/G&C failure

9c. Cost-Estimating Relationship - The analyst can use a generalized factor or the specific rates in Tables C-28 through C-37 of Appendix C. If the latter is utilized, then the following information must be obtained regarding the transportation requirements:

- . the number of missile G&C sections requiring transportation to the depot and back.
- . the number of missile rocket motors requiring transportation to the depot.
- . the containerized weights of all sections and AUR's to be shipped.

- . the number of AUR's requiring shipment to meet loadout requirements.
- . the transportation required for other reasons, e.g., shipment to Pacific Missile Test Center (PMTTC) Pt. Mugu, CA.
- . the quantities, shipment sizes, level of security for all of above.

The analyst can then compute specific shipment costs.

If a generalized factor is sufficiently accurate, the analyst can use one of the three given in this section, The equations are:

$$SDT = WL \times ASW \times 0.5200 \quad (\text{using Factor \#1})$$

$$SDT = WL \times ASW \times 1.4892 \quad (\text{using Factor \#2})$$

$$SDT = WL \times ASW \times 1.5672 \quad (\text{using Factor \#3})$$

where,

SDT = the annual cost of Second Destination Transportation (FY79\$K)

WL = the depot workload; ie., the number of G&C sections processed.

ASW = the unit containerized weight of the G&C unit (in thousands of pounds)

(See Exhibit III-5 for containerized weights of missiles currently in the inventory.)

9d.1 Example Calculation 1:

Assume: Generalized Factor #3 is appropriate:

WL = 144 G&C Sections

ASW = 0.228 pounds

SDT = $144 \times 0.228 \times 1.5672$

= 51.5 (FY79\$K)

EXHIBIT III-5
WEIGHTS OF AIR-LAUNCHED MISSILES
(pounds)

	<u>Missile/Section Weight</u>	<u>Weight of Container</u>	<u>Units per Container</u>	<u>Unit Contain- erized Weight</u>
Phoenix (AGM-54A)				
AUR	985	580	2	1,275
Guidance	146	64	1	228
Control	116	26	1	142
Propulsion	465	370	1	835
Shrike (AGM-45A, B)				
AUR	375	500	3	542
Guidance	96	41	1	137
Control	33	33	1	66
Propulsion	162	140	1	302
Sidewinder (AIM-9G, H)				
AUR	190	520	4	1,320
Guidance & Control	44	67	2	78
Propulsion	99	30	1	129
Sparrow (AIM-7E)				
AUR	500	695	3	2,732
Guidance & Control	156	135	1	291
Propulsion	156	124	1	280
Standard ARM (AGM-78D)				
AUR	1,370	680	1	2,050
Guidance	77	150	1	277
Control	76	68	1	144
Propulsion	724	268	1	992
Walleye I				
AUR	1,100	725	2	1,463
Guidance	102	118	1	220
Control	119	118	1	237

Metric Conversion: 1 pound = 0.453 kilograms

9d.2 Example Calculation 2: (Using modified Factor #2)

Assume:

IMA Annual Workload = 1,500 missiles

IMA Reject Ratios (G&C) = 0.22

IMA Reject Ratio (RM) = 0.05

G&C Containerized Weight = 0.228 pounds (K)

RM Containerized Weight = 0.900 pounds (K)

WL = 330 (1,500 x 0.22)

Recompute Rocket Motor Factor:

G&C Poundage = 1,500 x 0.22 x 0.228 = 75.24 (K)

RM Poundage = 1,500 x 0.05 x 0.900 = 67.50

RM Factor = 67.50 ÷ 75.24 = 0.897

Factor #2 is revised as follows:

G&C	\$0.2245/lb/G&C failure
Rocket Motor 0.897 x 0.2219	<u>0.1990</u>
	0.4235
Return Trip	<u>0.4235</u>
	0.8470
Transshipment Costs	<u>0.8470</u>
	\$1.6940/lb/G&C failure

SDT = 330 x .228 x 1.6940

= 127.5 (FY79\$K)

10. RECEIPT, SEGREGATION, STORAGE AND ISSUE (RSSI)

10a. Definition - This is the cost of personnel and material required for the on-loadings and off-loadings of ships, movement and handling of missiles to and from storage depots and NWS's, and storage of missiles.

10b. Discussion - The Naval Weapons Support Center, Crane, Indiana, maintains cognizance over the RSSI program and annually publishes a RSSI, Forecast of Requirements. The data contained in Table C-38 of Appendix C is from the Forecast of Requirements dated April 6, 1978. Since the RSSI functions support many other weapons and/or types of ammunition it is important to identify the costs incurred specifically for air-launched missiles. The Forecast of Requirements does identify the cost of receipts and issues for air-launched missiles, but the cost of on-loading and off-loading must be allocated. The procedure used to obtain the data in Table C-38 for on-loading and off-loading was to compute the average cost per ton for AO/AOE's and/or carriers and apply the cost per ton respectively for on-loading to issue tonnage and the cost per ton for off-loading to receipt tonnage. Mr. Wimmenauer of NWSC, Crane, (autovon 482-1308), who supplied the data and recommended the allocation procedure, is the expert on RSSI.

10c. Cost-Estimating Relationship - Although RSSI costs are not identifiable at this time to a particular type missile, an estimate can be obtained using the average cost per ton data contained in Table C-38 (Avg. = 0.29 per ton, FY79\$K). The equation is as follows:

$$\text{RSSI} = \text{NT} \times 0.29$$

$$\text{NT} = \text{NWSWL} \times \text{WM}$$

where,

RSSI = the annual RSSI cost for a particular missile type (FY79\$K).

NT = the number of short tons to be handled by the RSSI department.

NWSWL = the annual NWS workload; i.e., the number of missiles of a particular type which undergo NWS maintenance in a year.

WM = the containerized weight per missile (short tons).

10d. Example Calculation

Assume: 4 missile per container, total weight = 0.900 short tons

NWSWL = 1199 missiles

WM = 0.225 short ton

RSSI = $1199 \times 0.225 \times 0.29$

= 78.6 (FY79\$K)

Note: 1 short ton = 2,000 pounds = 907 kilograms

11. REPLACEMENT TRAINING

11a. Definition - This is the variable cost of recruit and technical training including:

- o the pay of personnel in training who will replace missile operations, below-depot maintenance and installation support personnel,
- o the cost of their instruction,
- o the pay of instructor personnel.

11b. Discussion - This cost may be estimated utilizing the factors in the Navy Resource Model (NARM) Program Factors Manual, which were developed by summing all of the costs of the students and two-thirds the cost of staff personnel and operating funds for the program elements shown below and allocating them to weapons systems on the basis of their personnel demands.

81114N	Flight Training
81111N	Recruit Training
81112N	Specialized Training
81113N	Professional Training
24633N	Fleet Support Training
88097N	Administrative Support Training

As with Base Operating Support, the factors used to compute this cost are not explicitly identified in the narrative of the Navy Program Factors Manual, although those factors used in the 31 August 1977 Factors Manual are given in this report. Information on subsequent revisions can be obtained from Ms. Ruth, Op-901 (X-55038).

11c. Cost-Estimating Relationship - The equations are:

$$TO = 0.0001 \text{ DBE} + 0.0028 \text{ DBT} + 0.0613 \text{ DBO}$$

$$TE = 0.1036 \text{ DBE} + 0.0233 \text{ DBT} + 0.0067 \text{ DBO}$$

$$TOM = 0.0041 DBE + 0.3377 DBT$$

$$TRT = (TO \times OPR) + (TE \times EPR) + TOM$$

where,

TO = the number of training officers required to support the weapon system.

DBE = the number of direct enlisted plus base operating enlisted (defined and computed in Section III, 5c.) required to support the weapon system.

DBT = the number of total (officer and enlisted) personnel, direct and base operating (defined and computed in Section III, 5c.) required to support the weapon system.

DBO = the number of direct officers plus base operating officers, (defined and computed in Element 5) required to support the weapon system.

TE = the number of training enlisted required to support the weapon system.

TOM = training O&M funds. (FY79\$K)

TRT = total replacement training costs. (FY79\$K)

OPR = officer pay rate. (FY79\$K = 22.141)

EPR = enlisted pay rate. (FY79\$K = 9.517)

11d. Example Calculation

Assume:

$$DBE = 6.0$$

$$DBT = 6.0$$

$$DBO = 0$$

$$TO = 0.0001(6.0) + 0.0028(6.0) + 0.0613(0)$$

$$= 0.02 = 0.0 \text{ officers}$$

$$TE = 0.1036(6.0) + 0.0233(6.0) + 0.0067(0)$$

$$= 0.7 \text{ enlisted}$$

$$TOM = 0.0041(6.0) + 0.3377(6.0)$$

$$= 2.1 \text{ O\&M funds (FY79\$K)}$$

$$TRT = (0 \times 22.1) + (0.7 \times 9.5) + 2.1$$

$$= 8.8 \text{ (FY79\$K)}$$

12. HEALTH CARE

12a. Definition - Health Care is the cost of providing medical support to missile operations, below-depot maintenance and base operating support and training pipeline personnel including:

- o the pay of medical personnel who provide this support,
- o the cost of medical material.

12b. Discussion - The NARM estimates this cost by summing two-thirds (2/3) of the cost of medical operations and adding the pay of patients. The program elements are:

81211N	Hospitals
81212N	Medical Centers
81216N	Other Medical Activities
81213N	Patients

As with Base Operating Support and Replacement Training, the factors used to compute this cost are not explicitly identified in the narrative of the Factors Manual. Those factors used in the most recent edition, 31 August 1977, are given in this report and subsequent revisions can be obtained from Ms. Ruth, Op-901 (X-55038).

12c. Cost-Estimating Relationship - The equations are:

$$\begin{aligned}
 HO &= 0.0092 \text{ DET} \\
 HE &= 0.0182 \text{ DBT} \\
 HOM &= 0.4148 \text{ DBT} \\
 HT &= (HO \times OPR) + (HE \times EPR) + HOM
 \end{aligned}$$

where,

HO = the number of health care officers necessary to support the weapon system.

- DBT = the total number of personnel, officers and enlisted, direct plus base operating required to operate and provide base support to the missile system (from Section III, 5c.)
- HE = the number of health care enlisted necessary to support the weapon system.
- HOM = the health care O&M funds necessary to support the weapon system.
- HT = the total cost of health care necessary to support the weapon system. (FY79\$K)
- OPR = officer pay rate (FY79\$K = 22.141)
- EPR = enlisted pay rate (FY79\$K = 9.517)

12d. Example Calculation

Assume: DBT = 6.0 (from Element 5, Section III, 5d.)

HO = 0.0092(6.0)

= 0.1 officer

HE = 0.0182(6.0)

= 0.1 enlisted

HOM = 0.4148(6)

= 2.5 O&M (FY79\$K)

HT = $(0.1 \times 22.1) + (0.1 \times 9.5) + 2.5$

= 5.7 (FY79\$K)

13. PERSONNEL SUPPORT

13a. Definition - Personnel Support is comprised of two parts. The first part consists of the costs incident to the Permanent Change of Station (PCS) of missile operation and below-depot maintenance personnel, either individually or as an organized unit, and base operating support personnel. PCS is the cost of duty station rotation for all squadron and supporting personnel. The second portion is the cost of recruiting and examining activities and the cost of transient personnel and prisoners.

13b. Discussion - PCS rates are figured in the Navy Resource Model by dividing the total PCS cost by the number of personnel, producing an annual PCS cost per person (officers/enlisted). This is applied to the number of personnel operating and supporting the missile system to obtain an estimate. The other costs, recruiting and examining, transients and prisoners, are estimated by the NARM by summing two-thirds (2/3) of the cost of recruiting and examining activities and all of the costs associated with transients and prisoners; and allocating these costs to the weapon system on the basis of the number of personnel. The program elements are given below:

81412N	Recruiting and Examining
81411N	Prisoners
81415N	Transients

13c. Cost-Estimating Relationship - The equations for estimating Personnel Support are:

$$PCS = 1.4515 DBO + 0.4615 DBE$$

$$REOM = 0.0889 DBE$$

$$REO = 0.0009 DBE$$

$$REE = 0.1036 DBE$$

$$\begin{aligned}
 PE &= 0.0119 \text{ DBE} \\
 TOT &= 0.0584 \text{ DBT} \\
 TET &= 0.0433 \text{ DBE} \\
 TPA &= REOM + (REO + TOT) \times OPR + (REE + PE + TET) \times EPR + PCS
 \end{aligned}$$

where,

- PCS = the annual cost (MPN funds) of PCS for weapon system direct and base operating personnel. (FY79\$K)
- DBO = the total number of officer personnel, direct plus base operating, required to operate and provide base support to the missile system (from Section III, 5c.)
- DBE = the total number of enlisted personnel, direct plus base operating, required to operate and provide base support to the missile system (from Section III, 5c.)
- REOM = recruiting and examining O&M funds. (FY79\$K)
- REO = the number of recruiting and examining officers necessary to support the weapon system.
- REE = the number of recruiting and examining enlisted necessary to support the weapon system.
- PE = the number of enlisted prisoners.
- TOT = the number of officers in transit.
- DBT = the total number of personnel, officers and enlisted, direct plus base operating, required to operate and provide base support to the missile system (from Section III, 5c.)
- TET = the number of enlisted personnel in transit.
- TPA = the total cost of Personnel Support. (FY79\$K)
- OPR = officer pay rate. (FY79\$K = 22.141)
- EPR = enlisted pay rate. (FY79\$K = 9.517)

13d. Example Calculation

Assume:

$$DBO = 0.0 \text{ officers}$$

DBE = 6.0 enlisted
DBT = 6.0 total personnel
PCS = $1.4515(0) + 0.4615(6.0)$
= 2.8 MPN funds (FY79\$K)
REOM = 0.0889(6.0)
= 0.5 O&M funds (FY79\$K)
REO = 0.0009(6.0)
= 0.0 officers
REE = 0.1036(6.0)
= 0.6 enlisted
PE = 0.0119(6.0)
= 0.1 enlisted
TOT = 0.0584(6.0)
= 0.4 officers
TET = 0.0433(6.0)
= 0.3 enlisted
TPA = $0.5 + (0.0 + 0.4) \times 22.1 + (0.6 + 0.1 + 0.3) \times 9.5 + 2.8$
= 21.6 (FY79\$K)

14. REPLENISHMENT SPARES

14a. Definition - This is the cost of procuring missile spares and repair parts which are normally repaired and returned to stock. In addition, this cost can include procurement of stock levels that are not provided by initial spares procurement. Repairable items are identifiable by the Aviation Supply Office (ASO) cognizance (COG) codes 6E (air-launched missile, non-explosive components) and 4E (air-launched missile, explosive components).

14b. Discussion - The requirements for 6E COG items are determined by the Inventory Control Point (ICP) which is the Ships Parts Control Center (SPCC), Mechanicsburg, Pennsylvania, through line-item stratification.* Usage rates, demand/issue data, carcass-return-rates, procurement lead times, and other factors are incorporated into the analysis to estimate the annual requirements for each Nationally Stock Numbered (NSN) item. 4E COG items are handled in similar fashion but tend to be heavily dependent on age-of-component considerations as opposed to observed failures.

Data for Replenishment Spares was obtained from Ms. Savage (X-20239) of NAVAIR 4123 and are shown in Tables C-39 and C-40 of Appendix C. The reader is cautioned that Replenishment Spares costs are extremely changeable and can vary significantly from missile to missile and from year to year depending on variation in the factors mentioned in the preceding paragraph. As an example, the following table presents two estimates of the costs of 6E COG Replenishment Spares for the fiscal year 1980. The first column presents the costs as they were estimated in support of the 1979 Program Objective Memorandum (POM 79); and the second, as they were estimated for POM 80.

*For more information on this process, refer to DOD Instruction 4140.24.

6E COG Replenishment Spares for FY80

<u>Missile</u>	<u>POM79</u> <u>(FY79\$K)</u>	<u>POM80</u> <u>(FY79\$K)</u>
Sidewinder	730	1,423
Sparrow	774	384
Shrike	59	604
Standard Arm	171	402
Phoenix	455	203
Harpoon	703	77

14c. Cost-Estimating Relationship - Keeping in mind the changeability of these costs, one can estimate the annual cost of Replenishment Spares with the following equation:

$$RS = 151.912 + 55.220PI \\ (5.53)$$

$$\bar{R}^2 = 0.86$$

$$S.E.E. = 242.871$$

$$\text{Det. of } X'X = 1.000$$

$$F = 30.624$$

where,

RS = the annual cost of Replenishment Spares (4E COG and 6E COG) for a particular type missile. (FY79\$K)

PI = the percent of the missile inventory comprised by the particular missile.

DATA BASE

<u>Missile</u>	<u>RS</u> <u>(FY82)</u> <u>(FY79\$K)</u>	<u>PI¹</u> <u>%</u> <u>(FY82)</u>
Sidewinder	1,401	23.0
Sparrow	2,034	33.1
Standard Arm	163	3.9
Phoenix	769	16.4
Harpoon	1,073	13.1
HARM	756	6.2

¹The variable PI has been adjusted from the values shown in Exhibit IV-1 to reflect only those missiles that have Replenishment Spares funding.

14d. Example Calculation

Assume:

$$PI = 18.5 \text{ (avg. of life cycle)}$$

$$RS = 151.912 + 55.220(18.5)$$

$$= 1173.5 \text{ (FY79\$K)}$$

15. MODIFICATIONS

15a. Definition - This is the cost of modifying missiles, missile support equipment, and training equipment that are in the operating inventory to make them safe for continued operations, to enable them to perform their missions and to improve reliability to reduce maintenance cost. This includes labor, modification kits, and consumable material.

15b. Discussion - Data for the cost of procuring modification kits or material was obtained from the WPN Budget and are shown in Table C-41 of Appendix C. Generally the procurement of Modifications is funded with WPN by the specific program office responsible for the missile and depends on a myriad of factors such as threat considerations, maintainability, safety, etc. Installation of Modifications, which is funded by O&MN and takes place at the depots and sometimes the NWS's, is dependent on the amount and kind of modification material that has been procured and is available for installation. Installation data from the FY78 and FY79 budget submissions is contained in Table C-42.

15c. Cost-Estimating Relationship - For some missile programs, the planned modifications kits or components may be specified in sufficient detail so that unit procurement and installation costs can be estimated using conventional procurement estimating methodology. In these cases, the analytical representation of the cost of Modifications would be:

$$M = NMK \times CMK + NMI \times CI$$

where,

M = the annual cost of Modifications for an air-launched missile type. (FY79\$K)

- NMK = the annual number of modification kits to be procured.
- CMK = the unit cost of a modification kit. (FY79\$K)
- NMI = the annual number of modification kits to be installed.
- CI = the unit cost of installing a modification kit. (FY79\$K)

For most missile programs still in development, there are no planned modifications and the analyst is forced to make an estimate with no supporting program information. Data from Tables C-41 and C-42 for the years FY78 and FY79 are summarized below to serve as guidelines or possible analogs.

Modification Costs (FY79\$K)

	FY78			FY79		
	<u>Proc.</u>	<u>Install</u>	<u>Total</u>	<u>Proc.</u>	<u>Install</u>	<u>Total</u>
Sidewinder	0	5	5	300	10	310
Sparrow	750	659	1,409	1,725	626	2,351
Walleye I	0	0	0	0	0	0
Walleye II	0	0	0	0	0	0
Shrike	0	0	0	700	0	700
Standard Arm	0	15	15	0	15	15
Phoenix	2,170	169	2,339	5,214	169	5,383
Harpoon	0	0	0	0	0	0
Harm	0	0	0	0	0	0

15d. Example Calculation

Assume example missile has Modifications costs comparable to the FY79 Sidewinder experience.

$$M = 310 \text{ (FY79$K)}$$

16. REPLENISHMENT GROUND SUPPORT EQUIPMENT (RGSE)

16a. Definition - Replenishment Ground Support Equipment (RGSE) is the cost of procuring missile ground servicing equipment, maintenance and repair shop equipment, instruments and laboratory test equipment, and other equipment items. These equipment demands are generated by a need to: (1) replace peculiar support equipment bought using procurement funds; (2) obtain common off-the-shelf ground equipment that are needed to support missile operations; and (3) replenish common ground equipment that is no longer useable.

16b. Discussion - These items are funded by the program office but unfortunately it is sometimes impossible to distinguish replacement items from initial items, therefore no data is currently available. Discussions with NAVAIR personnel indicate that RGSE costs for air-launched missiles are small. Items bought to be used in handling at the organizational level are relatively inexpensive and the expensive test sets at the NWS's and depots are seldom replaced entirely.

16c. Cost-Estimating Relationship - One method of estimating this cost is given below. It was developed from an OSD analysis of RGSE for all types of weapon systems.

$$RGSE = 0.0025 \times WL \times CAC_{1000}$$

where,

RGSE = the annual cost of Replenishment Ground Support Equipment.
(FY79\$K)

WL = the annual depot workload (computed in Element 6, Sec.III, 6c.)

CAC_{1000} = the cumulative average hardware cost of the first one thousand missiles procured. (FY79\$K)

16d. Example Calculation:

Assume:

 $WL = 144$ (from Element 6) $CAC_{1000} = 145$ (from Element 6) $RGSE = 0.0025 \times 144 \times 145$ $= 52.2$ (FY79\$K)

IV. DATA BASE

This section contains the data which were used in the cost-estimating relationship (CER) development including all independent or explanatory variables. The compilation of these data will enable the reader to continue CER development as new data become available in the future. It is important to point out some of the classical problems of CER development which were encountered in this study and will undoubtedly be encountered in future missile CER development.

The initial problem is the small data base, having at most eight observations. "No degree of sophistication in the use of advanced mathematical statistics can compensate very much for a seriously deficient data base."* Although this data base is not "seriously deficient," it does limit the flexibility of the analysts to make corrections for other data problems and still perform extensive statistical analyses. The other data problems which are also discussed by Fisher in the cited reference are temporal and comparability problems. The former is a group of problems that arise because information is collected over time; the first of which, adjusting for price level changes, is not too difficult to handle. OSD indices which are given in Section III were used to adjust all costs to FY79 dollars. A second temporal problem is the fact that formats and reporting requirements have changed over time, thus making it difficult or impossible to obtain each desired datum for every time period. This results in CER's which are based on data from slightly different time spans. This brings us to the third temporal problem, that of the quickly

*Fisher, Gene H., Cost Considerations in Systems Analysis, American Elsevier Publishing Co., Inc., New York, 1971, p. 123.

changing environment, both in hardware and in organizational and operational concepts. This makes it important to collect as many observations as possible which reflect the same environment, or to explicitly present environmental factors as dependent variables. Both are difficult to do with the small population of air-launched missile types.

The second group of problems is concerned with comparability and there are many comparability considerations to be made for this data base. The most obvious one is the case of the Walleye I and II, which are unpowered weapons. This is the reason that a CER was included in the Depot Maintenance section which estimates only G&C repair cost. The Harpoon missile also presents a comparability problem since it contains a small jet engine rather than a rocket motor; the Sidewinder missile is another, since under the current maintenance philosophy none of the G&C components are repairable. Standard Arm is yet another, because the small number in the inventory results in an unusually high unit cost. There are other comparability problems as well - some maintenance is done commercially rather than within the Navy; and some missile systems are just entering the inventory while others are being phased out.

The purpose of mentioning these problems is to alert the user to their presence and the fact these problems might result in a CER of a form which is contrary to a rational causal relationship (e.g., a negative intercept or slope). Analytical corrections of observations is very subjective and would require extensive research, and to remove the questionable observation is disadvantageous because of the small size of the data base. For the statistical

CER's contained in this report, an examination of the residuals was made to determine any obvious signs of temporal or comparability problems. Generally, ad hoc adjustments would not have improved the CER's but, again, the user is alerted to make these considerations when future data is analyzed.

The data used for CER development is contained in Exhibits IV-1 and IV-2. The latter contains Replenishment Spares data and the associated explanatory variables which were investigated; while the former contains NWS, Depot, Quality Evaluation, Fleet Support, and Engineering Support costs and explanatory variables. Exhibits IV-3 and IV-4 contain the correlation matrices for the data in Exhibits IV-1 and IV-2 respectively, and Exhibit IV-5 contains a definition for each variable in Exhibits IV-1 and IV-2.

EXHIBIT IV-1
DATA BASE FOR COST-ESTIMATING RELATIONSHIPS

<u>Missile</u>	1 DUC (FY79\$K)	2 NWS (FY79\$K)	3 IRR	4 D (m.)	5 L (m.)	6 LW (kg)	7 LWO (kg)	8 LWOP (kg)
Sidewinder	3.59	1.069	0.13	0.128	2.90	85	77	32
Sparrow (AIR)	3.97	1.837	0.30	0.204	3.66	227	200	129
Walleye I	2.19	1.154	0.07	0.381	3.44	510	225	225
Walleye II	2.85	1.343	0.09	0.457	4.04	1,089	182	182
Shrike	1.12	1.358	0.22	0.204	3.05	181	137	63
Standard Arm	15.35	3.483	0.30	0.335	4.54	615	548	220
Phoenix	6.90	1.765	0.24	0.381	3.96	447	421	211
Harpoon	5.94	2.669	0.19	0.335	3.81	530	375	322

<u>Missile</u>	9 79QE (FY79\$K)	10 QE (FY79\$K)	11 FS (FY79\$K)	12 ES4 (FY79\$K)	13 ES5 (FY79\$K)	14 ES (FY79\$K)	15 DDG (FY79\$K)	16 YS (Mach)
Sidewinder	480	465	271	742	689	1 431	2.1	4.0
Sparrow (AIR)	399	397	271	853	358	1 241	3.1	2.5
Walleye I	142	176	117	276	71	347	1.8	1.0
Walleye II	71	88	52	145	36	181	2.5	1.0
Shrike	337	324	192	439	218	657	1.3	2.0
Standard Arm	119	90	107	433	276	709	9.4	2.0
Phoenix	390	268	170	509	238	747	8.7	5.0
Harpoon	315	262	98	703	154	857	4.1	0.8

Note: See Exhibit IV-5 for definitions.

EXHIBIT IV-1 (cont'd.)
DATA BASE FOR COST-ESTIMATING RELATIONSHIPS

<u>Missile</u>	17	18	19
	PI79 %	CAC ₁₀₀₀ (FY79\$K)	AAD
Sidewinder	14.30	35.4	1
Sparrow (AIR)	14.10	129.6	1
Walleye I	18.30	47.3	0
Walleye II	2.90	56.1	0
Shrike	20.60	48.7	0
Standard Arm	2.00	222.0	0
Phoenix	5.90	335.2	1
Harpoon	3.10	340.9	0

Note: See Exhibit IV-5 for definitions.

EXHIBIT IV-2
DATA BASE FOR REPLENISHMENT SPARES COST-ESTIMATING RELATIONSHIPS

	20	21	22	23	24	25	26	27
<u>Missile</u>	<u>RS79</u> <u>(FY79\$M)</u>	<u>RS80</u> <u>(FY79\$M)</u>	<u>RS84</u> <u>(FY79\$M)</u>	<u>PI79</u> <u>%</u>	<u>DUC</u> <u>(FY79\$K)</u>	<u>CAC</u> <u>1000</u> <u>(FY79\$K)</u>	<u>AAD</u>	<u>LWO</u> <u>(kg)</u>
Sidewinder	2.60	3.17	2.87	14.3	3.54	35.4	1	77
Sparrow (AIR)	0.77	0.59	0.56	14.1	3.97	129.6	1	200
Shrike	0.72	0.83	0.76	20.6	1.12	48.7	0	137
Standard Arm	0.27	0.41	0.38	2.0	15.35	222.0	0	548
Phoenix	0.10	0.20	0.33	5.9	6.90	335.2	1	421
Harpoon	0.20	0.31	0.38	3.0	5.94	340.9	0	375
Harm	0.00	0.00	0.28	0.0	4.64	105.0	0	284

	28	29	30	31	32	33	34	35
<u>Missile</u>	<u>PI80</u> <u>%</u>	<u>PI</u> <u>%</u>	<u>RS82</u> <u>(FY79\$K)</u>	<u>NWSWL</u> <u>(thous.msl.)</u>	<u>80RS</u> <u>(FY79\$K)</u>	<u>RS</u> <u>(FY79\$K)</u>	<u>IV80</u> <u>(FY79\$M)</u>	<u>IN82</u> <u>(FY79\$M)</u>
Sidewinder	12.4	10.7	2,880	1.63	1,395	1,401		
Sparrow (AIR)	15.8	15.4	606	1.43	833	2,034		
Shrike	18.5	17.9	702	0.96	285	276		
Standard Arm	1.8	1.8	391	0.08	163	163		
Phoenix	6.1	7.6	246	0.97	428	769		
Harpoon	4.0	6.1	588	0.00	893	1,073		
Harm	0.1	2.9	102	0.00	0	756		

Note: See Exhibit IV-5 for definitions.

EXHIBIT IV-3
CORRELATION MATRIX FOR DATA IN EXHIBIT IV-1

	1	2	3	4	5	6	7	8	9	11
1	1.000									
2	.892	1.000								
3	.583	.650	1.000							
4	.196	.191	-.296	1.000						
5	.768	.756	.379	.689	1.000					
6	.201	.210	-.325	.899	.693	1.000				
7	.877	.868	.521	.482	.842	.328	1.000			
8	.404	.575	.004	.735	.678	.570	.717	1.000		
9	-.256	-.256	.298	-.766	-.597	-.341	-.321	-.470	1.000	
10	-.421	-.404	.161	-.872	-.755	-.878	-.551	-.612	.949	1.000
11	-.247	-.331	.339	-.887	-.617	-.888	-.458	-.720	.956	.919
12	.055	.162	.516	-.730	-.286	-.724	-.066	-.190	.827	.806
13	.078	-.103	.232	-.836	-.456	-.722	-.286	-.649	.737	.767
14	.071	.042	.420	-.845	-.396	-.787	-.180	-.433	.854	.856
15	.385	.734	.596	.334	.770	.201	.912	.442	-.112	-.371
16	.118	-.176	.317	-.367	-.174	-.498	.022	-.429	.682	.525
17	-.663	-.660	-.184	-.585	-.833	-.676	-.691	-.633	.363	.552
18	.569	.674	.497	.317	.576	.117	.804	.705	.131	-.147
19	-.077	-.274	.287	-.483	-.259	-.543	-.196	-.429	.776	.715
	11	12	13	14	15	16	17	18	19	
11	1.000									
12	.754	1.000								
13	.818	.696	1.000							
14	.850	.934	.906	1.000						
15	-.215	.019	-.013	.005	1.000					
16	.622	.389	.643	.549	.393	1.000				
17	.585	.125	.234	.191	-.670	.064	1.000			
18	-.236	.286	-.158	.091	.746	.202	-.655	1.000		
19	.793	.648	.701	.729	.133	.846	.141	.094	1.000	

EXHIBIT IV-4
CORRELATION MATRIX FOR DATA IN EXHIBIT IV-2

	20	21	22	23	24	25	26	27	28	29
20	1.000									
21	.991	1.000								
22	.983	.996	1.000							
23	.396	.370	.293	1.000						
24	-.346	-.292	-.317	.151	1.000					
25	-.609	-.560	-.564	-.439	.494	1.000				
26	.509	.460	.462	.035	-.230	-.052	1.000			
27	-.708	-.649	-.660	-.171	.974	.787	-.330	1.000		
28	.528	.449	.402	.599	-.645	-.545	.397	-.748	1.000	
29	.409	.326	.285	.479	-.727	-.487	.356	-.745	.983	1.000
30	.992	1.000	.997	.351	-.306	-.563	.470	-.660	.447	.326
31	.737	.673	.653	.413	-.506	-.467	.833	-.694	.805	.747
32	.781	.762	.750	.064	-.325	-.105	.599	-.504	.411	.347
33	.409	.314	.321	-.206	-.412	-.119	.686	-.468	.346	.355
34	-.193	-.253	-.285	-.055	-.159	.499	.555	.074	.361	.428
35	-.346	-.377	-.392	-.313	-.117	.696	.405	.214	.121	.217

	30	31	32	33	34	35
30	1.000					
31	.678	1.000				
32	.767	.621	1.000			
33	.332	.564	.703	1.000		
34	-.249	.386	.252	.461	1.000	
35	-.372	.148	.198	.373	.947	1.000

EXHIBIT IV-5
DEFINITIONS OF DATA ELEMENTS IN EXHIBITS IV-1 and IV-2

<u>Number</u>	<u>Abbr.</u>	<u>Definition</u>
1	DUC	the total depot unit cost for a particular type missile (FY79\$K)
2	NWS	the unit cost of NWS maintenance (FY79\$K)
3	IRR	the intermediate reject ratio, i.e., the percentage of missiles processed by the NWS which are determined to be failures and are sent to the depot for repair.
4	D	the missile diameter (meters)
5	L	the length of the missile (meters)
6	LW	the launch weight of the missile (kilograms)
7	LWO	the launch weight of the missile less the ordnance weight (kilograms)
8	LWOP	the launch weight of the missile less the ordnance and propulsion weights (kilograms)
9	79QE	the annual cost of Quality Evaluation for FY79 (FY79\$K)
10	QE	the average annual cost (FY77-79) of Quality Evaluation (FY79\$K)
11	FS	the average cost (FY76-79) of Fleet Support (FY79\$K)
12	ES4	the average cost (FY76-79) of Engineering Support funded by NAVAIR 4104 (FY79\$K)
13	ES5	the average cost (FY76-79) of Engineering Support funded by NAVAIR 510) (FY79\$K)
14	ES	the average cost (FY76-79) of total Engineering Support - the sum of 13 and 14 (FY79\$K)
15	DGC	the depot unit cost of rework of a missile G&C section. (This does not include repair of G&C repairables.) (FY79\$K)
16	MS	the maximum speed of the missile during free flight (Mach)
17	PI79	the percentage of the inventory represented by each missile in FY79
18	CAC ₁₀₀₀	the cumulative average cost of the first one thousand missiles procured (FY79\$K)
19	AAD	a dummy variable which is equal to 1 for air-to-air missiles, and 0 for air-to-ground missiles
20	RS79	the annual cost of Replenishment Spares in FY79 as shown in POM 80 (FY79\$M)

EXHIBIT IV-5 (cont'd.)

<u>Number</u>	<u>Abbr.</u>	<u>Definition</u>
21	RS80	the annual cost of Replenishment Spares in FY80 as shown in POM80 (FY79\$M)
22	RS84	the annual cost of Replenishment Spares in FY84 as shown in POM80 (FY79\$M)
23	PI79	the percentage of the inventory represented by each missile in FY79
24	DUC	the total depot unit cost for a particular type missile (FY79\$K)
25	CAC ₁₀₀₀	the cumulative average cost of the first one thousand missiles procured (FY79\$K)
26	AAD	a dummy variable which is equal to 1 for air-to-air missiles, and 0 for air-to-ground missiles
27	LWO	the launch weight of the missile less the ordnance weight (kilograms)
28	PI80	the percentage of the inventory represented by each missile in FY80
29	PI	the percentage of the missile inventory represented by each missile in FY82
30	RS82	the annual cost of Replenishment Spares in FY82 as shown in POM80 (FY79\$K)
31	NWSWL	the annual NWS workload based on FY79 (thousands of missiles)
32	8ORS	the annual cost of Replenishment Spares in FY80 as shown in POM79 (FY79\$K)
33	RS	the annual cost of Replenishment Spares in FY82 as shown in POM79 (FY79\$K)
34	IV80	the inventory value of each missile based on FY80 inventory (FY79\$M)
35	IV82	the inventory value of each missile based on FY82 inventory (FY79\$M)

APPENDIX A

CAIG GUIDANCE ON AIR-LAUNCHED
MISSILE O&S COST ELEMENT STRUCTURE



OFFICE OF THE SECRETARY OF DEFENSE
WASHINGTON, D. C. 20301

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August 31, 1977

MEMORANDUM FOR THE COST ANALYSIS IMPROVEMENT GROUP (CAIG) AND
VAMOSC TASK FORCE

SUBJECT: Weapon System Operating and Support Cost Element Structures
and Definitions

As you know, we have been working with the Services and the OSD staff for some time to develop CAIG operating and support costing structures for selected weapon classes.

Enclosed are aircraft, ship, combat vehicle and air-launched tactical missile cost element structures and definitions. The aircraft structure represents a modification to the structure contained in the May 1974 CAIG O&S cost development guide for aircraft systems. The ship, combat vehicle and tactical missile structures have not been previously issued.

Effective immediately, these new structures will be used when preparing and submitting O&S cost estimates of these weapon classes to the CAIG/DSARC and as the basis for collecting O&S cost data under DOD's VAMOSC Task.

Our current schedule calls for issuing a revised CAIG aircraft guide this fall; ship, combat vehicle and missile guides will follow early next year. These new guides will contain the enclosed cost structures and incorporate many of the analysis provisions and reporting formats contained in the "Guidelines for Analysis" developed for the CAIG by the Logistics Management Institute (LMI). Particular attention should be paid to: the System Program Definition Statement; the requirement for a pre-CAIG meeting to determine the groundrules for the O&S cost analysis to be conducted for the DSARC/CAIG; and the maintenance sizing methodology.

I recommend a thorough review of the LMI guidelines now as a preview of forthcoming CAIG/DSARC and OSD weapon systems analysis requirements. If you have not received copies of the LMI reports, please contact Frank Swofford at extension 52612.



Finally, I ask that Service CAIG representatives distribute the new cost structures to their respective system command and program manager organizations. It is important to obtain future PM cost estimates in a form consistent with those prepared by the independent cost teams.

Frank W. Schrift
for Milton A. Margolis
Chairman

OSD Cost Analysis Improvement Group

Enclosures (4)

AIR-LAUNCHED MISSILE OPERATING AND SUPPORT
COST ELEMENT STRUCTURE

- 301 Operations
 - 301.1 Operational Training
 - 301.2 Handling and Inspection
 - 301.3 Personnel Support
- 302 Below Depot Maintenance
 - 302.1 Missile Maintenance Manpower
 - 302.2 Munition Maintenance Manpower
 - 302.3 Maintenance Materiel
 - 302.4 Personnel Support
- 303 Installations Support
 - 303.1 Base Operating Support
 - 303.2 Real Property Maintenance
 - 303.3 Personnel Support
- 304 Depot Maintenance
 - 304.1 Manpower
 - 304.2 Materiel
- 305 Depot Supply Support
 - 305.1 Equipment Distribution
 - 305.2 Equipment Management
 - 305.3 Technical Support
- 306 Second Destination Transportation
- 307 Personnel Support and Training
 - 307.1 Individual Training
 - 307.2 Health Care
 - 307.3 Personnel Activities
 - 307.4 Personnel Support
- 308 Sustaining Investments
 - 308.1 Replenishment Spares
 - 308.2 Modifications
 - 308.3 Replenishment Ground Support Equipments

AIR-LAUNCHED MISSILE OPERATING AND SUPPORT
COST ELEMENT DEFINITIONS

300 OPERATING AND SUPPORT: The variable cost of supporting the air-launched missile operation of a deployed aircraft unit. 1/

301 OPERATIONS

301.1 Operational Training: The cost of: a) operational firings including such costs as range operation, instrumentation, drone and recovery costs; b) captive flight training planning, scheduling and evaluation costs.

301.2 Handling and Inspection: The cost of manpower and consumable materiel needed to conduct missile launch and recovery operations in the deployed unit. Included are such tasks as: Removing missiles from storage; missile inspection; missile assembly; transporting missiles to the aircraft; missile uploading; and missile check out and arming prior to a captive flight or firing. This cost also includes a similar series of tasks to download the missile and return it to storage if not fired.

301.2.1 Manpower: The pay and allowances of missile handling and inspection personnel.

301.2.2 Materiel: The cost of materiel consumed in the missile handling and inspection operation. Excludes the cost of reparable spares which are included in cost element 308.1, Replenishment spares.

301.3 Personnel Support: The cost of supplies, services, and equipment needed for support of missile handling and inspection personnel. Included are administrative supply items; expendable office machines and equipment; custodial services; and personnel-oriented support items such as desks and chairs.

302 BELOW DEPOT MAINTENANCE

302.1 Missile Maintenance Manpower

302.1.1 Organizational/AIMD: The cost of paying the personnel needed for maintenance of aircraft missile release systems; missile and missile components; and missile support equipment of the deployed aircraft unit. Included are the costs of supervisory personnel needed for such functions as missile-related maintenance supervision and control; missile quality control; and missile maintenance analyses.

302.1.2 Intermediate Maintenance: The cost of paying the personnel needed for missile and missile component checkout and repair at Naval Weapon Stations and Mobile Missile Maintenance units.

302.2 Munitions Maintenance Manpower: The cost of paying the personnel needed for handling and maintenance of missile warheads. Included are the costs of personnel needed to supervise warhead maintenance, storage and disposal.

302.3 Maintenance Materiel: The cost of purchasing material from the General and System Support Divisions of the stock funds. This cost includes all non-reparable expense items consumed in the missile and warhead repair process. Excludes reparable spares costs which are included in cost element 308.1 (Replenishment Spares).

302.4 Personnel Support: The cost of supplies, services and equipment needed to support below-depot maintenance personnel. Examples of included costs are administrative supply items; travel expenses; expendable office machines and equipment; custodial services; and other variable personnel-oriented support costs incurred at the maintenance activities.

303 INSTALLATIONS SUPPORT

303.1 Base Operating Support: The cost of installation personnel necessary to directly support missile handling and inspection and below-depot maintenance personnel. Examples of installation functions which directly support the unit include food services, custodial services, supply, motor pool, payroll, ADP and communication operations.

303.2 Real Property Maintenance: The variable cost of construction, maintenance and operation of real property facilities and related management, engineering and support work including contracted services that support the missile handling, inspection, maintenance and storage functions.

303.3 Personnel Support: The cost of supplies and equipment needed to support installation support personnel. Examples of included costs are administrative supply items and expendable office machines and equipment.

304 DEPOT MAINTENANCE: The cost of manpower and materiel needed to perform missile and missile component and support equipment maintenance at DoD centralized repair depots and contractor repair facilities.

304.1 Manpower: The cost of paying the personnel needed to perform major overhaul; repair; modification; calibration; inspection; and storage and disposal of missile and missile components and support equipment. Includes a pro rata

share of variable depot facility overhead costs.

- 304.2 Materiel: The cost of materiel consumed in the depot overhaul, repair, inspection and storage and disposal process.
- 305 DEPOT SUPPLY: The cost of manpower and materiel needed to buy, store, package, manage and control the supplies, spares and repair parts used in operating and maintaining missiles and missile components and support equipment; and to provide sustaining (service) engineering and technical data support for missile systems.
 - 305.1 Equipment Distribution: The cost of manpower and materiel needed to fill requisitions for missile and missile support equipment supplies, spares and repair parts. Included are receiving, unpacking, storage, inspection, packing and crating and issuing costs.
 - 305.2 Equipment Management: The cost of manpower and materiel needed to manage the procurement of missile and missile support equipment supplies, spares and repair parts and maintain control and accountability of these assets.
 - 305.3 Technical Support: The cost of sustaining (service) engineering and technical data and documents needed to perform sustaining engineering and maintenance on missile and missile component and support equipment.
- 306 SECOND DESTINATION TRANSPORTATION: The round trip cost of transporting missiles, missile support equipment and reparable secondary items to the depot maintenance facilities and back to the operational unit, Naval Weapons stations or Service stock points; and the one-way cost of transporting repair parts from Service stock points to depot and below depot maintenance and supply activities.
- 307 PERSONNEL SUPPORT AND TRAINING: The variable cost of training, moving and providing health care for personnel needed to replace missile handling, inspection, below-depot maintenance and installation support personnel.
 - 307.1 Individual Training: 2/ The variable cost of recruit and technical (skill) training including:
 - o the pay of personnel in training who will replace missile handling and inspection, below-depot maintenance and installation support personnel
 - o the cost of their instruction
 - o the pay of instructor personnel
 - 307.2 Health Care: The variable cost of providing medical support to: missile handling and inspection, below-depot maintenance, installation personnel and training

pipeline personnel including:

- o the pay of medical personnel who provide this support
- o the cost of medical materiel

- 307.3 Personnel Activities: The costs incident to the PCS of: missile handling and inspection and below-depot maintenance personnel either individually or as an organized unit; installation personnel; and training pipeline personnel.
- 307.4 Personnel Support: The cost of supplies, services and equipment needed to support instructor, trainee and medical personnel. Examples of these costs are administrative supply, expendable office equipment and machines, and custodial services.
- 308 SUSTAINING INVESTMENTS: The cost of procuring spares, modification kits and materiel and ground support equipment for missile support.
- 308.1 Replenishment Spares: The cost of procuring missile spares and repair parts which are normally repaired and returned to stock. In addition, this cost can include procurement of stock levels that are not provided by initial spares procurement.
- 308.2 Modification Kits and Materiel: The cost of modifying missiles, missile support equipment, and training equipment that are in the operating inventory to make them safe for continued operation, to enable them to perform their missions and to improve reliability or reduce maintenance cost. Includes spares.
- 308.3 Replenishment Ground Support Equipment: The cost of procuring missile ground servicing equipment, maintenance and repair shop equipment, instruments and laboratory test equipment, and other equipment items including spares. Covers such items as ground generators and test sets for missile checkout. These equipment demands are generated by a need to: (1) replace peculiar support equipment bought using procurement funds; (2) obtain common off-the-shelf ground equipment that are needed to support missile operations as production aircraft arrive in the operating inventory; and (3) replenish common ground equipment that is no longer useable.

NOTES:

- 1/ A deployed aircraft unit consists of any unit operating in the field for combat, training or other operating purpose. To determine the O&S cost of the air-launched tactical missile under consideration, a typical deployed aircraft unit operation will be assumed. The O&S estimate will reflect the portion of the aircraft unit O&S cost that is missile related as well as the variable O&S cost of training at National Test Ranges.
- 2/ Factory training provided by contractors at their facilities to qualify an initial cadre of skilled personnel to: (1) operate and maintain a missile system when operationally deployed or (2) initially man Services missile system-related training courses, is paid for by both investment and O&M funds. Contractor instructor pay and the cost of instruction at contractor facilities is categorized as an investment cost; the pay of Service military and civilian personnel attending the factory schools is an O&S cost.

APPENDIX B
NAVY AIR-LAUNCHED MISSILE
O&S COST ELEMENT STRUCTURE

TABLE B-1

**NAVY OPERATING AND SUPPORT COST ELEMENT
STRUCTURE FOR AIR-LAUNCHED MISSILES**

	<u>Appropriation</u>	<u>Budget Category¹</u>	<u>Claimant²</u>	<u>Accounting Visibility³</u>
o <u>Operations</u>				
1. Handling and Inspection	MPN		CINC	A
2. Operational Training	MPN, O&MN		CINC, NAVAIR NAVSEA	A, D/A
o <u>Below-Depot Maintenance</u>				
3. Organizational/ALMD Maint.	MPN, O&MN		OP-01, NAVAIR	A
4. Intermediate Maintenance	O&MN	7/A/2	NAVAIR 4104	D
o <u>Installations Support</u>				
5. Base Operating Support	MPN, O&MN		CINC, NAVAIR NAVSEA	I
o <u>Depot Maintenance</u>				
6. Depot Maintenance	O&MN	7/A/2	NAVAIR 4104	D
o <u>Depot Supply and Technical Support</u>				
7. Supply Depot Ops	O&MN	7/E/1,2,3	NAVSUP	A/I
8. Technical Support				
Fleet Support	O&MN	7/A/2	NAVAIR 4104	D
Engineering Support	O&MN	7/A/2	NAVAIR 4104	D
Quality Evaluation	O&MN	7/A/4	NAVAIR 4104	D
Program Management	MPN, O&MN		NAVAIR	D/A
o <u>Second Destination Transportation</u>				
9. Transportation	O&MN	7/E/3	NAVSUP	A
10. Receipt, Segregation, Storage & Issue	O&MN, MPN	7/B/1	NAVSEA 04J	A
o <u>Personnel Support Training</u>				
11. Replacement Training	MPN, O&MN	8/A/2,2/E	CNET	A/I
12. Health Care	MPN, O&MN		BUMED	I
13. Personnel Support	MPN, O&MN		OP-01	I
o <u>Sustaining Investments</u>				
14. Replenishment Spares	WPN	2	NAVAIR 412	D/A
15. Modifications	WPN, O&MN	2,7/A/2	NAVAIR 412	D
16. Replenishment Ground Support Equipment	WPN		NAVAIR 4104	A

¹7/A/2 refers to Budget Program 7, Budget Activity A, Budget Project 2

²Claimants: CINC - the Commander-in-chiefs of the Naval Fleets
 NAVAIR - Naval Air Systems Command
 NAVSEA - Naval Sea Systems Command
 CNET - Chief of Naval Education and Training
 NAVSUP - Naval Supply Systems Command
 BUMED - Bureau of Medicine and Surgery
 OP-01 - DCNO Manpower Personnel and Training

³D = Direct Cost with individual weapon system visibility
 A = Direct Cost without individual weapon system visibility; must be allocated
 I = Indirect

DEFINITIONS

1. Handling and Inspection - The cost of personnel and consumable material needed to perform the following tasks: removing missiles from storage; missile inspection; missile assembly; transporting missiles to the aircraft; missile uploading; and missile check out and arming prior to a captive flight or firing. This cost also includes a similar series of tasks to download the missile and return it to storage if not fired. These tasks are performed at the Naval Air Station and aboard a carrier.
2. Operational Training - The cost of operational firings consisting of range cost, instrumentation, target presentation, recovery, and any other support. This would also include any shipboard or NAS familiarization training for missile operational personnel.
3. Organizational/AIMD Maintenance - This is the cost of labor and consumable material required at the Squadron and CVA/NAS Intermediate Maintenance Activity to perform maintenance on the missile or its associated equipment. The concept of the all-up-round theoretically precludes this type of maintenance, but nevertheless, there are some maintenance functions which are performed when the missile fails a pre-flight test. Also organizational and intermediate level maintenance is required on missile-dedicated aircraft equipment.
4. Intermediate Maintenance - The cost of personnel, consumable material and station overhead required to perform missile and missile component checkout and repair at the Naval Weapons Stations. This includes such procedures as the functional test of the assembled round, fault isolation of the failed rounds, removal and replacement of faulty major subgroups such as the flight control group of the guidance section, and fault confirmation and other support from the Weapons Quality Evaluation Center (WQEC).

5. Base Operating Support - The cost of installation personnel and material necessary to directly support missile handling and inspection and below-depot maintenance personnel. Examples of installation functions which directly support the unit include food services, custodial services, supply, motor pool, payroll, ADP and communication operations. It also includes a proportional share of work center costs such as real property maintenance, etc. This cost may be estimated by utilizing the Base Operating Support factors in the Navy Resource Model (NARM) Program Factors Manual.
6. Depot Maintenance - The cost of manpower, material, and overhead needed to perform missile and missile component and support equipment maintenance at Navy and contractor repair facilities.
7. Supply Depot Operations - The cost of manpower and material needed to buy, store, package, manage and control supplies, spares and repair parts used in operating and maintaining missiles and missile components and support equipment.
8. Technical Support - The cost of a number of technically oriented programs usually centrally managed by the Systems Command or one of its field activities.
 - Fleet Support - The cost of on-site technical personnel (usually Navy civilians) who provide technical advice and assistance in the operation and maintenance of the weapon system.
 - Engineering Support - The cost of engineering support is comprised of two major areas - maintenance engineering and design engineering. The former consists of efforts at the various Naval engineering activities in support of the missile maintenance systems and is funded through NAVAIR 410, while the latter is concerned with engineering for the missile itself, i.e., the design and configuration matters, and is funded by the NAVAIR 510.

Quality Evaluation - The cost of the Navy Weapons Quality Program whose purpose is to monitor the status and condition of the air-launched weapon stockpile. Principal activities include maintenance/reliability/performance trend analysis, calibration of test equipment, destructive testing of missile sections, certification of NWS failures and related data collection and analysis.

Program Management - The O&S cost of missile-specific project management both at the SYSCOM level and below.

9. Transportation - This is the cost of second destination transportation which primarily consists of transporting the missiles or missile sections from the Naval Weapons Stations to the depots and back.
10. Receipt, Segregation, Storage & Issue - Personnel and material costs of on-loadings and off-loadings of ships, movement and handling of missiles to and from storage depots and NWS's, and storage.
11. Replacement Training - The variable cost of recruit and technical training including:
 - o the pay of personnel in training who will replace missile operations, below-depot maintenance and installation support personnel;
 - o the cost of their instruction; and
 - o the pay of instructor personnel.

This cost may be estimated utilizing the factors in the Navy Resource Model (NARM) Program Factors Manual.

12. Health Care - The variable cost of providing medical support to: missile operation, below-depot maintenance and installation personnel; and training pipeline personnel including:
 - o the pay of medical personnel who provide this support; and
 - o the cost of medical material.

This cost may be estimated utilizing the factors in the Navy Resource Model (NARM) Program Factors Manual.

13. Personnel Support - The costs incident to the PCS of: missile operation and below-depot maintenance personnel either individually or as an organized unit; installation personnel; and training pipeline personnel. This cost may be estimated utilizing the factors in the Navy Resource Model (NARM) Program Factors Manual.
14. Replenishment Spares - The cost of procuring missile spares and repair parts which are normally repaired and returned to stock. In addition, this cost can include procurement of stock levels that are not provided by initial spares procurement.
15. Modifications - The cost of modifying missiles, missile support equipment, and training equipment that are in the operating inventory to make them safe for continued operation, to enable them to perform their missions and to improve reliability or reduce maintenance cost. This includes labor, modification kits, and consumable material.
16. Replenishment Ground Support Equipment - The cost of procuring missile ground servicing equipment, maintenance and repair shop equipment, instruments and laboratory test equipment, and other equipment items. These equipment demands are generated by a need to: (1) replace peculiar support equipment bought using procurement funds; (2) obtain common off-the-shelf ground equipment that are needed to support missile operations; and (3) replenish common ground equipment that is no longer useable.

APPENDIX C

TABLE C-1 (cont'd.)
HANDLING AND INSPECTION DETAILED WORKSHEETS FROM AIM-7F MEA
MAINTENANCE TASK ANALYSIS
WORKSHEET IV

Document Control Number
80000

1 Item Nomenclature _____ Part No. _____ FSN _____ NAVORD Drawing Number _____
2 Next Higher Assembly _____ Part No. _____
3 WBS _____ Drawing No. _____ EIC _____ APL/CID _____

MAINTENANCE IDENTIFICATION CODE FOR BLOCK 4									
Maintenance Level		1st Character	Maintenance Requirement		2nd Character	3rd Character			
O - Organizational		D - Depot	A - Trouble Shoot	C - Repair	E - Test	G - Lubricate	I - Adjust	K - Service	
I - Intermediate			B - Remove & Replace	D - Inspect	F - Disassemble/Assemble	H - Calibrate	J - Align	L - Other	
Maintenance Frequency		3rd Character	C - Overhaul Cycle		4th Character	Reference			
D - Daily		S - Semiannually	U - Unscheduled			Refer to Appendix B, Worksheet IV, Block 4, for Explanation			
W - Weekly		A - Annually							
4 Maintenance Identification Code		5 Maintenance Requirement	6 Facility Requirement	7 Training Req't Code	8 Task Data Code	9 Maint. Req't. Freq Per Year			
10 Step No.	11 Sequential Maintenance Task	12 Repair Part Line Item Code	13 Consumable Materials	14 Quantity Used	15 Support Equip.	16 Logistics Support Personnel Resource Requirements			
						a Task Time	b No. of Men	c Rating and Skill Level	d NEC
1.0.3 (Cont.)	b. Transport assembled missile from flight ready storage area to loading area.				Aero 21A Weapons Skid with Aero 67A Adapter or Aero 16B Missile Skid with Aero 42A Adapter	10.0	2	MT(B)	
	c. Transport missile within storage area.				Aero 16B Missile Skid	2.0	2	MT(B)	
	d. Transport missiles in container/cradle from supply source to storage area aboard CVA (CNU-166/E container or MK 12 Mod 0 cradle).				Aero 21A Weapons Skid with Aero 58A and Aero 91A Adapters.				

HANDLING AND INSPECTION DETAILED WORKSHEETS FROM AIM-7F MEA

MAINTENANCE TASK ANALYSIS

WORKSHEET IV

Document Control Number
80000

Item Nomenclature	Part No.	FSN	NAVORD Drawing Number
AT-7F Missile	917AS101		

Part No.	2 Next Higher Assembly	AT4-7F Missile System
1	2 Next Higher Assembly	AT4-7F Missile System

3 WBS	001-001/000	Drawing No. 917AS101	EIC	APL/CID
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[illegible]

TABLE C-1 (cont'd.)

HANDLING AND INSPECTION DETAILED WORKSHEETS FROM AIM-7F MEA

MAINTENANCE TASK ANALYSIS

WORKSHEET IV

Document Control Number

80000

1 Item Nomenclature AIM-7F Missile Part No. 917AS101 FSN NAVORD Drawing Number

2 Next Higher Assembly AIM-7F Missile System Part No.

3 WBS 001-001/000 Drawing No. 917AS101 EIC APL/CID

MAINTENANCE IDENTIFICATION CODE FOR BLOCK 4

Maintenance Level		1st Character	Maintenance Requirement	2nd Character	Reference			
O - Organizational	I - Intermediate	D - Depot	A - Trouble Shoot B - Remove & Replace	C - Repair D - Inspect	E - Test F - Disassemble/Assemble	G - Lubricate H - Calibrate	I - Adjust J - Align	K - Service L - Other
Maintenance Frequency	D - Daily W - Weekly	M - Monthly Q - Quarterly	S - Semiannually A - Annually	C - Overhaul Cycle U - Unscheduled	4th Character Refer to Appendix B, Worksheet IV, Block 4, for Explanation			
4 Maintenance Identification Code	5 Maintenance Requirement	6 Facility Requirement	7 Training Req't Code	8 Task Data Code	9 Maint. Req't. Freq Per Year			
OEU2	Loaded Missile Functional Test		B	E				
10 Step No.	11 Sequential Maintenance Task	12 Repair Part Line Item Code	13 Consumable Materials	14 Quantity Used	15 Support Equip.	16 Logistic Support Personnel Resource Requirements		
1.5	Functional test of loaded missile (Missile on aircraft test (MDAT)) a. Perform tune check of missile to assure that the missile rear receiver will tune to the aircraft radar frequency and lock-on a simulated target doppler signal. b. If missile fails test, download, then upload on known good station. c. Repeat functional test. d. If missile fails test the second time, download and upload a serviceable missile.				Delivery Aircraft Avionics	a Task Time	b No. of Men	c Rating and Skill Level
						6.00	1	AD (I)
						3.00	4 1	AD (B) AD (I)
						6.00	1	AD (I)
						3.00	4 1	AD (B) AD (I)

TABLE C-1 (cont'd.)

HANDLING AND INSPECTION DETAILED WORKSHEETS FROM AIM-7F MEA

MAINTENANCE TASK ANALYSIS

WORKSHEET IV

Document Control Number

80000

1 Item Nomenclature AIM-7F Missile Part No. 917AS101 FSN NAVORD Drawing Number

2 Next Higher Assembly AIM-7F Missile System Part No.

3 WBS 001-001/000 Drawing No. 917AS101 EIC APL/CID

MAINTENANCE IDENTIFICATION CODE FOR BLOCK 4											
Maintenance Level O - Organizational I - Intermediate	1st Character D - Depot	Maintenance Requirement A - Trouble Shoot B - Remove & Replace	2nd Character C - Repair D - Inspect E - Test F - Disassemble/Assemble	3rd Character S - Semiannually A - Annually	Maintenance Requirement C - Overhaul Cycle U - Unscheduled	4th Character Reference Refer to Appendix B, Worksheet IV, Block 4, for Explanation	5 Maintenance Requirement Faulty or Damaged Missile Repair	6 Facility Requirement Missile Assembly or Flightline Operating Space	7 Training Req Code C	8 Task Data Code D	9 Maint. Reqmt. Freq Per Year
4 Maintenance Identification Code OCU2											
10 Step No.	11 Sequential Maintenance Task	12 Repair Part Line Item Code	13 Consumable Materials	14 Quantity Used	15 Support Equip.	16 Logistic Support Personnel Resource Requirements	a Task Time	b No. of Men	c Rating and Skill Level	d NEC	
1.6	Repair faulty or damaged missile						10.00 (AVG)	1	Mc (B)		
1.6.1	Missiles determined to be faulty as a result of inspection or MOAT test shall be repaired by replacing the component or components determined to be faulty.										
1.6.2	Repair at the organizational level is restricted to the following: a. Touchup of illegible identification markings and color bands. b. Replacement of damaged or missing protective covers, screws, or bolts.						10.00	1	Mc (B)		
							10.00	1	Mc (B)		

TABLE C-1 (cont'd.)

HANDLING AND INSPECTION DETAILED WORKSHEETS FROM AIM-7F MEA

MAINTENANCE TASK ANALYSIS

WORKSHEET IV

DOCUMENT CONTROL NUMBER

80000

1 Item Nomenclature AIM-7F Missile Part No. 917AS101 FSN NAVORD Drawing Number

2 Next Higher Assembly AIM-7F Missile System Part No.

3 WBS 001-001/000 Drawing No. 917AS101 EIC APL/CID

MAINTENANCE IDENTIFICATION CODE FOR BLOCK 4										
Maintenance Level 1st Character		Maintenance Requirement		2nd Character		3rd Character		4th Character		
O - Organizational	I - Intermediate	A - Trouble Shoot	C - Repair	E - Test	G - Lubricate	I - Adjust	K - Service			
	D - Depot	B - Remove & Replace	D - Inspect	F - Disassemble/Assemble	H - Calibrate	J - Align	L - Other			
Maintenance Frequency	3rd Character	Maintenance Requirement		Facility Requirement		Training		Task Data		Maint. Reqmt. Freq Per Year
D - Daily	M - Monthly	C - Overhaul Cycle		Missile Repair Facility		Prqst Code		Code		
W - Weekly	Q - Quarterly	U - Unscheduled				C		D		
4 Maintenance Identification Code	5 Maintenance Requirement	Returned Missile Functional Test								
10 Step No.	11 Sequential Maintenance Task	12 Repair Part Line Item Code	13 Consumable Materials	14 Quantity Used	15 Support Equip.	16 Logistic Support Personnel Resource Requirements				
						a Task Time	b No. of Men	c Rating and Skill Level	d NEC	
1.8	Functionally test the returned missile. All missiles returned to NWS/AFMOT because of failure to pass the MOAT shall be subjected to a functional test in accordance with the parameters contained in AD-1298.				AN/DPH-21 Test Set (Modified) For AIM-7F Missiles)	120.0	2	Mt (I)		
1.8.1	Disposition of missiles failing test a. If the missile fails to meet the requirements of operational checkout tests, the faulty section shall be removed and replaced with another section of the same type. In the event that either the target seeker or flight control group is					10.00	2	Mt (B)		

TABLE C-2
 NAVAL WEAPONS STATION MAINTENANCE COSTS
 FROM FY77 CONGRESSIONAL BUDGET SUBMISSION
 NAVAL AIR SYSTEMS COMMAND
 (FY79\$)

	<u>FY75</u>	<u>FY76</u>	<u>FY77</u>	<u>FY78</u>
<u>SIDEWINDER</u>				
Quantity	1,750	1,823	551	3,591
Unit Cost	732	711	677	704
Total Cost (\$K)	1,282	1,296	373	2,527
<u>SPARROW (Air)</u>				
Quantity	2,730	3,066	887	4,016
Unit Cost	1,191	1,155	1,100	1,144
Total Cost (\$K)	3,250	3,542	965	4,592
<u>WALLEYE I</u>				
Quantity	983	218	213	310
Unit Cost	799	775	741	763
Total Cost (\$K)	785	169	158	237
<u>SHRIKE</u>				
Quantity	1,813	838	14	303
Unit Cost	609	591	612	585
Total Cost (\$K)	1,105	496	8	178
<u>STANDARD ARM</u>				
Quantity	298	34	22	206
Unit Cost	2,951	2,843	2,722	2,830
Total Cost (\$K)	878	97	60	583
<u>PHOENIX</u>				
Quantity	200	7	3	20
Unit Cost	2,517	2,448	2,304	2,221
Total Cost (\$K)	503	17	7	44

TABLE C-3
 NAVAL WEAPONS STATION MAINTENANCE COSTS
 FROM FY78 OSD BUDGET SUBMISSION, NAVAL AIR SYSTEMS COMMAND
 (FY79\$)

	<u>FY76</u>	<u>FYTQ</u>	<u>FY77</u>	<u>FY78</u>
<u>SIDEWINDER</u>				
Quantity	2,434	351	1,945	2,186
Unit Cost	908	942	909	919
Total Cost (\$K)	2,212	331	1,769	2,009
<u>SPARROW (Air)</u>				
Quantity	2,103	396	1,973	1,286
Unit Cost	1,275	1,408	1,273	1,282
Total Cost (\$K)	2,683	558	2,513	1,648
<u>WALLEYE I</u>				
Quantity	782	124	658	1,157
Unit Cost	760	780	732	806
Total Cost (\$K)	595	99	482	933
<u>WALLEYE II</u>				
Quantity	103	25	436	611
Unit Cost	1,141	1,336	1,212	1,228
Total Cost (\$K)	118	33	528	750
<u>SHRIKE</u>				
Quantity	696	396	1,261	1,392
Unit Cost	775	702	827	833
Total Cost (\$K)	540	278	1,042	1,160
<u>STANDARD ARM</u>				
Quantity	35	12	149	292
Unit Cost	2,728	2,688	2,706	2,726
Total Cost (\$K)	95	32	403	796
<u>PHOENIX</u>				
Quantity	216	—	470	793
Unit Cost	1,496	—	1,502	1,516
Total Cost (\$K)	323	—	706	1,202

TABLE C-4
 NAVAL WEAPONS STATION MAINTENANCE COSTS
 FROM FY79 CONGRESSIONAL BUDGET SUBMISSION
 NAVAL AIR SYSTEMS COMMAND
 (FY79\$)

	<u>FY77</u>	<u>FY78</u>	<u>FY79</u>
<u>SIDEWINDER</u>			
Quantity	1,439	1,626	1,632
Unit Cost	1,032	1,029	1,002
Total Cost (\$K)	1,485	1,672	1,635
<u>SPARROW (Air)</u>			
Quantity	1,152	1,286	1,433
Unit Cost	1,917	1,821	1,773
Total Cost (\$K)	2,207	2,343	2,541
<u>WALLEYE I</u>			
Quantity	717	833	577
Unit Cost	1,227	1,132	1,102
Total Cost (\$K)	879	943	636
<u>WALLEYE II</u>			
Quantity	83	294	258
Unit Cost	1,026	1,521	1,481
Total Cost (\$K)	85	448	382
<u>SHRIKE</u>			
Quantity	808	781	964
Unit Cost	1,318	1,397	1,360
Total Cost (\$K)	1,065	1,091	1,311
<u>STANDARD ARM</u>			
Quantity	17	85	75
Unit Cost	19,428	3,529	3,436
Total Cost (\$K)	330	300	258
<u>PHOENIX</u>			
Quantity	339	678	967
Unit Cost	1,647	1,594	1,552
Total Cost (\$K)	558	1,081	1,501

TABLE C-5
NAVAL WEAPONS STATION MAINTENANCE - UNIT COSTS
(FY79\$)

	<u>FY77</u>	<u>FY78</u>	<u>FY79</u>	<u>AVG.</u>
SIDEWINDER	1,032	1,029	1,002	1,069
SPARROW	1,917	1,821	1,773	1,837
WALLEYE I	1,227	1,132	1,102	1,154
WALLEYE II	1,026	1,521	1,481	1,343
SHRIKE	1,318	1,397	1,360	1,358
STANDARD ARM	19,428*	3,529	3,436	3,483
PHOENIX	2,150	1,594	1,552	1,765

*Not included in average

TABLE C-6
MISSILE MAINTENANCE DUE DATES

<u>Missile</u>	<u>Test Internal Prior to Issue¹</u>	<u>G&C Cert. Time²</u>
SIDEWINDER AIM-9D/G/H	180 days	24 mos.
SPARROW III AIM-7E/E2/E3/E4	180 days	24 mos.
STANDARD ARM AGM-78/B/C/D	24 mos.	24 mos.
WALLEYE MK-1 MOD 9/2 MK-1 MOD 6/7 MK-2 MOD 0 MK-13 MOD 0 MK-5 MOD 4	210 days (prior serv.) 420 days (no serv.)	36 mos.
SHRIKE AGM-45A/B	27 mos.	36 mos.
PHOENIX AIM-54	60 days	14 mos.
BULLPUP		36 mos.

Source: ¹Performance Monitoring System, 2 August 1977

²Performance Monitoring System, 2 September 77

TABLE C-7
INTERMEDIATE REJECT RATIO DATA

<u>Missile</u>	<u>Number processed</u>	<u>Number Rejected</u>	<u>Ratio</u>
SIDEWINDER			
AIM-9G	1,127	349	0.31
AIM-9H	2,608	117	0.04
AIM-9YH	<u>6</u>	<u>3</u>	<u>0.50</u>
Total	3,741	469	0.13
SPARROW			
AIM-7E2	1,167	414	0.35
AIM-7E3	606	152	0.25
AIM-7E4	562	181	0.32
AIM-7E5	<u>187</u>	<u>0</u>	<u>0</u>
Total	2,522	747	0.30
WALLEYE I	798	53	0.07
WALLEYE II	184	20	0.09
WALLEYE II ERDL	135	8	0.06
SHRIKE			
AGM-45A/3	376	96	0.26
AGM-45A/3A	124	23	0.19
AGM-45A/4	111	21	0.19
AGM-45A/6	135	23	0.17
AGM-45A/7	187	38	0.20
AGM-45B/3	1	0	0
AGM-45B/6	<u>171</u>	<u>37</u>	<u>0.22</u>
Total	1,105	238	0.22
STANDARD ARM	56	17	0.30
PHOENIX	761	184	0.24
HARPOON	216	40	0.19

TABLE C-9

FY77 BUDGET BACK-UP DATA FOR A/L MISSILE MAINTENANCE

Exhibit OP-5
(Dollars in Thousands)Department of the Navy
Naval Air Systems Command
Operation and Maintenance, Navy
FY 1977 Congressional SubmissionBudget Activity 7: Central Supply and Maintenance
Budget Program A: Air Systems Technical Support
Budget Project (2): Air Launched Weapons Ework & Maintenance

FY 1976 ESTIMATE									
DEPOT MAINTENANCE									
	MARF NORFOLK		Qty	MARF ALAMEDA		Qty	NOS INDIAN HEAD		COMMERCIAL Qty \$
	\$	Man/Hours		\$	Man/Hours		Qty	\$	
Sidewinder IC(IR) AIM-9D/G/H	195	377	17,160	-	-	-	299	160	-
Sparrow III	434	1,100	38,192	287	727	27,483	537	421	14 38
Bullpup	-	-	-	-	-	-	-	-	-
Walleye	-	-	-	-	-	-	-	-	-
Shrike	-	-	-	320	423	13,974	69	54	229 846
Standard Arm	-	-	-	-	-	-	-	-	-
Phoenix	-	-	-	20	173	-	-	-	61 548
	-	-	-	-	-	-	-	-	21 174
Total	\$1,477	55,352		\$1,323	41,457		\$ 635		\$1,606

January 1976

TABLE C-11

FY77 BUDGET BACK-UP DATA FOR A/L MISSILE MAINTENANCE

(Dollars in Thousands)

Department of the Navy
Naval Air Systems Command
Operation and Maintenance, Navy
FY 1977 Congressional Submission

Budget Activity 7: Central Supply and Maintenance
Budget Program A: Air Systems Technical Support
Budget Project (2): Air Launched Weapons Rework & Maintenance

	FY 1977 ESTIMATE						NOS INDIAN HEAD QTY	COMMERCIAL QTY	\$
	DEPOT MAINTENANCE								
	BZZZ NORFOLK		MAPP ALAMEDA						
	QTY	\$	Man/Hours	QTY	\$	Man/Hours			
Sidevinder IC(IR) AIR-90/G/H	1,504	3,119	97,835	-	-	-	589	335	-
Sparrow III	975	2,631	85,829	656	1,771	62,313	703	586	244
Bullpup	-	-	-	626	423	23,606	-	-	-
Walleye	-	-	-	-	-	-	-	-	-
Shrike	-	-	-	25	34	949	25	21	142
Standard Arm	-	-	-	-	-	-	-	-	-
Phoenix	-	-	-	21	193	-	-	-	92
Total	\$5,750	183,664		\$2,421	86,868		-	\$942	\$2,289

January 1976

TABLE C-12

FY78 BUDGET BACK-UP DATA FOR A/L MISSILE MAINTENANCE

Department of the Navy
Naval Air Systems Command
Operations, Navy
(Dollars in Thousands)

Exhibit OF-5
FY 1978 OSD/ONR

Budget Activity: 7

78017M Maintenance Support Activities

Budget Project: Air-Launched Weapons Rework & Maintenance

DEPOT MAINTENANCE

FY 1976 Actual

	NAVF NORFOLK				NAVF ALABAMA				INDIAN HEAD				NAVF/COMMERICAL				OTHERS		TOTAL
	Unit		Man/		Unit		Man/		Unit		Man/		Unit		REWORK				
	Qty	Cost (\$)	Total Cost	Hours	Qty	Cost (\$)	Total Cost	Hours	Qty	Cost (\$)	Total Cost	Hours	Qty	Cost (\$)	Total Cost				
Sidewinder	568	1,801	1,023	36,920	-	-	-	-	452	562	254	-	-	-	-	-	311	1,588	
Sparrow (AIR)	337	2,463	830	32,015	519	2,533	1,315	49,305	193	782	151	-	-	-	-	-	529	2,825	
Sparrow (AIR) (Mint)	137	620	85	3,014	57	565	32	1,824	-	-	-	-	-	-	-	-	-	117	
Sparrow (APD)	127	2,481	315	12,065	89	2,680	239	8,455	-	-	-	-	-	-	-	-	85	639	
Sparrow (APD) (Mint)	6	618	4	132	-	-	-	-	-	-	-	-	-	-	-	-	-	4	
Sparrow (LPD)	10	2,505	25	950	-	-	-	-	-	-	-	-	-	-	-	-	-	25	
Bullpup	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	48	
Valley I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	48	
Valley II	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	558	
Shrike	-	-	-	-	112	1,107	124	4,368	60	800	48	-	-	-	-	-	9	9	
Standard Arm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	47	
Phoenix C	-	-	-	-	49	4,078	200	7,350	-	-	221	-	17	11,111	189	-	41	451	
Phoenix G	-	-	-	-	26	2,752	71	2,600	-	-	-	-	-	-	-	-	-	-	
TOTAL	-	-	\$2,282	85,096	-	-	\$1,981	73,902	-	-	\$674	-	-	-	-	-	38	309	
																	\$1,263	\$6,792	

Other rework includes rework of warheads, TDD's, wings and fins, antennas, containers, training material maintenance, repair of repairables, and HMM-1 operations.

30 September 1976

TABLE C-13
FY78 BUDGET BACK-UP DATA FOR A/L MISSILE MAINTENANCE

Department of the Navy
Naval Air Systems Command
Operations, Navy
(Dollars in Thousands)

Exhibit OP-5
FY 1978 OSD/CSS

Budget Activity: 7

78017N Maintenance Support Activities

Budget Project: Air-Launched Weapons Revort & Maintenance

DEPOT MAINTENANCE

FY 1979 Estimate

	MARF NORFOLK				MARF ALAMEDA				INDIAN HEAD				NAF/COMMERCIAL				OTHERS		TOTAL
	Unit				Unit				Unit				Unit				REWORK		
	Qty	Cost (\$)	Total Cost	Man/Hours	Qty	Cost (\$)	Total Cost	Man/Hours	Qty	Cost (\$)	Total Cost	Qty	Cost (\$)	Total Cost	Qty	Cost (\$)			
Sidewinder	200	1,018	364	12,400	-	-	-	-	36	534	18	-	-	-	-	-	62	445	
Sparrow (Air)	73	2,404	175	5,060	88	2,734	241	7,920	78	797	62	-	-	-	-	-	108	506	
Sparrow (Air)(Mini)	28	493	14	360	25	583	14	625	-	-	-	-	-	-	-	-	-	28	
Sparrow (RPD)	5	2,449	12	400	55	2,734	150	5,225	-	-	-	-	-	-	-	-	27	189	
Sparrow (RPD)(Mini)	6	515	3	126	3	583	2	75	-	-	-	-	-	-	-	-	-	5	
Sparrow (RPD)	25	2,515	63	2,000	-	-	-	-	-	-	-	-	-	-	-	-	-	63	
Bullpup	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	59	59	
Valleye I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	56	56	
Valleye II	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3	
Strike - G	-	-	-	-	36	855	31	1,080	60	797	48	-	-	-	-	-	21	113	
Strike - C	-	-	-	-	42	301	13	336	-	-	-	-	-	-	-	-	-	-	
Standard Arm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Phoenix - G	-	-	-	-	5	4,182	21	750	9	1,945	18	-	-	-	-	-	21	39	
Phoenix - C	-	-	-	-	5	2,821	14	40	-	-	-	-	-	-	-	-	27	62	
TOTAL			\$631	21,376			\$486	16,051			\$147			\$0			\$304	\$1,648	

*Other rework includes rework of warheads, TDD's, wings and fins, antennas, containers, training material maintenance, repair of repairables, and W88U-1 operations.

30 September 1976

TABLE C-14
FY78 BUDGET BACK-UP DATA FOR A/L MISSILE MAINTENANCE

Department of the Navy
Naval Air Systems Command
Operations, Navy
(Dollars in Thousands)

Exhibit OP-5
FY 1978 OSD/OWB

Budget Activity: 7

78017N Maintenance Support Activities

Budget Project: Air-Launched Weapons Rework & Maintenance

DEPOT MAINTENANCE

FY 1977 Estimate

	NAVFAC NORFOLK				NAVFAC ALAMEDA				NOS				COMMERCIAL				OTHER*		TOTAL
	Unit		Man/		Unit		Man/		Unit		Unit		Unit		REWORK				
	Qty	Cost (\$)	Total Cost	Hours	Qty	Cost (\$)	Total Cost	Hours	Qty	Cost (\$)	Total Cost	Qty	Cost (\$)	Total Cost	Qty	Cost (\$)			
Sidewinder	479	1,923	921	29,698	-	-	-	-	300	596	179	-	-	-	-	249	1,349		
Sparrow (AIR)	412	2,729	1,125	32,880	327	2,932	958	30,575	382	833	318	-	29	5,000	145	270	2,816		
Sparrow (AIR) (Mini)	-	-	-	-	10	760	8	250	-	-	-	-	-	-	-	-	8		
Sparrow (MRB)	30	2,464	74	2,400	41	3,036	124	3,895	-	-	-	-	-	-	-	67	265		
Sparrow (MRB) (Mini)	23	539	12	483	27	760	21	675	-	-	-	-	-	-	-	-	33		
Sparrow (MRB)	12	2,464	30	960	-	-	-	-	-	-	-	-	-	-	-	-	30		
Sparrow (MRB) (Mini)	22	539	12	462	-	-	-	-	-	-	-	-	-	-	-	-	12		
Bullpup	-	-	-	-	-	-	-	-	400	600	240	-	-	-	-	-	42		
Valley I	-	-	-	-	-	-	-	-	-	-	-	-	194	1,572	305	64	369		
Valley II	-	-	-	-	-	-	-	-	-	-	-	-	58	1,940	113	34	147		
Shrike G	-	-	-	-	333	904	301	5,920	190	852	162	-	-	-	-	87	550		
Shrike C	-	-	-	-	333	310	103	2,664	-	-	-	-	-	-	-	-	103		
Standard Arm (Regrain)	-	-	-	-	-	-	-	-	88	9,600	845	-	37	11,884	440	87	1,372		
Standard Arm (Repair)	-	-	-	-	-	-	-	-	23	2,042	47	-	-	-	-	-	47		
Phoenix G	-	-	-	-	171	5,820	995	25,650	-	-	-	-	-	-	-	149	1,144		
Phoenix C	-	-	-	-	87	3,554	309	6,960	-	-	-	-	-	-	-	-	309		
Harpoon	-	-	-	-	-	-	-	-	-	-	-	-	21	3,675	77	4	81		
TOTAL	-	-	\$2,174	66,883	-	-	\$2,819	80,659	-	-	\$1,791	-	-	-	-	\$1,053	\$8,917		

Other rework includes \$75K for 68 COG (Repair of Repairables); balance includes rework of warheads, TDO's, wings & fins, antennas, canisters, trailing material maintenance, and MMU-1 operations.

30 September 1976

TABLE C-15
FY78 BUDGET BACK-UP DATA FOR A/L MISSILE MAINTENANCE

Department of the Navy
Naval Air Systems Command
Operations, Navy
(Dollars in Thousands)

Exhibit OP-5
FY 1978 OSD/OMB

Budget Activity: 7
76017M Maintenance Support Activities
Budget Project: Air-Launched Weapons Rework & Maintenance

DEPOT MAINTENANCE

FY 1978 Estimate

	NAVF NORFOLK				NAVF ALABAMA				INDIAN HEAD				NAVF/COMMERCIAL		OTHER+REMARK	TOTAL
	Unit		Total Cost	Man/Hours	Unit		Total Cost	Man/Hours	Unit		Total Cost	Qty	Unit			
	Qty	Cost (\$)			Qty	Cost (\$)			Qty	Cost (\$)			Cost (\$)	Qty		
Sidevinder	522	2,034	1,062	32,364	-	-	-	-	300	644	193	-	-	-	272	1,527
Sparrow (AIR)	505	2,059	1,444	40,400	287	3,199	918	25,830	337	900	303	76	5,275	401	344	3,410
Sparrow (AIR) (Mini)	10	562	6	200	10	862	9	250	-	-	-	-	-	-	-	15
Sparrow (IPD)	66	2,681	177	5,280	65	3,313	215	6,175	-	-	-	-	-	-	71	463
Sparrow (IPD) (Mini)	14	588	8	294	14	862	12	350	-	-	-	-	-	-	-	20
Sparrow (IPD)	16	2,681	43	1,280	16	3,313	53	1,570	-	-	-	-	-	-	48	144
Sparrow (IPD) (Mini)	39	588	23	819	2	862	2	50	-	-	-	-	-	-	-	25
Bullpup	-	-	-	-	-	-	-	-	400	648	259	-	-	-	-	53
Valleye I	-	-	-	-	-	-	-	-	-	-	-	111	1,658	184	66	312
Valleye II	-	-	-	-	-	-	-	-	-	-	-	64	1,940	124	32	250
Shrike G	-	-	-	-	306	1,030	315	9,180	-	-	-	-	-	-	-	156
Shrike C	-	-	-	-	306	307	118	2,448	240	920	221	-	-	-	116	770
Standard Arm (Regrain)	-	-	-	-	-	-	-	-	110	10,368	1,140	-	-	-	-	1,140
Standard Arm (Repair)	-	-	-	-	-	-	-	-	31	2,205	68	84	12,538	1,053	102	1,223
Phoenix C	-	-	-	-	296	6,339	1,876	44,400	-	-	-	-	-	-	-	-
Phoenix C	-	-	-	-	146	3,887	568	11,680	64	2,470	156	-	-	-	233	2,833
Harpoon	-	-	-	-	-	-	-	-	17	3,499	59	69	3,826	264	43	366
TOTAL			\$2,763	80,637		\$4,086	101,883				\$2,399		\$2,026	\$1,380		\$12,654

*Other rework includes \$752K for 6E CCG (Repair of Repairables); balance includes rework of warheads, TDO's, wings & fins, antennas, containers, training material maintenance, and M88U-1 operations.

30 September 1976

TABLE C-16
FY79 BUDGET BACK-UP DATA FOR A/L MISSILE MAINTENANCE

Budget Justification Material
FY 1979 Congressional

DEPARTMENT OF THE NAVY
Naval Air Systems Command
Operations, Navy

(Dollars in Thousands)

Budget Activity 7: Central Supply and Maintenance
78017N Maintenance Support Activities
Budget Project: Air-Launched Weapons Rework and Maintenance

DEPOT MAINTENANCE

FY 1977 ACTUAL

	NAVF NORFOLK				NAVF ALAMEDA				INDIAN HEAD				NAVF/COMMERCIAL				OTHER 1/ WORK	TOTAL
	Qty	Unit Cost (\$)	Total Cost	Man/Hours	Qty	Unit Cost (\$)	Total Cost	Man/Hours	Qty	Unit Cost (\$)	Total Cost	Qty	Unit Cost (\$)	Total Cost				
Skeiwinder	480	1,861	893	29,760	-	-	-	-	225	555	125	-	-	-	-	524	1,542	
Sparrow (AIR)	586	2,686	1,574	46,880	353	2,775	980	31,182	192	852	164	-	-	-	-	192	2,910	
Sparrow (AIR) (Mint)	28	549	15	588	-	-	-	-	-	-	-	-	-	-	-	-	15	
Sparrow (BPD)	11	2,674	30	880	18	2,959	53	1,710	-	-	-	-	-	-	-	51	134	
Sparrow (BPD) (Mint)	25	539	14	525	38	697	26	950	-	-	-	-	-	-	-	-	40	
Sparrow (IPD)	22	2,652	58	1,760	2	2,930	6	190	-	-	-	-	-	-	-	-	64	
Sparrow (IPD) (Mint)	6	539	3	126	-	-	-	-	-	-	-	-	-	-	-	-	3	
Bullpup	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	115	
Valleye I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	115	115	
Valleye II	-	-	-	-	-	-	-	-	-	-	-	297	1,637	486 1/2	156	642	642	
Shrike	-	-	-	-	-	-	-	-	-	-	-	9	2,689	24 1/2	35	59	59	
Shrike G	-	-	-	-	-	-	-	-	65	865	56	-	-	-	-	20	76	
Shrike C	-	-	-	-	196	763	150	5,880	-	-	-	-	-	-	-	80	230	
Standard Arm	-	-	-	-	311	294	91	4,043	-	-	-	-	-	-	-	-	91	
Phoenix G	-	-	-	-	-	-	-	-	19	10,267	195	-	-	-	-	-	253	532
Phoenix C	-	-	-	-	99	6,429	636	14,850	-	-	-	-	-	-	-	150	786	
TOTAL	1,158	-	\$2,587	-	1,066	3,771	\$2,127	3,920	501	-	\$540	313	-	-	\$594	\$1,576	\$7,424	

1/ Includes \$81K for NAFT and \$405K COMMERCIAL
2/ NAFT.

3/ Other Rework includes \$600K for 6E COG (repair of non-trailers); balance includes rework of Warheads, TDD's, Wings and Fins, Antennas, 4/ Containers, Training Material Maintenance, 1981-1 Operations and Test set Maintenance

TABLE C-17

FY79 BUDGET BACK-UP DATA FOR A/L MISSILE MAINTENANCE

Budget Justification Material
FY 1979 CongressionalDEPARTMENT OF THE NAVY
Naval Air Systems Command
Operations, Navy

(Dollars in Thousands)

Budget Activity 7: Central Supply and Maintenance
78017N Maintenance Support Activities
Budget Project: Air-Launched Weapons Rework and Maintenance

DEMOT MAINTENANCE

FY 1978 Estimate

	MARF NORFOLK				MARF ALAMEDA				NOS INDIAN HEAD				NAFT/ COMMERCIAL				OTHER ^a REWORK	TOTAL
	Unit		Total Cost	Man/ Hours	Unit		Total Cost	Man/ Hours	Unit		Total Cost	Unit	Total Cost					
	Qty	Cost (\$)			Qty	Cost (\$)			Qty	Cost (\$)				Qty	Cost (\$)			
Sidewinder	505	2,013	1,017	31,310	-	-	-	-	300	631	189	-	-	-	-	321	1,527	
Sparrow (AIR)	469	2,953	1,385	37,250	287	3,061	679	25,830	311	882	274	-	65	4,295	279	296	3,113	
Sparrow (AIR) (HML)	10	546	5	200	10	819	8	250	-	-	-	-	-	-	-	-	13	
Sparrow (BPD)	66	2,953	195	5,280	45	3,058	138	4,275	-	-	-	-	-	-	-	67	400	
Sparrow (BPD) (HML)	25	571	14	525	10	819	8	250	-	-	-	-	-	-	-	-	22	
Sparrow (IPD)	12	2,953	35	960	12	3,058	37	1,140	-	-	-	-	-	-	-	38	110	
Sparrow (IPD) (HML)	10	571	6	210	-	-	-	-	-	-	-	-	-	-	-	-	6	
Walleye I	-	-	-	-	-	-	-	-	-	-	-	-	257	1,677	430	54	484	
Walleye II	-	-	-	-	-	-	-	-	-	-	-	-	26	2,055	53	28	81	
Shrike G	-	-	-	-	193	829	160	5,790	-	-	-	-	-	-	-	-	-	
Shrike C	-	-	-	-	193	364	70	1,544	240	902	216	-	-	-	-	88	534	
Standard Arm	-	-	-	-	-	-	-	-	88	10,166	895	-	25	15,599	384	-	1,279	
Phoenix G	-	-	-	-	232	6,035	1,400	34,800	-	-	-	-	-	-	-	-	-	
Phoenix C	-	-	-	-	116	3,685	421	9,280	64	2,357	151	-	-	-	-	191	2,169	
Harpoon	-	-	-	-	-	-	-	-	17	3,394	58	-	25	3,892	97	-	155	
TOTAL	-	-	\$2,657	75,735	-	-	\$3,127	83,159	-	-	\$1,783	-	-	-	\$1,243	\$1,083	\$9,893	

^aOther Rework includes \$752K for 6E COG (Repair of Repairables) and \$96K for 4E COG (Container Repair).

TABLE C-18

FY79 BUDGET BACK-UP DATA FOR A/L MISSILE MAINTENANCE

Budget Justification Material
FY 1979 CongressionalDEPARTMENT OF THE NAVY
Naval Air Systems Command
Operations, Navy

(Dollars in Thousands)

Budget Activity 7: Central Supply and Maintenance
78017N Maintenance Support Activities

Budget Project: Air-Launched Weapons Rework and Maintenance

DEPOT MAINTENANCE
FY 1979 Estimate

	NAVF NORFOLK				NAVY ALABAMA				NOS INDIAN HEAD				NAVY/COMMERCIAL				OTHER ^a REWORK	TOTAL
	Qty	Unit Cost (\$)	Total Cost	Man/ Hours	Qty	Unit Cost (\$)	Total Cost	Man/ Hours	Qty	Unit Cost (\$)	Total Cost	Man/ Hours	Qty	Unit Cost (\$)	Total Cost	Man/ Hours		
Sidewinder	587	2,082	1,222	36,394	-	-	-	-	300	653	196	-	98	2,082	204	-	-	-
Sparrow (AIR)	533	3,055	1,628	47,640	263	1,165	832	30,789	397	912	362	-	118	4,632	547	-	1,049	2,671
Sparrow (AIR) (Mint)	48	656	22	960	35	847	30	875	-	-	-	-	-	-	-	-	294	3,663
Sparrow (APU)	80	3,055	244	6,400	56	3,162	176	5,320	-	-	-	-	-	-	-	-	-	57
Sparrow (APU) (Mint)	10	591	6	210	5	842	4	125	-	-	-	-	-	-	-	-	162	582
Sparrow (TPU)	71	3,055	216	5,680	49	3,162	156	4,655	-	-	-	-	-	-	-	-	-	10
Sparrow (TPU) (Mint)	8	591	5	168	4	847	3	100	-	-	-	-	-	-	-	-	122	494
Valley I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8
Valley II	-	-	-	-	-	-	-	-	-	-	-	-	267	1,723	460	-	54	514
Strike C	-	-	-	-	381	858	327	11,430	-	-	-	-	106	2,114	225	-	28	253
Strike C	-	-	-	-	393	377	148	3,144	212	933	198	-	-	-	-	-	88	761
Standard Arm (Regrain)	-	-	-	-	-	-	-	-	79	12,176	961	-	-	-	-	-	-	961
Standard Arm (Repair)	-	-	-	-	-	-	-	-	22	2,237	50	-	31	13,599	491	-	48	589
Phoenix C	-	-	-	-	275	6,244	1,717	41,250	-	-	-	-	-	-	-	-	-	-
Phoenix C	-	-	-	-	178	3,812	526	11,040	101	2,438	246	-	-	-	-	-	-	-
Harpoon	-	-	-	-	-	-	-	-	18	3,511	64	-	50	4,004	200	-	190	2,679
TOTAL	-	-	\$3,368	92,652	-	-	\$3,919	108,728	-	-	\$2,077	-	-	-	\$2,127	-	\$2,035	\$13,506

^aOther rework includes \$1,499 for 6E COC (Repair of Repairables) and \$258K for 4E COC (Container Repair); balance includes 1984-1 operations and test set maintenance.

January 1978

TABLE C-19
 DEPOT MAINTENANCE COST PER UNIT GUIDANCE
 AND CONTROL (\$79)
 (i.e. Total Depot Cost ÷ G&C Qty.)

<u>Missile</u>	<u>FY75</u>	<u>FY76</u>	<u>FY70</u>	<u>FY77</u>	<u>FY78</u>	<u>FY79</u>	<u>Avg.</u>
<u>SIDEWINDER</u>							
77 Submission	2,397	3,370	2,584	2,617			2,742
78 Submission		3,422	2,563	3,208	3,053		3,062
79 Submission				3,659	3,217	3,899	3,592
<u>SPARROW (Air)</u>							
77 Submission	3,154	3,807	3,377	3,429			3,442
78 Submission		3,430	3,305	4,134	4,028		3,724
79 Submission				3,530	4,381	4,008	3,973
<u>WALLEYE I</u>							
77 Submission ¹	2,517	4,521	4,279	4,483			3,950
78 Submission		2,530	—	2,166	2,351		2,349
79 Submission				2,462	—	1,925	2,194
<u>WALLEYE II</u>							
77 Submission	—	—	—	—			—
78 Submission		—	—	2,887	2,545		2,716
79 Submission				7,467 ²	3,314	2,387	2,851
<u>SHRIKE</u>							
77 Submission	1,605	1,824	1,548	2,506			1,871
78 Submission		2,393	1,559	2,233	2,626		2,230
79 Submission				892	1,471	983	1,115
<u>STANDARD ARM</u>							
77 Submission	11,352	10,995	10,668	10,869			10,971
78 Submission		32,838	—	43,680	29,364		35,294
79 Submission					54,426 ²	15,347	15,347
<u>PHOENIX</u>							
77 Submission	13,444	10,359	10,176	10,251			11,058
78 Submission		5,043	7,143	9,678	9,991		7,964
79 Submission				7,473	6,631	6,487	6,863
<u>HARPOON</u>							
77 Submission							
78 Submission		—	—	4,393	5,537		4,965
79 Submission				—	6,596	5,280	5,938

¹WALLEYE I and II combined.

²Not included in average.

TABLE C- 20

UNIT COSTS TO REPAIR GUIDANCE AND CONTROL SECTIONS AT THE DEPOT (\$79)

<u>Missile</u>	<u>FY75</u>	<u>FY76</u>	<u>FYTQ</u>	<u>FY77</u>	<u>FY78</u>	<u>FY79</u>	<u>Avg.</u>
<u>SIDEWINDER</u>							
77 Submission	2,123	2,366	2,272	2,362			2,280
78 Submission		2,204	2,094	2,190	2,164		2,163
79 Submission				2,120	2,141	2,082	2,114
<u>SPARROW</u>							
77 Submission	2,820	3,102	2,962	3,074			2,990
78 Submission		3,067	2,770	3,211	3,172		3,055
79 Submission				3,098	3,186	3,090	3,125
<u>WALLEYE I</u>							
77 Submission	—	—	—	—			—
78 Submission		1,827	—	1,790	1,764*		1,794
79 Submission				1,864	1,784	1,723	1,790
<u>WALLEYE II</u>							
77 Submission	—	—	—	—			—
78 Submission		—	—	2,210	2,064*		2,137
79 Submission				3,063	2,186	2,114	2,454
<u>SHIRKE</u>							
77 Submission	1,456	1,618	1,509	1,549			1,533
78 Submission		1,355	1,408	1,382	1,505		1,413
79 Submission				1,400	1,268	1,247	1,305
<u>STANDARD ARM</u>							
77 Submission	—	—	—	—			—
78 Submission		13,600	—	—	13,338		13,469
79 Submission				13,535	—	—	13,535
<u>PHOENIX</u>							
77 Submission	—	10,588	10,291	10,467			10,449
78 Submission		6,769	8,064	8,685	8,784		8,076
79 Submission				9,445	8,378	8,156	8,660
<u>HARPOON</u>							
77 Submission	—	—	—	—			—
78 Submission		—	—	—	4,070		4,070
79 Submission					4,140	4,004	4,072

*Commercial

TABLE C-21
DEPOT LEVEL MANHOURS FOR REPAIR OF
GUIDANCE AND CONTROL SECTIONS

<u>Missile</u>	<u>FY75</u>	<u>FY76</u>	<u>FY77</u>	<u>FY78</u>	<u>FY79</u>
<u>SIDEWINDER</u>					
77 Submission	65	88	65		
78 Submission		65	62	62	
79 Submission			62	62	62
<u>SPARROW</u>					
77 Submission	91	91	74	91	
78 Submission		95	85	86	84
79 Submission			85	83	92
<u>SHRIKE</u>					
77 Submission	38	44	39	38	
78 Submission		39	38	38	
79 Submission			43	38	38
<u>PHOENIX</u>					
77 Submission					
78 Submission		250	230	230	
79 Submission			230	230	230

DEPOT LABOR RATES FOR MISSILE REPAIR
(then year dollars)

<u>Fiscal Year</u>	<u>Rate</u>	<u>Source</u>
73	\$17.75	Industrial Performance Summary for Naval Air Rework Facilities, 1973
74	20.54	Industrial Performance Summary for Naval Air Rework Facilities, 1974
75	23.25	Industrial Performance Summary for Naval Air Rework Facilities, 1975
76	29.62	Industrial Performance Summary for Naval Air Rework Facilities, 1976
77	32.45	FY79 Congressional Budget Submission
78	36.40	FY79 Congressional Budget Submission
79	36.12	FY79 Congressional Budget Submission

TABLE C-22
DEPOT MAINTENANCE COSTS
(OTHER THAN REPAIR OF GUIDANCE & CONTROL)
(79\$)

<u>Rocket Motor Repair</u> (Unit Cost)	<u>FY75¹</u>	<u>FY76²</u>	<u>FYTQ³</u>	<u>FY77⁴</u>	<u>FY78⁵</u>	<u>FY79⁶</u>
SIDEWINDER	707	688	615	632	671	653
SPARROW	763	957	918	970	938	912
SHRIKE	1,060	979	918	985	960	933
STANDARD ARM				11,694	10,815	10,010
PHOENIX					2,507	2,438
HARPOON					3,611	3,511

<u>NAFI/Commercial Repair</u> (Unit Cost)						
SIDEWINDER						2,082
SPARROW					4,569	4,632
WALLEYE	2,513	1,827		1,899	1,816	1,836
STANDARD ARM	11,289	13,600		13,535	16,595	15,599
PHOENIX	13,449					
HARPOON					4,140	4,004

<u>Other Depot Costs</u> (per G&C unit)						
SIDEWINDER		671	357	1,243	677	1,787
SPARROW		617	582	232	417	369
WALLEYE		743		711	309	220
SHRIKE		514	310	221	485	114
STANDARD ARM		2,952		41,164	—	1,548
PHOENIX		621	3,111	1,155	876	460

¹ FY77 Congressional Budget Submission

^{2,3} FY78 OSD Budget Submission

^{4,5,6} FY79 Congressional Budget Submission

TABLE C-23

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FLEET SUPPORT COSTS
(Thous. of 79\$)

<u>Missile</u>	<u>FY75</u>	<u>FY76</u>	<u>FY70</u>	<u>FY77</u>	<u>FY78</u>	<u>FY79</u>	<u>Avg.</u>
<u>SIDEWINDER</u>							
77 Submission	265	268					267
78 Submission		262	62	295	350		298
79 Submission				292	311	217	273
<u>SPARROW</u>							
77 Submission	252	258					255
78 Submission		252	62	334	293		290
79 Submission				336	240	251	276
<u>WALLEYE I</u>							
77 Submission*	132	208					170
78 Submission		179	36	123	150		150
79 Submission				85	113	88	95
<u>WALLEYE II</u>							
77 Submission							
78 Submission		29	13	50	100		59
79 Submission				33	76	66	58
<u>SHRIKE</u>							
77 Submission	212	245					229
78 Submission		245	56	228	254		241
79 Submission				154	178	188	173
<u>STANDARD ARM</u>							
77 Submission	146	208					177
78 Submission		208	50	205	200		204
79 Submission				33	62	125	73
<u>PHOENIX</u>							
77 Submission	159	171					165
78 Submission		171	40	171	246		193
79 Submission				199	151	156	169
<u>HARPOON</u>							
77 Submission	—						
78 Submission		—	—	89	250		170
79 Submission				57	79	156	97

*Data is for WALLEYE I and II.

TABLE C-24
ENGINEERING SUPPORT (NAVAIR 410)
(Thous. of FY79\$)

<u>Missile</u>	<u>FY75</u>	<u>FY76</u>	<u>FYTQ</u>	<u>FY77</u>	<u>FY78</u>	<u>FY79</u>	<u>Avg.</u>
<u>SIDEWINDER</u>							
77 Submission	493	574					534
78 Submission		574	120	708	871		699
79 Submission				791	662	941	798
<u>SPARROW</u>							
77 Submission	497	802					650
78 Submission		802	168	896	916		856
79 Submission				871	777	961	870
<u>WALLEYE I</u>							
77 Submission*	397	367					382
78 Submission		316	60	203	203		241
79 Submission				261	295	229	262
<u>WALLEYE II</u>							
77 Submission							
78 Submission		51	21	82	138		90
79 Submission				132	216	177	175
<u>SHRIKE</u>							
77 Submission	405	441					423
78 Submission		441	123	243	288		337
79 Submission				313	650	350	438
<u>STANDARD ARM</u>							
77 Submission	503	367					435
78 Submission		367	82	344	420		373
79 Submission				442	494	425	454
<u>PHOENIX</u>							
77 Submission	559	343					451
78 Submission		343	81	319	455		369
79 Submission				405	793	492	563
<u>HARPOON</u>							
77 Submission							
78 Submission		—	—	178	567		373
79 Submission				184	793	613	530

*WALLEYE I and II combined.

TABLE C-25
ENGINEERING SUPPORT (NAVAIR 510)
(Thous. of FY79\$)

<u>Missile</u>	<u>FY76 & TQ</u>	<u>FY77</u>	<u>FY78</u>	<u>FY79</u>	<u>Avg.</u>
<u>SIDEWINDER</u>					
77 Actual	817	574	677	686	689
78 Plan	—	1,704	1,353	1,272	
<u>SPARROW</u>					
77 Actual	256	227	273	675	388
78 Plan		523	564	1,464	
<u>WALLEYE I</u>					
77 Actual	56	60	99	69	71
78 Plan		184	196	163	
<u>WALLEYE II</u>					
77 Actual	28	31	50	35	36
78 Plan		92	98	81	
<u>SHRIKE</u>					
77 Actual	210	186	279	195	218
78 Plan		534	556	455	
<u>STANDARD ARM</u>					
77 Actual	319	277	245	263	276
78 Plan		540	609	549	
<u>PHOENIX</u>					
77 Actual	52	67	151	680	238
78 Plan		239	124	1,107	
<u>HARPOON</u>					
77 Actual				154	154
78 Plan				250	

TABLE C-26
QUALITY EVALUATION COSTS
(79\$ in thous.)

<u>Missile</u>	<u>FY77</u>	<u>FY78</u>	<u>FY79</u>	<u>Avg.</u>
SIDEWINDER	465	449	480	465
SPARROW	365	425	399	397
WALLEYE I	184	200	142	175
WALLEYE II	92	100	70	88
SHRIKE	303	332	337	324
STANDARD ARM	102	47	119	90
PHOENIX	168	246	390	268
HARPOON	201	268	315	262

TABLE C-27

Second Destination Transportation

Navy Claimant CMM (NAVSUP)

Department of the Navy
Operations, NavyExhibit OP-5
FY 1977 Congressional Submission

JUSTIFICATION BY SUBPROGRAM

Program Element: 78010M (Second Destination Transportation - Summary)

		FY 1975 Actual Workload (\$000)	FY 1976 Estimate Workload (\$000)	FY 1976 Estimate Workload (\$000)	FY 1977 Estimate Workload (\$000)	FY 1977 Estimate Workload (\$000)
1. Transportation						
a. POC		58,636	76,886	19,221	69,293	
Channel Traffic Cargo	(S/Tons)	44,450	50,477	12,619	51,083	62,425
Overseas Mail	(S/Tons)	3,825	4,943	1,160	4,696	4,568
Special Assignment		4,828	2,240	560	2,267	2,267
b. ISC		61,575	65,084	16,471	60,060	
Ocean Cargo	(H/Tons)	40,770	712,202	178,050	720,748	43,166
Bay Exchange Cargo	(H/Tons)	13,473	274,535	16,351	4,088	13,776
Overseas Mail	(H/Tons)	787	14,541	800	200	745
Per Diem		3,417	2,048	512	2,073	2,073
POL (Japan)		3,128	-0-	-0-	-0-	-0-
c. Other		66,015	78,985	19,746	79,748	
Commercial Overseas Mail		20,723	21,812	5,453	22,014	
Inland Commercial Cargo	(S/Tons)	33,921	403,955	100,989	408,802	42,266 ←
QUICKTRANS		11,371	15,408	3,852	15,406	15,406
Subtotal - Transportation		186,226	221,755	55,438	209,101	
2. Terminal Services	(H/Tons)	12,109	1,097,472	271,868	1,100,522	12,047
Total		198,335	233,659	58,414	221,149	
Available Funding		198,335	218,865	53,503	207,099	
Deficiency		-0-	14,794	4,911	14,059	

TABLE C-28
REPRESENTATIVE TRANSPORTATION RATES

Origin: NWS, Concord, CA
Destination: NOS, Indianhead, MD
Distance: 2,793 miles

All costs are \$ per hundred weight unless labeled otherwise

	TL	— LTL —		Dual Driver Protective Service (per shipment)
		DRUM	MIXED	
Class A Explosive				
Rate	10.32	36.71	64.78	516.22
Min weight	38,000	2,500	5,000	
Class B Explosive				
Rate	10.32	36.71	64.78	516.22
Min weight	38,000	2,500	5,000	
Class C Explosive				
Rate	10.32	36.71	64.78	516.22
Min weight	38,000	2,500	5,000	
INERT				
Rate	11.61		27.09	
Min weight	24,000		min. chg.	
LTL under 500 lbs			18.50 ¹	
LTL 500-2,000			18.06	
LTL 2,000-5,000			16.77	
LTL 5,000-10,000			16.26	
LTL 10,000-15,000			14.13	
LTL over 15,000			12.57	

¹Plus Single Shipment Charge of \$2.93 per cwt.

Key

- TL - Truck load
LTL - Less than truck load
DRUM - Components are shipped inside a dromedary unit and therefore isolated from the rest of the shipment. Each dromedary used has a 5000 lb. maximum.
MIXED - Components are not isolated from rest of shipment.

Metric Conversion: 1 mile - 1.6093k ; 1 lb. = 0.453kg.

TABLE C-29
REPRESENTATIVE TRANSPORTATION RATES

Origin: NWS Concord, CA
Destination: NWS Earle, NJ
Distance: 2,901 miles

All costs are \$ per hundred
weight unless labeled otherwise

	TL	LTL		Dual Driver Protective Service (per shipment)	
		DROM	MIXED		
Class A Explosive					
Rate	16.23	14.75	14.73	38.63	68.34
Min weight	30,000	38,000	42,000	2,500	5,000
545.90					
Class B Explosive					
Rate	10.85			38.63	68.34
Min weight	38,000			2,500	5,000
545.90					
Class C Explosive					
Rate	10.85			38.63	63.34
Min weight	38,000			2,500	5,000
545.90					
INERT					
Rate	10.93				29.07 ¹
Min weight	24,000				min. chg.
LTL under 500 lbs					18.50
LTL 500-2,000					18.06
LTL 2,000-5,000					16.77
LTL 5,000-10,000					16.26
LTL 10,000-15,000					14.13
LTL over 15,000					12.57

¹Plus Single Shipment Charge of \$2.93 per cwt.

Key

TL - Truck Load

LTL - Less than truck load

DROM - Components are shipped inside a dromedary unit and therefore isolated from the rest of the shipment. Each dromedary used has a 5000 lb. maximum.

MIXED - Components are not isolated from rest of shipment.

Metric Conversion: 1 mile = 1.6093km; 1 lb. = 0.453kg.

TABLE C-30
REPRESENTATIVE TRANSPORTATION RATES

Origin: NARM, Alameda, CA
Destination: NWSC, Crane, IN
Distance: 2,255 miles

All costs are \$ per hundred weight unless labeled otherwise

	TL			LTL		Dual Driver Protective Service (per shipment)
				DRUM	MIXED	
Class A Explosive						
Rate	5.44	5.37	5.34	32.18		442.02
Min weight	38,000	40,000	42,000	2,500		
Class B Explosive						
Rate	5.44	5.37	5.34	32.18		442.02
Min weight	38,000	40,000	42,000	2,500		
Class C Explosive						
Rate	5.44	5.37	5.34	32.18		442.02
Min weight	38,000	40,000	42,000	2,500		
INERT						
Rate	4.79	4.47	4.27		24.76 ¹	
Min weight	30,000	38,000	40,000		min.chg.	
LTL under 500 lbs					15.71	
LTL 500-2,000					15.34	
LTL 2,000-5,000					14.16	
LTL over 5,000					13.93	

¹Plus Single Ship Charge of \$2.93 per cwt.

Key

TL - Truck load

LTL - Less than truck load

DRUM - Components are shipped inside a dromedary unit and therefore isolated from the rest of the shipment. Each dromedary used has a 5000 lb. maximum.

MIXED - Components are not isolated from rest of shipment.

Metric Conversion: 1 mile = 1.6093km; 1 lb. = 0.453kg.

TABLE C-31
REPRESENTATIVE TRANSPORTATION RATES

Origin: NARF, Alameda, CA
Destination: NWS, Yorktown, VA
Distance: 2,903 miles

All costs are \$ per hundred
weight unless labeled otherwise

	TL			LTL		Dual Driver Protective Service (per shipment)
				DROM	MIXED	
Class A Explosive						
Rate	16.23	14.75	14.73	38.63	68.34	545.90
Min weight	30,000	38,000	42,000	2,500	5,000	
Class B Explosive						
Rate		10.85		38.63	68.34	545.90
Min weight		38,000		2,500	5,000	
Class C Explosive						
Rate		10.85		38.63	68.34	545.90
Min weight		38,000		2,500	5,000	
INERT						
Rate	8.77	7.01	6.07		26.43 ¹	
Min weight	20,000	30,000	30,000		min. chg.	
LTL under 500 lbs					15.93	
LTL 500-2,000					15.59	
LTL 2,000-5,000					14.41	
LTL 5,000-10,000					14.11	
LTL 10,000-15,000					12.14	
LTL over 15,000					10.82	

¹Plus Single Ship Charge of \$2.93 per cwt.

Key

- TL - Truck load
LTL - Less than truck load
DROM - Components are shipped inside a dromedary unit and therefore isolated from the rest of the shipment. Each dromedary used has a 5000 lb. maximum.
MIXED - Components are not isolated from rest of shipment.

Metric Conversion: 1 mile = 1.6093km; 1 lb. = 0.453kg.

TABLE C-32
REPRESENTATIVE TRANSPORTATION RATES

Origin: NARM, Alameda, CA
Destination: NAS, Miramar, CA
Distance: 506 miles

All costs are \$ per hundred
weight unless labled otherwise

	TL		LTL		Signature ¹ Security Service (per shipment)
	<u>Min. Wt.</u>	<u>Rate</u>	<u>Weight</u>	<u>Rate</u>	
Class A Explosive	36,000	1.60	2500-5000	295.00	14.00
	40,000	1.50	5000-10000	340.00	14.00
Class B Explosive	36,000	1.60	2500-5000	295.00	14.00
	40,000	1.50	5000-10000	340.00	14.00
Class C Explosive	35,000	1.60	2500-5000	295.00	14.00
	40,000	1.50	5000-10000	340.00	14.00
INERT					
	10,000	1.15	0-100	10.85	
	15,000	1.02	100-150	15.45	
	20,000	0.87	150-200	18.10	
	30,000	0.67	200-250	21.10	
	40,000	0.51	250-300	24.00	
	45,000	0.47	300-400	28.60	
			400-500	33.45	
	50,000	0.46	over 500	37.90	

¹For dual driver protective service add \$16.13 per hr. Minimum charge is \$85.00.

Key

TL - Truck load

LTL - Less than truck load

DROM - Components are shipped inside a dromedary unit and therefore isolated from the rest of the shipment. Each dromedary used has a 5000 lb. maximum.

MIXED - Components are not isolated from rest of shipment.

Metric Conversion: 1 mile = 1.6093km; 1 lb. = 0.453kg.

TABLE C-33
REPRESENTATIVE TRANSPORTATION RATES

Origin: NARF, Alameda, CA
Destination: NWS, Seal Beach, CA
Distance: 417 miles

All costs are \$ per hundred
weight unless labled otherwise

	TL		LTL		Signature ¹ Security Service (per shipment)
	Min. Wt.	Rate	Weight (per shipment)	Rate	
Class A Explosive	40,000	0.95	2500-5000	270.00	14.00
			5000-10000	320.00	14.00
Class B Explosive	40,000	0.95	2500-5000	270.00	14.00
			5000-10000	320.00	14.00
Class C Explosive	40,000	0.95	25000-5000	270.00	14.00
			5000-10000	320.00	14.00
INERT	10,000	1.10	0-100	9.45	
	15,000	0.86	100-150	12.65	
	20,000	0.76	150-200	14.65	
	30,000	0.55	200-250	17.20	
	40,000	0.43	250-300	19.15	
	45,000	0.40	300-400	22.75	
	50,000	0.38	400-500	25.65	
			over 500	28.45	

¹For dual driver protective service add \$16.13 per hr. Minimum charge is \$85.00.

Key

TL - Truck Load

LTL - Less than truck load

DRUM - Components are shipped inside a dromedary unit and therefore isolated from the rest of the shipment. Each dromedary used has a 5000 lb. maximum.

MIXED - Components are not isolated from rest of shipment.

Metric Conversion: 1 mile = 1.6093km; 1 lb. = 0.453kg.

TABLE C-34
REPRESENTATIVE TRANSPORTATION RATES

Origin: NWS, Charleston, SC
Destination: NARF, Alameda, CA
Distance: 2,763 miles

All costs are \$ per hundred weight unless labled otherwise

	TL			LTL		Dual Driver Protective Service (per shipment)
				DROM	MIXED	
Class A Explosive						
Rate	15.40	14.00	13.98	36.71	64.28	516.22
Min. Weight	30,000	38,000	42,000	2500	5000	
Class B Explosive						
Rate		10.85		36.71	64.28	516.22
Min. Weight		28,000		2500	5000	
Class C Explosive						
Rate		10.85		36.71	64.28	516.22
Min. Weight		38,000		2500	5000	
INERT						
Rate	9.79	7.48	6.18 ¹		28.13	
Min. Weight	20,000	30,000	40,000		Min.chg.	
LTL under 500 lbs.					17.38 ²	
LTL 500 - 1000					17.00	
LTL 1000 - 2000					16.51	
LTL 2000 - 5000					15.76	
LTL 5000 - 9999					15.45	

¹Overflow rate of \$13.25 wigh 15,000 minimum applies when first truck is loaded.

²Plus Single Shipment Charge of \$293 per cwt.

Key

TL - Truck Load

LTL - Less than truck load

DROM - Components are shipped inside a dromedary unit and therefore isolated from the rest of the shipment. Each dromedary used has a 5000 lb. maximum.

MIXED - Components are not isolated from rest of shipment.

Metric Conversion: 1 mile = 1.6093km; 1 lb. = 0.453kg.

TABLE C-35
REPRESENTATIVE TRANSPORTATION RATES

Origin: NWS Yorktown, VA
Destination: NARF, Alameda, CA
Distance: 2,903 miles

All costs are \$ per hundred
weight unless labeled otherwise

	TL		LTL		Dual Driver Protective Service (per shipment)	
			DROM	MIXED		
Class A Explosive						
Rate	16.23	14.75	14.73	38.63	68.34	545.90
Min. Weight	30,000	38,000	42,000	2500	5000	
Class B Explosive						
Rate		10.85		38.63	68.34	545.90
Min. Weight		38,000		2500	5000	
Class C Explosive						
Rate		10.85		38.63	68.34	545.90
Min. Weight		38,000		2500	5000	
INERT						
Rate		— 1			26.43 ²	
Min. Weight					Min.chg.	
LTL under 500 lbs					15.93	
LTL 500 - 2000					15.59	
LTL 2000 - 5000					14.41	
LTL 5000 - 10,000					14.11	
LTL 10,000 - 15,000					12.14	
LTL over 15,000					10.82	

¹TL rate quoted was higher than LTL, therefore use LTL.

²Plus Single Shipment Charge of \$2.93 per cwt.

Key

TL - Truck Load

LTL - Less than truck load

DROM - Components are shipped inside a dromedary unit and therefore isolated from the rest of the shipment. Each dromedary used has a 5000 lb. maximum.

MIXED - Components are not isolated from rest of shipment.

Metric Conversion: 1 mile = 1.6093km; 1 lb. = 0.453kg.

TABLE C-36
REPRESENTATIVE TRANSPORTATION RATES

Origin: NWS, Yorktown, VA
Destination: NOS, Indianhead, MD
Distance: 170 miles

All costs as \$ per hundred
weight unless labeled otherwise

	TL		LTL				Dual Driver Protective Service (per shipment)
	<u>Min. Wt.</u>	<u>Rate</u>	DROM		MIXED		
			<u>Wt.</u>	<u>Rate</u>	<u>Wt.</u>	<u>Rate</u>	
Class A Explosive	16,000	3.63	2500	12.18	5000	10.89	143.10
	22,000	2.86					
	30,000	2.42					
	38,000	2.20					
	42,000	2.18					
	40,000	1.46 ¹					
Class B Explosive	16,000	3.63	2500	12.18	5000	10.89	143.10
	22,000	2.86					
	30,000	2.42					
	38,000	1.98					
	40,000	1.46 ¹					
Class C Explosive	16,000	3.63	2500	12.18	5000	10.89	143.10
	22,000	2.86					
	30,000	2.42					
	38,000	1.98					
INERT	14,000	3.92			Min.chg.	30.67 ²	
	16,000	3.60			under 500	16.03	
	23,000	3.44			500 - 1000	13.42	
	31,000	2.69			1000 - 2000	10.51	
	35,000	2.43			2000 - 5000	8.90	
	40,000	2.15			5000 - 9999	6.44	

¹To Naval Propellant Plant only

²Per shipment

Key

TL - Truck Load

LTL - Less than truck load

DROM - Components are shipped inside a dromedary unit and therefore isolated from the rest of the shipment. Each dromedary used has a 5000 lb. maximum.

MIXED - Components are not isolated from rest of shipment.

Metric Conversion: 1 mile = 1.6093km; 1 lb. = 0.453kg.

TABLE C-37
REPRESENTATIVE TRANSPORTATION RATES

Origin: NWS Yorktown, VA
Destination: NWS, Charleston, SC
Distance: 432 miles

All costs are \$ per hundred
weight unless labeled otherwise

	TL		LTL				Dual Driver Protective Service (per shipment)
	Min. Wt.	Rate	DROM		MIXED		
			Wt.	Rate	Wt.	Rate	
Class A Explosive	16,000	5.61	2500	14.94	5000	16.55	143.10
	22,000	4.42					
	30,000	3.74					
	38,000	3.40					
	42,000	3.38					
Class B Explosive	16,000	5.61	2500	14.94	5000	16.55	143.10
	22,000	4.42					
	30,000	3.74					
	38,000	3.06					
Class C Explosive	16,000	5.61	2500	14.94	5000	16.55	143.10
	22,000	4.42					
	30,000	3.74					
	38,000	3.06					
INERT	20,000	1.38				9.00 ¹	
	30,000	1.25				Under 1000 4.64 ²	
						1000 - 2000 3.41	
						2000 - 5000 2.99	
						5000 - 10,000 2.10	

¹Minimum Charge

²Plus Single Shipment Charge of \$3.24 per cwt.

Key

TL - Truck load

LTL - Less than truck load

DROM - Components are shipped inside a dromedary unit and therefore isolated from the rest of the shipment. Each dromedary used has a 5000 lb. maximum.

MIXED - Components are not isolated from rest of shipment.

Metric Conversion: 1 mile = 1.6093km; 1 lb. = 0.453kg.

TABLE C-38
 RECEIPT, SEGREGATION, STORAGE & ISSUE COSTS
 FOR AIR-LAUNCHED MISSILES
 (FY79\$ in Thous.)

<u>Cost</u>	<u>NTS Keyport</u>	<u>NWS Charleston</u>	<u>NWS Concord</u>	<u>NWS Earle</u>	<u>NWS SealBeach</u>	<u>NWS Yorktown</u>	<u>Total</u>
<u>FY78 2nd Half</u>							
Off-loads	0.3	0.2	37.1	0.3	11.8	50.8	100.5
On-loads	0.1	0.3	69.3	0.4	30.0	96.4	196.5
Receipts	1.3	0.3	31.4	0.1	23.2	41.6	97.9
Issues	<u>0.9</u>	<u>0.6</u>	<u>48.7</u>	<u>1.0</u>	<u>111.7</u>	<u>178.0</u>	<u>340.9</u>
TOTAL	2.6	1.4	186.5	1.8	176.7	366.8	735.8
<u>FY79</u>							
Off-loads	0.4	0.6	91.8	0.7	22.3	104.6	220.4
On-loads	0.4	0.7	104.8	0.5	45.8	145.8	298.0
Receipts	25.9	1.1	82.7	0.3	45.9	85.7	241.6
Issues	<u>2.4</u>	<u>1.5</u>	<u>87.7</u>	<u>1.2</u>	<u>166.4</u>	<u>249.2</u>	<u>508.4</u>
TOTAL	29.1	3.9	367.0	2.7	280.4	585.3	1,268.4
<u>FY80</u>							
Off-loads	0.7	0.8	67.6	0.4	6.1	107.2	182.8
On-loads	3.7	0.8	116.0	0.3	51.0	101.7	273.5
Receipts	2.9	1.3	60.9	0.2	14.4	87.7	167.4
Issues	<u>24.1</u>	<u>1.8</u>	<u>73.2</u>	<u>0.8</u>	<u>189.9</u>	<u>156.9</u>	<u>446.7</u>
TOTAL	31.4	4.7	317.7	1.7	261.4	453.5	1,070.4
<u>TONNAGE*</u>							
78 2nd Half Receipts	5	12	461	4	448	771	1,701
Issues	4	15	804	6	486	1,830	3,144
79 Receipts	9	38	1,185	8	798	1,521	3,559
Issues	8	35	1,273	7	696	2,648	4,667
80 Receipts	11	50	943	5	236	1,685	2,930
Issues	93	43	1,511	4	838	1,996	4,485

*Short tons

TABLE C-39
6E-COG REPLENISHMENT SPARES FOR AIR-LAUNCHED MISSILES
(FY79\$ in thous.)

	<u>FY76/TQ</u>	<u>FY77</u>	<u>FY78</u>	<u>FY79</u>	<u>FY80</u>	<u>FY81</u>	<u>FY82</u>	<u>FY83</u>	<u>FY84</u>
SIDEWINDER	178	115	211	958	1,423	1,374	1,380	1,351	1,367
SPARROW	1,226	79	105	179	384	422	366	310	323
SHRIKE	115	51	238	408	604	583	581	569	562
STANDARD ARM	13	98	102	271	402	389	388	378	374
PHOENIX	438	34	69	103	203	191	246	248	325
HARPOON	—	—	—	—	77	112	108	141	148
HARM	—	—	—	—	—	—	102	300	279
OTHER	149	51	89	181	50	108	165	73	29
TOTAL	2,119	428	814	2,100	3,143	3,179	3,336	3,370	3,407

TABLE C-40
4E-COG REPLENISHMENT SPARES FOR AIR-LAUNCHED MISSILES
(FY79\$ in thous.)

	<u>FY76/TQ</u>	<u>FY77</u>	<u>FY78</u>	<u>FY79</u>	<u>FY80</u>	<u>FY81</u>	<u>FY82</u>	<u>FY83</u>	<u>FY84</u>
SIDEWINDER	1,417	812	1,937	1,637	1,749	1,605	1,500	1,500	1,500
SPARROW	210	85	227	591	210	216	240	240	240
WALLEYE	—	—	126	118	118	118	118	118	118
SHRIKE	12	11	319	328	228	211	201	201	201
STANDARD ARM	—	—	—	3	3	3	3	3	3
HARPOON	—	—	3	201	234	234	234	234	234
TOTAL	1,639	908	2,612	2,878	2,542	2,387	2,272	2,296	2,296

TABLE C-41
AIR-LAUNCHED MISSILE MODIFICATION PROCUREMENT
(FY79\$ in Thous.)

	Prior Years		78		79		80		Total Prog.	
	Qty.	\$K	Qty.	\$K	Qty.	\$K	Qty.	\$K	Qty.	\$K
AIM-7E/2 Motor Regrain.	1,590	2,413	441	750	500	850	—	—	2,531	4,013
7F Auto-pilot Sep.	—	—	—	—	290	875	800	2,400	1,090	3,270
TOTAL AIM-7	1,590	2,413	441	750	790	1,725	800	2,400	3,441	7,283
AIM-9L HiCapacity Gyro*	—	—	—	—	145	300	400	900	900	2,020
AIM-9L Cold Gas Servo Sys.*	—	—	—	—	—	—	340	500	940	1,450
TOTAL AIM-9	—	—	—	—	145	300	740	1,400	1,840	3,470
AIM-54 (ECP-57)*	438	876	586	1,170	182	515	191	590	1,397	3,151
AIM-54 Life/Oper. Time Impr.*	—	—	200	1,000	200	1,000	600	3,000	1,600	8,000
AIM-54 NARF Test Set Rel. Impr.	—	—	—	—	1	1,300	—	—	1	1,450
AIM-54 DSM-130 Test Capab.	—	—	—	—	3	835	7	1,946	10	2,781
AIM-54 G&C Sys. Test Set AIM 54C Capab.	1	1,733	—	—	1	1,564	—	—	2	3,297
TOTAL AIM-54	439	2,609	786	2,170	387	5,214	798	5,536	3,010	18,679
AGM-45 A/B Warhead Mod.*	—	—	—	—	—	—	400	1,100	400	1,100
AGM-45 A/B Guidance Sec.* Boresight Mod.	—	—	—	—	—	—	200	200	200	200
AGM-45 A/B MK39 Mod 3,4 RM Regrain. to 7*	—	—	—	—	325	700	325	700	650	1,430
TOTAL AGM-45	—	—	—	—	325	700	925	2,000	1,250	2,730

*Requires O&MN installation funds.

TABLE C-42
 AIR-LAUNCHED MISSILE O&MN INSTALLATION OF MODIFICATION
 (FY79\$ in Thous.)

<u>Missile</u>	<u>FY76</u>	<u>FY77</u>	<u>FY78</u>	<u>FY79</u>
SIDEWINDER				
78 Submission			5	
79 Submission			5	10
SPARROW				
78 Submission		738	681	
79 Submission		877	659	626
STANDARD ARM				
78 Submission				
79 Submission			15	
PHOENIX				
78 Submission		310	248	
79 Submission			169	276

APPENDIX D
METRIC CONVERSION CHART

TABLE D-1
METRIC CONVERSION CHART

2.2046	Pounds per Kilogram
0.4535	Kilograms per Pound
0.6214	Miles per Kilometer
1.6093	Kilometers per Mile
1209	Speed (Mach) in Kilometers/hour
0.9144	Meters per Yard
1.0936	Yards per Meter
39.3700	Inches per Meter
0.0254	Meters per Inch

APPENDIX E

USER'S GUIDE

USER'S GUIDE

This appendix is included to provide the users of this estimating model with a simple guide. It is designed to provide sufficient guidance for the uninitiated analyst and to provide an expedient reference for the experienced analyst.

The first step in preparing a missile O&S estimate with this model is to read the entire report thoroughly including the reference material, if necessary. This should provide a good basis of understanding of air-launched missile O&S costs. Table E-1 provides an alphabetical listing of all the variables defined in this report. The analyst should be familiar with all of them.

The second step is to become as familiar as possible with the missile system, its operational and support concepts, and other pertinent data. Table E-2 provides a listing of the variables defined in this report, arranged according to their most probable source. This table should enable the uninitiated analyst to gather all the required data with a single request. Obviously, situations vary and, in some instances, the analyst may have to revert to a second or third source. Also, the values of some variables are simply not defined early in the program and the analyst must solicit an informed estimate or refer to the information and examples contained in this report and make his own informed estimate. These types of problems are not unusual, especially if the system is very early in the acquisition cycle.

Table E-3 contains a listing of the cost elements and the Cost-Estimating Relationships (CER's). This provides a summary of the estimating procedures for the experienced analysts. Table E-4 provides a listing of the Cost Element Structure (CES) and points of contact for each element. Since

the situation in the fleet changes often, the analyst may want to update cost data, or discuss support policy as part of the O&S analysis. This table provides a starting point for finding the responsible individual.

Life Cycle Costs

This report was written to provide a capability for estimating average annual O&S costs for air-launched missiles. It is possible to convert the average annual cost into life cycle cost in several ways.

The first is simply to perform the entire analysis procedure for each year, computing the annual workloads, unit costs and all other variables year-by-year. A second method is to compute a single average annual O&S cost and multiply it by the number of years the system is deployed. The average annual cost can be multiplied by an appropriate fraction for each year that the system is not fully deployed.

It is realized that these are simplistic methodologies and that there are more complex and sophisticated issues involved in computing life cycle O&S costs, but they will not be discussed further in this report.

TABLE E-1
ALPHABETICAL LISTING OF VARIABLES

Variable	Definition	Cost Ele. Ref.	Variable	Definition	Cost Ele. Ref.
AAD	A dummy variable which takes the following values; 0, if the missile is an air-to-surface missile 1, if the missile is an air-to-air missile	8.1, 8.3	CAC ₁₀₀₀	the cumulative average hardware cost of the first one thousand missiles procured (FY79\$K)	3, 16
ACHRT	the total annual time spent training on the Advanced Combat Maneuvering Range (hours)	2	CF	the annual number of captive flights	1
AF	the annual NWS workload resulting from missile failures, determined by BIT check and visual inspection.	4	CFD	the average captive flight duration (hours)	4
ARR	the failure rate at the NWS of missiles which were returned to the NWS as observed failures in the fleet	4	CFER	the captive flight failure rate (MTBF in hours)	4
ANSA	the average number of missiles stored afloat	4	CI	the unit cost of installing a modification kit	15
ANSS	the average number of missiles stored ashore	4	CM	the cost of consumable material used in handling and inspection tasks (FY79\$K)	1
ASR	the afloat storage recertification time (maintenance due date - in years)	4	CMK	the unit cost of a modification kit (FY79\$K)	15
ASW	the average section weight (thous. of kg.)	9	CMA	the annual cost of consumable material for missile-dedicated aircraft equipment maintenance (FY79\$K)	3
BE	the number of base operating enlisted personnel necessary to provide BOS services to missile system personnel	5	CP ₁	the annual cost of paying one Program Management person in the 1st grade (FY79\$K)	8.4
BO	the number of base operating officers necessary to provide BOS services to missile system personnel	5	DBE	the number of direct enlisted plus base operating enlisted (computed in Element 5) required to support the weapon system	5, 11, 13
BOM	the O&M funds required to provide BOS services to missile system personnel (FY79\$K)	5	DBO	the number of direct officers plus base operating officers required to support the weapon system	5, 11, 13
BOS	the total cost (O&M and MPN) of base operating support (FY79\$K)	5			

TABLE E-1 (cont'd.)
ALPHABETICAL LISTING OF VARIABLES

Variable	Definition	Cost Ele. Ref.	Variable	Definition	Cost Ele. Ref.
UBT	the total number of personnel, officers and enlisted, direct plus base operating required to operate and provide base support to the missile system	5, 11, 12, 13	HO	the number of health care officers necessary to support the weapon system	12
UC	the total annual depot cost (FY79\$K)	6	HOM	the health care O&M funds necessary to support the weapon system (FY79\$K)	12
UE	the number of equivalent direct enlisted personnel for handling and inspection tasks (see Element 1)	1, 5	HT	the total cost of health care necessary to support the weapon system (FY79\$K)	12
URC	the depot unit cost of rework of a missile G&C section. (This does not include repair of G&C repairables.) (FY79\$K)	6	IRR	the intermediate reject ratio, i.e., the number of missiles failed by the MMS and forwarded to the depot for repair divided by the total number processed by the MMS	4, 6
UD	the number of equivalent direct officers required for handling and inspection tasks.	1, 5	LH	the labor required to successfully upload and download a missile (manhours)	1
UR	the direct requirements of manpower and operating funds represented by the total cost of Elements 1, 3, 4 and 6 (FY79\$K)	7	LW	the launch weight of the missile (kilograms)	8.3
UDC	the total depot unit cost for a particular type missile (FY79\$K)	6	LMO	the launch weight of the missile less the ordnance weight (kilograms)	4, 6
EPR	the estimated pay rate (FY79\$K - 9.517)	1, 3, 5, 11, 12, 13	M	the annual cost of modifications for an air-launched missile type (FY79\$K)	15
ES	the annual cost of Engineering Support for a particular missile type (FY79\$K)	8.2	MISA	the annual MMS workload resulting from missiles stored afloat which reach their maintenance due date	4
EHY	the flying hours per year	3	MUSARR	the failure rate at the MMS of missiles which were returned to the MMS because the afloat storage maintenance due date had been reached	4
FS	the annual cost of Fleet Support for a particular missile type (FY79\$K)	8.1	MOSS	the annual MMS workload resulting from missiles stored ashore which reach the maintenance due date	4
HE	the number of health care enlisted necessary to support the weapon system	12			
HI	the cost of handling and inspection of air-launched tactical missiles (FY79\$K)	1			

TABLE E-1 (cont'd.)
ALPHABETICAL LISTING OF VARIABLES

Variable	Definition	Cost Ele. Ref.	Variable	Definition	Cost Ele. Ref.
MSSRR	the failure rate at the NWS of missiles which were returned to the NWS because the afloat storage maintenance due date had been reached	4	OMC	the annual cost of organizational/AIMD maintenance (FY79\$K)	3
MS	the maximum speed of the missile in free flight (mach)	6	OME	the number of equivalent enlisted man-years required for organizational AIMD maintenance of missile system equipment	3,5
MTBF	the mean-time-between-failure of the missile-dedicated equipment (hours)	3	OPR	the officer pay rate (FY79\$K = 22.141)	1,5,11,12,13
MTR	the mean-time-to-repair the missile-dedicated equipment (hours)	3	OT	the annual cost of operational training (FY79\$K)	2
NA	the number of aircraft carrying the missile-dedicated equipment	3	PE	the number of enlisted prisoners	13
NLF	the annual number of live firings	2	PI	the percent of the inventory represented on a missile	8.1, 8.3
NM	the number of missiles carried per captive flight	1, 4	PCS	the annual cost (MPN funds) of PCS for weapon system direct and base operating personnel (FY79\$K)	13
NMI	the annual number of modification kits to be installed	15	PH	the annual cost of Program Management (FY79\$K)	8.4
NMK	the annual number of modification kits to be procured	15	QE	the annual cost of Program Management (FY79\$K)	8.3
NM ₁	the number of Program Management personnel in the 1st pay grade	8.4	REE	the number of recruiting and examining enlisted necessary to support the weapon system	13
NS	the annual number of missile sections to be transported	9	RED	the number of recruiting and examining officers necessary to support the weapon system	13
NT	the number of short tons to be handled by the RSSI department	10	REOM	recruiting and examining O&M funds (FY79\$K)	13
NWS	the unit cost of NWS maintenance (FY79\$K)	4	RGSE	the annual cost of replenishment ground support equipment (FY79\$K)	16
NWS ₁	the annual NWS workload; i.e., the number of missiles of a particular type which undergo NWS maintenance in a year	4,6,10	RSSI	the annual RSSI cost for a particular missile type (FY79\$K)	10

TABLE E-1 (cont'd.)
ALPHABETICAL LISTING OF VARIABLES

<u>Variable</u>	<u>Definition</u>	<u>Cost Ele. Ref.</u>	<u>Variable</u>	<u>Definition</u>	<u>Cost Ele. Ref.</u>
SDD	the annual cost of Supply Depot Operations required to support a weapon system (FY79\$K)	7	WM	the containerized weight per missile (short tons)	10
SDD	the annual cost of Second Destination Transportation (FY79\$K)	9			
SSR	the shore storage recertification time (maintenance due date - in years)	4			
TDP	the number of total direct personnel (officers and enlisted) involved in operating and supporting the missile system	5			
TE	the number of training enlisted required to support the weapon system	11			
TET	the number of enlisted personnel in transit	13			
TU	the number of training officers required to support the weapon system	11			
TUM	training O&M funds (FY79\$K)	11			
TUT	the number of officers in transit	13			
TPA	the total cost of Personnel Support (FY79\$K)	13			
TRT	total replacement training costs (FY79\$K)	11			
TMS	the total MMS maintenance cost (FY79\$K)	4			
UCLF	the unit cost of a live firing including range costs, target simulation and post flight analysis support (FY79\$K)	2			
WL	the depot workload; i.e., the number of G&C sections processed	6, 16			

TABLE E-2
LISTING OF VARIABLES BY SOURCE

1. Program Sponsor (Op-506)

<u>Variable</u>	<u>Definition</u>	<u>Cost Ele. Ref.</u>
ACMRT	the total annual time spent training on the Advanced Combat Maneuvering Range	2
CF	the annual number of captive flights	1
FHY	the flying hours per year	3
NA	the number of aircraft carrying the missile-dedicated equipment	3
NLF	the annual number of live firings	2

TABLE E-2 (cont'd.)
LISTING OF VARIABLES BY SOURCE

2. Program Office (PMA)

<u>Variable</u>	<u>Definition</u>	<u>Cost Ele. Ref.</u>
CAC ₁₀₀₀	the cumulative average hardware cost of the first one thousand missiles procured (FY79\$K)	6, 16
CM	the cost of consumable material used in handling and inspection tasks (FY79\$K)	1
CP _i	the annual cost of paying one Program Management person in the i th grade (FY79\$K)	8.4
NM	the number of missiles carried per captive flight	1, 4
NMP _i	the number of Program Management personnel in the i th pay grade	8.4

TABLE E-2 (cont'd.)
LISTING OF VARIABLES BY SOURCE

3. Program Documents

<u>Variable</u>	<u>Definitions</u>	<u>Cost Ele. Ref.</u>
AAD	a dummy variable which takes the following values; 0, if the missile is an air-to-surface missile; 1, if the missile is an air-to-air missile	8.1, 8.3
AFRR	the failure rate at the NWS of missile which were returned to the NWS as observed failures in the fleet	4
ANSA	the average number of missiles stored afloat	4
ANSS	the average number of missiles stored ashore	9
ASR	the afloat storage recertification time (maintenance due date - in years)	4
ASW	the average section weight (thous. of kg.)	9
CFD	the average captive flight duration (hours)	4
CFFR	the captive flight failure rate (MTBF in hours)	4
LW	the launch weight of the missile (kilograms)	8.3
LWO	the launch weight of the missile less the ordnance weight (kilograms)	4
MDSARR	the failure rate at the NWS of missiles which were returned to the NWS because the afloat storage maintenance due date had been reached	4
MDSSRR	the failure rate at the NWS of missiles which were returned to the NWS because the shore storage maintenance due date had been reached	4
PI	the percent of the missile inventory comprised by the missile	8.1, 8.3

TABLE E-2 (cont'd.)
LISTING OF VARIABLES BY SOURCE

3. Program Documents (cont'd.)

<u>Variable</u>	<u>Definition</u>	<u>Cost Ele. Ref.</u>
MS	the maximum speed of the missile in free flight (mach)	6
MTBF	the mean-time-between-failure of the missile-dedicated equipment (hours)	3
MTTR	the mean-time-to-repair the missile-dedicated equipment (hours)	3
SSR	the shore storage recertification time (maintenance due date - in years)	4

TABLE E-2 (cont'd.)
LISTING OF VARIABLES BY SOURCE

4. Assistant Project Manager for Logistics (APML)

<u>Variable</u>	<u>Definition</u>	<u>Cost Ele. Ref.</u>
CI	the unit cost of installing a modification kit (FY79\$K)	15
CMK	the unit cost of a modification kit (FY79\$K)	15
CMA	the annual cost of consumable material for missile-dedicated aircraft equipment maintenance (FY79\$K)	3
LU	the labor required to successfully upload and download a missile (manhours)	1
NMI	the annual number of modification kits to be installed	15
NMK	the annual number of modification kits to be procured	15
WM	the containerized weight per missile (short tons)	10

TABLE E-2 (cont'd.)
LISTING OF VARIABLES BY SOURCE

5. Computed by Model

<u>Variable</u>	<u>Definition</u>	<u>Cost. Ele. Ref.</u>
AF	the annual NWS workload resulting from missile failures, determined by BIT check and visual inspection	4
BE	the number of base operating enlisted personnel necessary to provide BOS services to missile system personnel	5
BO	the number of base operating officers necessary to provide BOS services to missile system personnel	5
BOM	the O&M funds required to provide BOS services to missile system personnel (FY79\$K)	5
ROS	the total cost (O&MN and MPN) of base operating support (FY79\$K)	5
DBE	the number of direct enlisted plus base operating enlisted (computed in Element 5) required to support the weapon system	5, 11, 13
DBO	the number of direct officers plus base operating officers required to support the weapon system	5, 11, 13
DBT	the total number of personnel, officers and enlisted, direct plus base operating required to operate and provide base support to the missile system	5, 11, 12, 13
DC	the total annual depot cost (FY79\$K)	6
DE	the number of equivalent direct enlisted required for handling and inspection tasks (from Element 1)	1, 5
DGC	the depot unit cost of rework of a missile G&C section. (This does not include repair of G&C repairables.) (FY79\$K)	6
DO	the number of equivalent direct officers required for handling and inspection tasks.	1, 5

TABLE E-2 (cont'd.)
LISTING OF VARIABLES BY SOURCE

5. Computed by Model (cont'd.)

<u>Variable</u>	<u>Definition</u>	<u>Cost Ele. Ref.</u>
DR	the direct requirements of manpower and operating funds represented by the total cost of Elements 1, 3, 4 and 6 (FY79\$K)	7
DUC	the total depot unit cost for a particular type missile (FY79\$K)	6
ES	the annual cost of Engineering Support for a particular missile type (FY79\$K)	8.2
FS	the annual cost of Fleet Support for a particular missile type (FY79\$K)	8.1
HE	the number of health care enlisted necessary to support the weapon system	12
HI	the cost of handling and inspection of air-launched tactical missiles (FY79\$K)	1
HO	the number of health care officers necessary to support the weapon system	12
HOM	the health care O&M funds necessary to support the weapon system (FY79\$K)	12
HT	the total cost of health care necessary to support the weapon system (FY79\$K)	12
IRR	the intermediate reject ratio, i.e., the number of missiles failed by the NWS and forwarded to the depot for repair divided by the total number processed by the NWS	4, 6
M	the annual cost of Modifications for an air-launched missile type (FY79\$K)	15
MDSA	the annual NWS workload resulting from missiles stored afloat which reach their maintenance due date	4
MDSS	the annual NWS workload resulting from missiles stored ashore which reach the maintenance due date	4

TABLE E-2 (cont'd.)
LISTING OF VARIABLES BY SOURCE

5. Computed by Model (cont'd.)

<u>Variable</u>	<u>Definition</u>	<u>Cost Ele. Ref.</u>
NS	the annual number of missile sections to be transported	10
NT	the number of short tons to be handled by the RSSI department	10
NWS	the unit cost of NWS maintenance (FY79\$K)	4
NWSWL	the annual NWS workload; i.e., the number of missiles of a particular type which undergo NWS maintenance in a year	4, 6, 10
OMC	the annual cost of Organizational/AIMD Maintenance (FY79\$K)	3
OME	the number of equivalent enlisted manyears required for Organizational/AIMD Maintenance of missile system equipment	3, 5
OT	the annual cost of Operational Training (FY79\$K)	2
PE	the number of enlisted prisoners	13
PCS	the annual cost (MPN funds) of PCS for weapon system direct and base operating personnel (FY79\$K)	13
PM	the annual cost of Program Management (FY79\$K)	8.4
QE	the annual cost of Quality Evaluation (FY79\$K)	8.3
REE	the number of recruiting and examining enlisted necessary to support the weapon system	13
REO	the number of recruiting and examining officers necessary to support the weapon system	13
REOM	recruiting and examining O&M funds (FY79\$K)	13
RGSE	the annual cost of Replenishment Ground Support Equipment (FY79\$K)	16
RSSI	the annual RSSI cost for a particular missile type (FY79\$K)	10

TABLE E-2 (cont'd.)
LISTING OF VARIABLES BY SOURCE

5. Computed by Model (cont'd.)

<u>Variable</u>	<u>Definition</u>	<u>Cost Ele. Ref.</u>
SDO	the annual cost of Supply Depot Operations required to support a weapon system (FY79\$K)	7
SDT	the annual cost of Second Destination Transportation (FY79\$K)	9
TDP	the number of total direct personnel (officers and enlisted) involved in operating and supporting the missile system	5
TE	the number of training enlisted required to support the weapon system	11
TET	the number of enlisted personnel in transit	13
TO	the number of training officers required to support the weapon system	11
TOM	training O&M funds (FY79\$K)	11
TOT	the number of officers in transit	13
TPA	the total cost of Personnel Support (FY79\$K)	13
TRT	total Replacement Training costs (FY79\$K)	11
TNWS	the total NWS maintenance cost (FY79\$K)	4
UCLF	the unit cost of a live firing including range costs, target simulation and post flight analysis support (FY79\$K)	2
WL	the depot workload; i.e., the number of G&C sections processed	6, 16

TABLE E-2 (cont'd.)
LISTING OF VARIABLES BY SOURCE

6. Other

<u>Variable</u>	<u>Definition</u>	<u>Cost Ele. Ref.</u>
EPR	the enlisted pay rate (FY79\$K = 9.517)	1,3,5,11,12,13
OPR	the officer pay rate (FY79\$K = 22.141)	1,5,11,12,13

TABLE E-3
NAVY AIR-LAUNCHED MISSILE OPERATING AND SUPPORT
COST-ESTIMATING RELATIONSHIPS
(All Costs - FY79\$K)

<u>Cost Elements</u>	<u>Definitions</u>	<u>CER</u>	<u>Reference</u>
<u>Operations</u>			
1. Handling and Inspection	Organizational handling and inspection of missile and missile equipment	$HI = DE \times EPR + DO \times OPR + CH$ $DE = \frac{LU}{1440} \times NM \times CF$	Maintenance Engineering Analysts Deployment Reports
2. Operational Training	Pilot operational readiness training and live firings of missile	$OT = 0.80 \times ACHRT + NLF \times UCLF$	ACHR and live firings see Exhibit IFF-2
<u>Below-Depot Maintenance</u>			
1. Organizational/AIWD Maint.	Maintenance of missile dedicated aircraft equipment at O&I levels	$OMC = OME \times EPR + CHA$ $OME = NA \times (ENV/MTBP) \times MTTR/1440$	Can be estimated with J-M data
4. Intermediate Maintenance	Cost of personnel, consumable material and station overhead required for missile maintenance at Weapons Stations	$TNMS = NMS \times MWSML$ $NMS = 0.312 + 2.561118R + 0.0041MO$ $MWSML = AF + MDSA + MDSS$	Based on Budget Submission data, NAVAIR 4104 costs, and DCP failure rates
<u>Installations Support</u>			
5. Base Operating Support	Personnel and material in direct support of missile handling and inspection pers.	$BO = 0.0014TDP; BE = 0.0178TDP;$ $BOM = 0.4945TDP; BOS = (BO \times OPR) + (BE \times EPR) + BOM$ $DBE = DE + OME + BE$ $DBO = DO + BO$ $DBT = DBE + DBO$	MARM Methodology, Proxy - number of personnel DBE, DBO, DBT used as proxy for succeeding Element 5
<u>Depot Maintenance</u>			
6. Depot Maintenance	Manpower material and overhead costs needed for missile maintenance at Navy and contractor repair facilities	$DC = IUC \times VI$ $IUC = 1.251 + 0.324MS + 0.013CAC_{1000}$ $VI = MWSML \times IRR$	Based on data from MARM's NAVAIR cost factors. Budget Submission data
<u>Depot, Supply & Technical Support</u>			
7. Supply Depot Ops.	Costs of manpower and material needed for supply support of missile maintenance and operation	$SDO = 0.025DR$	MARM Methodology, Proxy - direct costs
8. Technical Support 8.1 Fleet Support	Cost of on-site technical personnel	$FS = 64.307 + 4.229PI + 113.530AAD$	Based on Budget Submission NAVAIR 4104 costs

TABLE E-3 (Cont'd.)

NAVY AIR-LAUNCHED MISSILE OPERATING AND SUPPORT
COST-ESTIMATING RELATIONSHIPS
(All Costs - FY79\$K)

<u>Cost Elements</u>	<u>Definitions</u>	<u>CER</u>	<u>Reference</u>
8.2 Engineering Support	Cost of maintenance and design engr.	ES = 80.950 + 4.306FS	Based on data from NAVAIR 410 and NAVAIR 510
8.3 Quality Evaluation	Cost of Naval Weapons Quality Program monitoring status & condition of air-launched weapon stockpile	QE = 109.559 + 7.785 + 171.660AAD	NAVAIR 4104
8.4 Program Management	O&S cost of missile-specific project	PM = INMP ₁ x CP ₁	Refer to PMA/PMS, See Section III-8.4
o Second Destination Transportation			
9. Transportation	Cost of commercial transportation of missiles from MWS's to depots & back	SDT = NS x ASW x 0.1297	Based on Budget Submission NAVAIR 412; see Sec. III-9
10. Receipt, Segregation, Storage, Issue	Cost of personnel and material for on-loadings and offloadings of equipment to & from storage depots & MWS's.	RSSI = 0.29NT NT = MWSUL x WM	NAVSEA 04J, See Table C-28 Appendix C
o Personnel Support Training			
11. Replacement Training	Variable cost of recruit and technical training	TO = 0.0001DBE + 0.0028DBT + 0.0613DBO TE = 0.1036DBE + 0.02332DBT + 0.0067DBO TOM = 0.0041DBE + 0.3377DBT TRT = (TO x OPR) + (TE x EPR) + TOM HO = 0.0092DBT, HE = 0.0182DBT HOM = 0.4148DBT, HT = /HO x OPR + (HE x EPR) + HOM PCS = 1.4515DBO + 0.4615DBE REOM = 0.0889DBE, REO = 0.0009DBE REE = 0.1036DBE, PE = 0.0119DBE TOT = 0.0584DBT, TET = 0.0433DBE TPA = REOM + (REO + TOT) x OPR + (REE + PE + TET) x EPR	NARM Methodology, Proxy - Number of officer, enlisted and total pers.
12. Health Care	Cost of medical support to personnel		NARM Methodology, Proxy - Number of personnel
13. Personnel Support	Cost of personnel programs		NARM Methodology, Proxy - Number of officers and enlisted
o Sustaining Investments			
14. Replenishment Spares	Cost of procuring missile spares and repair parts	RS = 151.912 + 55.220PI	NAVAIR 4123
15. Modifications	Cost of safety mods for missiles and equipment	M = NMK x CMK + NMH x CI	Based on Budget Submission O&M - NAVAIR 4104, WPN-2
16. Replenishment Ground Support Equipment	Cost of replacing GSE	RCSE = 0.0025 x WL x CAC ₁₀₀₀	Refer to PMA/PMS, See Section III-8.4

TABLE E-4
SUMMARIZATION OF POINTS OF CONTACT

	<u>Code</u>	<u>Person</u>	<u>Telephone</u>
o <u>Operations</u>			
1. Handling and Inspection	NAVAIR 4104	Mr. I. Koniak	X-29773
2. Operational Training	NAVAIR-06E	Mr. R. Crangle	X-27785
	NAVAIR-06	Mr. H. Kollshegg	X-27675
	NAVSEA-06N	Mr. F. Belen	X-27748
o <u>Below-Depot Maintenance</u>			
3. Organizational/AIMD Maint.	NAVMAT 0415	Mr. Schanamann	X-28781
	NAVAIR 5205	Mr. F. Norton	X-27596
4. Intermediate Maintenance	NAVAIR 4104	Mr. I. Koniak	X-29773
o <u>Installations Support</u>			
5. Base Operating Support	Op901 (NARM)	Ms. Ruth	X-55038
o <u>Depot Maintenance</u>			
6. Depot Maintenance	NAVAIR 4104	Mr. I. Koniak	X-29773
o <u>Depot Supply and Technical Support</u>			
7. Supply Depot Ops	Op901 (NARM)	Ms. Ruth	X-55038
8. Technical Support			
Fleet Support	NAVAIR 4104	Mr. I. Koniak	X-29773
Engineering Support	NAVAIR 410	Mr. I. Koniak	X-29773
	NAVAIR 510	CAPT Glunt or	X-28571
		Mr. Cooper	X-28620
Quality Evaluation	NAVAIR 4104	Mr. Sanders	X-29828
Program Management	(see Sec. III, 8.4)		
o <u>Second Destination Transportation</u>			
9. Transportation	NAVAIR 412	Mr. Roberts	X-20091
10. Receipt, Segregation, Storage & Issue	NAVSEA 04J	Mr. Warfield	X-21163
	NWSC Crane, Ind.	Mr. Wimmenauer	8-482-1358
o <u>Personnel Support Training</u>			
11. Replacement Training	Op901 (NARM)	Ms. Ruth	X-55038
12. Health Care	Op901 (NARM)	Ms. Ruth	X-55038
13. Personnel Support	Op901 (NARM)	Ms. Ruth	X-55038
o <u>Sustaining Investments</u>			
14. Replenishment Spares	NAVAIR 412	Ms. Savage	X-20239
15. Modifications	PMA/PMS	(see table, Sec. III, 8.4)	
16. Replenishment Ground Support Equipment	PMA/PMS	(see table, Sec. III, 8.4)	

GLOSSARY

ACMR	Advanced Combat Maneuvering Range
AFWTF	Atlantic Fleet Weapons Training Facility
AIMD	Aircraft Intermediate Maintenance Department
AO	Oiler
AOE	Fast Combat Support Ship
APML	Assistant Project Manager for Logistics
ASO	Aviation Support Office
AUR	All-Up-Round
BIT	Built-In-Test
BOS	Base Operating Support
CAIG	Cost Analysis Improvement Group
CER	Cost-Estimating Relationship
CES	Cost Element Structure
CVA	Attack Carrier
DCP	Decision Coordinating Paper
DOD	Department of Defense
DSARC	Defense Systems Acquisition Review Council
FLTAC	Fleet Analysis Center
FYDP	Five Year Defense Program
G&C	Guidance and Control
HARM	High Speed Anti-Radiation Missile
ICP	Inventory Control Point
ILS	Integrated Logistic Support
ILSP	Integrated Logistic Support Plan
MDCS	Maintenance Data Collection System
MDD	Maintenance Due Date
MEA	Maintenance Engineering Analysis
MMU	Mobile Missile Maintenance Unit
MOAT	Missile-On-Aircraft-Test
MPN	Military Personnel, Navy
MSOD	Maintenance Support Office Department of Fleet Material Support Office

MTBF	Mean-Time-Between-Failure
MTTR	Mean-Time-To-Repair
NARF	Naval Air Rework Facility
NARM	Navy Resource Model
NAS	Naval Air Station
NAVAIR	Naval Air Systems Command
NOS	Naval Ordnance Station
NSN	National Stock Number
NWS	Naval Weapons Station
NWSC	Naval Weapons Support Center, Crane, Indiana
O&MN	Operations and Maintenance, Navy
OPNAV	Office of the Chief of Naval Operations
O&S	Operating and Support
OSD	Office of the Secretary of Defense
PCS	Permanent Change of Station
PMA	Program Management Air
PMA	Performance Monitoring System
PMTIC	Pacific Missile Test Center
POM	Program Objectives Memorandum
R&D	Research and Development
RGSE	Replenishment Ground Support Equipment
RSSI	Receipt, Segregation, Storage and Issue
SPCC	Ships Parts Control Center
T/M/S	Type, Model, Series
WPN	Weapons Procurement, Navy
WQEC	Weapons Quality Evaluation Center
WUC	Work Unit Code
3-M	Maintenance and Material Management System