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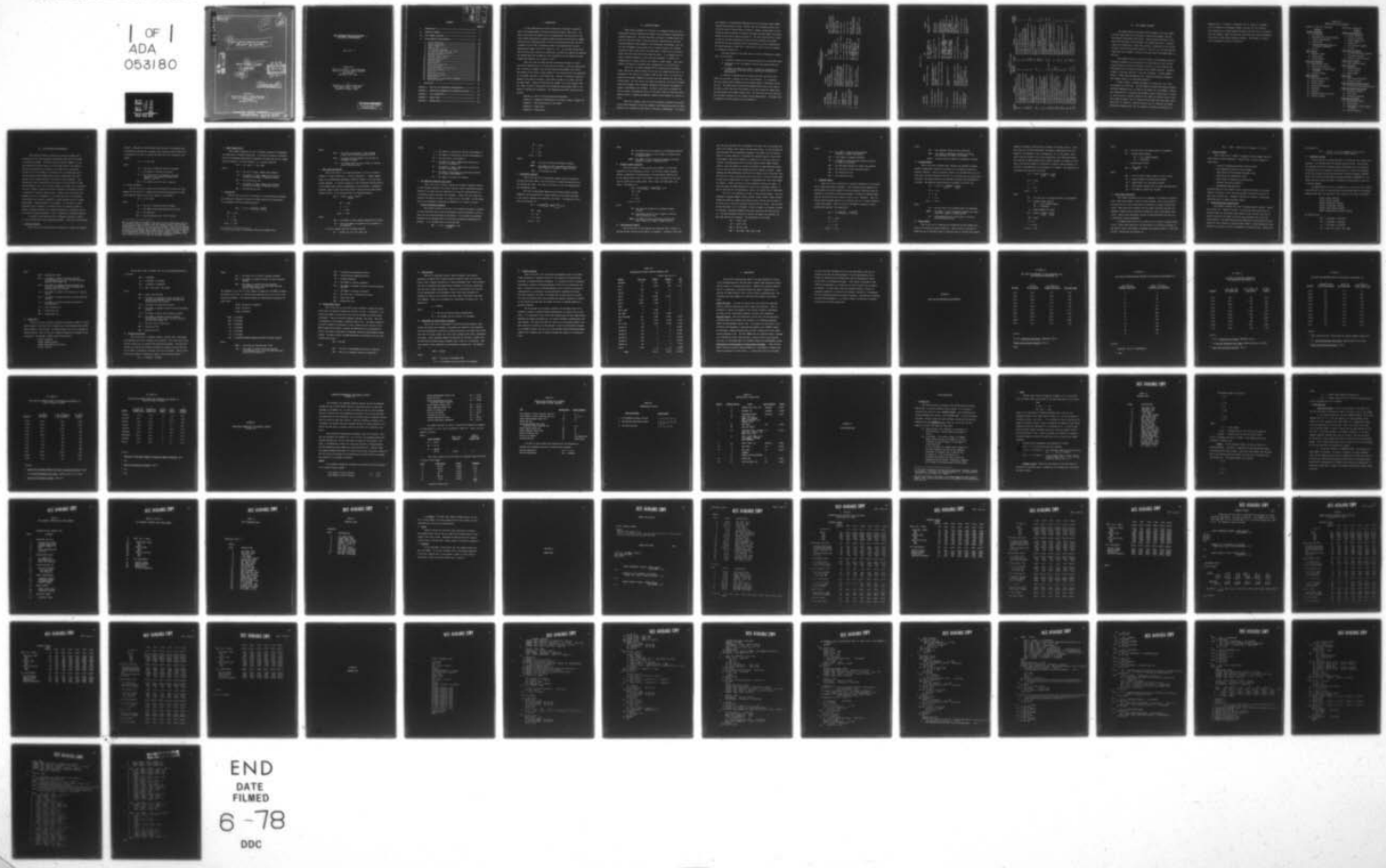

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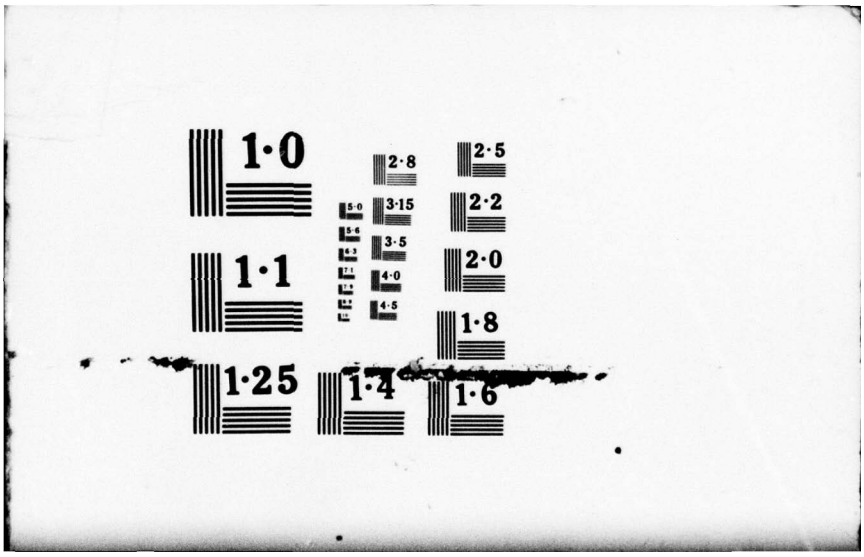
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Prepared for

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Advisor for Resource Analysis (Op-96D)
The Pentagon
Washington, D.C. 20350

Administrative Sciences Corporation
ALEXANDRIA, VIRGINIA

# NAVAL AIRCRAFT OPERATING AND SUPPORT COST MODEL - FY76 REVISION

March 1978

Prepared for

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

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CONTENTS

# I. INTRODUCTION

In 1974 Administrative Sciences Corporation developed a parametric model for estimating Naval aircraft operating and support (O&S) costs. The model, which proved extremely useful in preparing O&S cost estimates of aircraft systems approaching a Defense Systems Acquisition Review Council (DSARC) milestone and in supporting other force/cost effectiveness studies, was first documented in ASC R-107 "A Parametric Model for Estimating Naval Aircraft Operating and Support Costs (U)," August 31, 1974. As more data became available and better data sources were identified, the model was updated and improved. The changes made were documented in ASC R-109 "Force Mix and Related Aircraft Systems Cost Analysis (U)," August 31, 1975.

Since that time the model has been continuously revised to reflect the latest available data, to utilize new data sources, to add new capabilities, and to conform to guidance from the Cost Analysis Improvement Group (CAIG). The purpose of this report, which consists of five sections with five appendices, is to document the model in its FY1976 form. Section II provides an executive summary of the report including a chart which explains, at a glance, the way the model works. Section III discusses the changes in the cost element structure (CES), Section IV details the cost-estimating relationships (CER's), and Section V contains the conclusions. The appendices and their contents are as follows:

Appendix A - Data for Cost-Estimating Relationships.

Appendix B - Computation Methodology for Technical Support (Element 18).

Appendix C - User Instructions for the Model.

Appendix D - Sample Runs.

Appendix E - Program Code.

## II. EXECUTIVE SUMMARY

This report documents the revisions of a parametric model for estimating Naval aircraft operating and support costs developed by Administrative Sciences Corporation. The model provides an estimate of average annual and life cycle O&S costs based on aircraft physical characteristics and basic program parameters using parametric cost-estimating relationships, cost factors and throughputs, and has been used to support numerous cost analyses prepared for CAIG review as well as other special studies such as the Naval Escort Force Mix Study and the Sea Based Air Study. It is updated often in order to remain responsive to each particular analysis, to reflect the changing nature of Naval aviation, and simply to remain timely. This report reflects the status of the model after incorporation of all FY1976 data.

The bulk of the report ~~(Section IV)~~ is concerned with providing a clear, concise and complete definition of each cost element and the way it is estimated by the model. If a parametric CER is used, then it is fully documented with pertinent regression statistics and the complete data base with sources noted. All cost factors are given and explained, and even the elements requiring throughput have sufficient explanatory information and examples to support a preliminary cost estimate. In short, this report is prepared so that an analyst uninitiated in the use of the model could sit down and, with a moderate amount of program information, produce an O&S estimate in a matter of hours.

Table II-1 contains a list of the cost elements estimated by the model, a very brief definition of each cost element, the estimating equation (if space permits) and a reference to the source of the data or methodology. For several

cost elements, the methodology developed for the Navy Resource Model (NARM) Program Factors Manual is used. Briefly, this is a methodology which allocates the costs of various kinds of support to weapon systems based on proxy variables which are chosen to represent the weapon systems' demand for support. Details on this can be found in Section IV. The table should give the reader a brief but accurate description of how costs are estimated by the model. Definitions for the variables used in the equations are given alphabetically for quick reference in Table II-2. More detail on each of the cost elements is contained in Section IV.

The major changes in the model since it was last documented in August, 1975, are as follows:

1) A complete revision of all data and equations to utilize FY76 data.

2) Conversion to the cost element structure and format dictated by the CAIG.

3) A complete recoding of the model to improve its efficiency, reduce its size, facilitate its use, and provide visibility by appropriation.

In addition to generating the average annual O&S cost per UE, the model also provides a complete life cycle cost estimate. It is generated with the average annual estimate and the average number of operating aircraft per year. The model lags the airframe and engine rework costs to put them in the year in which they would occur based on the input values for engine time-between-overhaul and airframe rework cycle. The resulting life cycle O&S estimate provides visibility by cost element and by appropriation. The sample runs in Appendix B provide examples of this capability.

TABLE II-1

AIRCRAFT OPERATING AND SUPPORT COST MODEL
COST-ESTIMATING RELATIONSHIPS

| | Cost Element | Definition | CER | Reference |
|---|---|---|---|---|
| 1. | Aircrew (Officers) | Officer Aircrewmen | $OA = OxCFxOPR$ | Based on program information |
| 2. | Aircrew (Enlisted) | Enlisted Aircrewmen | $EA = ExCFxEPR$ | Based on program information |
| 3. | Combat Command Staff | Non-flying Command Admin. Pers. | $CCS = (OCxOPR)+(ECxEPR)$ | Based on program information and squadron size |
| 4. | Aviation POL | Fuel and additives for A/C | $POLF = 9.153GTOW^{0.534}{}_{MS}{}^{0.808}$ | Based on actual usage |
| 5. | Other Deployed Manpower | Various utility and miscellaneous personnel not previously counted | $ODM = (-0.503+2.239SP^{0.500}) \times EPR$ | Based on OpNAV policy |
| 6. | Air TAD | Travel and TAD expenses to obtain maintenance and other training | Thruput (usually \$5,000 - \$13,000) | Based on NARM data |
| 7. | Aircraft Maintenance Manpower | Squadron O&I level maintenance pers. | $AMM = (1.670 + 0.018MMHMO)$ | Based on 3-M data |
| 8. | Maintenance Material | Non-repairable O&I level maintenance material | $MM = (0.008MS^{0.369}{}_{MMHMO}{}^{1.098})0.940$ | Actual data - Op-51C |
| 9. | Personnel Support Supplies | Non-maintenance O&I level material | $PSS = (0.008MS^{0.369}{}_{MMHMO}{}^{1.098})0.060$ | Actual data - Op-51C |
| 10. | Base Operating Support | Cost of base support services to squadron | $BO = 0.002TSP$; $BE = 0.027TSP$<br>$BOM = 463.700 \times TSP$<br>$BOS = (BOxOPR)+(BExEPR)+BOM$ | NARM Methodology; Proxy number of squadron personnel |
| 11. | Component Rework | Depot repair of repairables | $CR = 0.727MMH^{1.249}{}_{GTOW}{}^{0.405}$ | NAVAIR Cost factors |
| 12. | Airframe Rework | Depot repair/overhaul of airframe | $AR = -15.078 + 0.130MMHMO + 0.092MS$ | Data from Naval Air Rework Facilities |

TABLE II-1 (cont'd.)

| | Cost Element | Definition | CER | Reference |
|---|---|---|---|---|
| 13. | Engine Rework | Depot repair/overhaul of engines | EO = 1.093 + 45.064TD + 1.211<br>ER = 8.469 + 4.138TD + 0.752T<br>ERT = $(\frac{EO + 1.6ER}{TBO})$ x NE | Data from Naval Air Rework Facilities |
| 14. | Depot Supply Operations | Cost of supply depot support for A/C parts and squadron material | 0.025 x (costs from #1-9, 11-13) | NARM Methodology |
| 15. | Technical Support | Large number of technical support programs | Details in Appendix B | NARM Methodology |
| 16. | Second Destination Trans. | SDT costs of A/C and squadron material | 0.057(costs from 4,8,9,12,13 + AR) | NARM Methodology, Proxy all other costs |
| 17. | Individual Training | Training costs up to Readiness Squadron | TOM = 0.007(SBE) + 0.215(SBT)<br>TO = 0.002(SBE) + 0.680(SBO)+0.004(SBT)<br>TE = 0.101(SBE) + 0.025(SBT)<br>TT = TOM + (TOxOPR) + (TExEPR) | NARM Methodology, Proxy - squadron and base operating enlisted, officer and total |
| 18. | Health Care | Cost of providing health care to squadron | HOM = 0.346(SBT)<br>HO = 0.001(SBO) + 0.010(SBT)<br>HE = 0.005(SBE) + 0.018(SBT)<br>HT = HOM + (HOxOPR) + (HExEPR) | NARM Methodology, Proxy - squadron and base operating officer, enlisted and total personnel |
| 19. | Personnel Activities | The cost of a number of personnel programs | Details in Section IV | NARM Methodology, Proxy - Number of personnel |
| 20. | Replenishment Spares | The cost of purchasing replenishment reparable material | RSF = $(0.727MMH^{1.247}GTOW^{0.405})0.590$ | NAVAIR Cost Factors |
| 21. | Modifications | The cost of safety mods for A/C and equipment | M = 0.004FC | Cost Factor used by OSD |
| 22. | Replacement of GSE | The cost of replacing GSE | RGSE = 0.003FC | Cost Factor used by OSD |
| 23. | Training Ordnance | The cost of all expendables used in training | Determined by weapons on A/C and training requirements | Refer to Table IV-1 for guidelines |

TABLE II-2

ALPHABETICAL LISTING OF VARIABLES

| Variable | Definition | Cost Element Reference |
|---|---|---|
| AMM | the cost of aircraft maintenance manpower | 7 |
| AR | the unit cost of an airframe rework (in thous.) | 12 |
| BE | the number of base operating enlisted necessary to support the squadron | 10 |
| BO | the number of base operating officers necessary to support the squadron | 10 |
| BOM | the O&M funds necessary to support the squadron | 10 |
| BOS | the total cost of base operating support | 10 |
| CCS | the cost of combat command staff manpower | 3 |
| CF | the crew factor or the number of aircrews contained in the squadron divided by the number of aircraft | 1,2 |
| CRF | the component rework cost per flying hour | 11,20 |
| D | engine diameter in inches | 13 |
| E | the number of enlisted personnel per aircrew | 2 |
| EA | the cost of paying enlisted aircrewmen | 2 |
| EC | the number of combat command staff enlisted divided by the number of squadron aircraft | 3 |
| EO | the unit cost of an engine overhaul (in thous.) | 13 |
| EPR | the enlisted pay rate | 2,3,5,10,17,18 |
| ER | the unit cost of an engine repair (in thous.) | 13 |
| ERT | the total annual engine rework cost per aircraft | 13 |
| FC | the flyaway cost per aircraft (in thous.) | 21,22 |
| GTOW | the gross take-off weight (in thous. of lbs.) | 4,11,20 |
| HE | the number of health care enlisted personnel | 18 |
| HO | the number of health care officers | 18 |
| HOM | health care O&M funds | 18 |
| HT | the total cost of health care | 18 |
| M | the cost of aircraft safety modifications | 21 |
| MM | the annual cost per flying hour of maintenance material | 8 |
| MMH | the number of maintenance manhours per flying hour necessary to support an aircraft | 11,20 |
| MMHMO | the number of maintenance manhours per month required to support an aircraft | 7,8,9,12 |
| MS | the maximum speed for level flight at altitude given in miles per hour | 4,8,9,12 |
| NE | the number of engines per aircraft | 13 |
| O | the number of officers per aircrew | 1 |
| OA | the cost of paying the officer aircrewmen | 1 |
| OC | the number of combat command staff officers divided by the number of squadron aircraft | 3 |
| ODM | the number of other deployed manpower per aircraft | 5 |
| OPR | the officer pay rate | 13,10 |
| POLF | the cost per flying hour of POL assuming a base price of $0.394 per gallon of JP-5 | 4 |
| PSS | the cost per flying hour of personnel support supplies | 9 |
| RGSE | the cost of replacement GSE | 22 |
| RSF | the cost of replenishment spares per flying hour | 20 |
| SBE | the number of squadron enlisted personnel (from Elements 2,3,4, and 7) and base operating enlisted (from Element 10) | 17,18 |
| SBO | the number of squadron officers and base operating officers | 17,18 |
| SBT | the number of squadron enlisted personnel and officers (from Elements 2 & 3) and base operating enlisted and officers | 17,18 |
| SP | the total number of personnel in the squadron to be supported | 5 |
| T | maximum engine thrust | 13 |
| TBO | time between overhaul given in engine operating hours | 13 |
| TE | the number of enlisted personnel required for training duties | 17 |
| TD | turbofan dummy variable | 13 |
| TO | the number of officer staff required for training duties | 17 |
| TOM | training O&M funds | 17 |
| TSP | total number of squadron personnel | 10 |
| TT | total training cost | 17 |

## III. COST ELEMENT STRUCTURE

The revised model incorporated several changes in the cost element structure (CES) which were instituted to conform with guidance from the Cost Analysis Improvement Group (CAIG). Because previous editions of this model have been based on CAIG guidance, the changes were minor - primarily a matter of reformatting. Table III-1 provides a comparison of the old CES (Column A) and the revised CES (Column B). The latter is the CAIG preferred format with minor changes to reflect the unique mission and organization of the Navy.

The personnel which are costed are those of the deployable squadron. Although the members of the squadron do not discretely fall into the functional categories outlined in the CES, as they do in other services, they nevertheless can be divided according to their primary function. Therefore elements 1 (Aircrew, Officers), 2 (Aircrew, Enlisted), 3 (Combat Command Staff), 5 (Other Deployed Manpower) and 7 (Aircraft Maintenance Manpower), when summed, equate to the deployable squadron.

Several elements, although unchanged, were split into one or more new elements and vice-versa. The old element of Squadron Maintenance Material and Other Consumables (CE. 5, Column A) was broken into two elements - Maintenance Material (CE. 8, Column B) and Personnel Support Supplies (CE. 9, Column B). This was done to provide visibility into these two distinct areas of cost. Also Logistics Support (CE. 21, Column A) was divided into Depot Supply Operations (CE. 14, Column B), Technical Support (CE. 15, Column B) and Second Destination Transportation (CE. 16, Column B). Conversely, Recruiting and

Examining (CE. 17, Column A), Transients (CE. 18, Column A), Prisoners (CE. 19, Column A) and Permanent Change of Station (CE. 20, Column A) were combined into a single element Personnel Activities (CE. 19, Column B). All other elements remain the same even though some have slightly different titles and are shown under different headings. Each element in Column B will be discussed in detail in Section IV.

TABLE III-1

COMPARISON OF COST CATEGORIES

| August 31, 1975 Cost Categories | Revised Cost Categories |
|---|---|
| Column A | Column B |
| **Squadron Operations** | **Deployed Unit Operations** |
| 1. Crew Manpower | 1. Aircrew (Officers) |
| 2. Maintenance and Support Manpower | 2. Aircrew (Enlisted) |
| 3. Squadron Administration | 3. Combat Command Staff |
| 4. Aviation POL | 4. Aviation POL |
| 5. Squadron Maintenance Material and Other Consumables | 5. Other Deployed Manpower |
| 6. Air TAD | 6. Air TAD |
| **Depot Support** | **Below Depot Maintenance** |
| 7. Component Rework | 7. Aircraft Maintenance Manpower |
| 8. Engine Rework | 8. Maintenance Material |
| 9. Airframe Rework | 9. Personnel Support Supplies |
| **Recurring Investment** | **Installation Support** |
| 10. Replenishment Spares | 10. Base Operating Support |
| 11. Aircraft Modifications | **Depot Maintenance** |
| 12. Replacement of Ground Support Equipment | 11. Component Rework |
| 13. Training Ordnance | 12. Airframe Rework |
| **General Support** | 13. Engine Rework |
| 14. Base Operating Support | **Depot Supply** |
| 14. Training Support | 14. Depot Supply Operations |
| 16. Medical Support | 15. Technical Support |
| 17. Recruiting & Examining | **Second Destination Transportation** |
| 18. Transients | 16. Second Destination Transportation |
| 19. Prisoners | **Personnel Support and Training** |
| 20. Permanent Change of Station | 17. Individual Training |
| 21. Logistics Support | 18. Health Care |
| | 19. Personnel Activities |
| | **Sustaining Investments** |
| | 20. Replenishment Spares |
| | 21. Modifications |
| | 22. Replacement of Ground Support Equipment |
| | 23. Training Ordnance |

# IV. COST-ESTIMATING RELATIONSHIPS

This section provides a definition of each cost element and a description of the cost-estimating relationship (CER) used in the model to provide an estimate. Each CER is based on what is judged to be the best available historical data, but as one might expect, the quality of the data and therefore the precision of the CER's vary considerably. Several of the cost elements are estimated with the methodology used by the Navy Resource Model (NARM) Program Factors Manual which allocates support costs to weapon systems on the basis of proxy variables. This methodology, which is discussed in more detail in the discussion of Base Operating Support (CE. 10), is useful because it provides a way to estimate the cost of support services which would otherwise be extremely difficult to identify to a specific weapon system. Finally, there are several cost elements which are not dependent on the characteristics of the aircraft and therefore are virtually impossible to treat parametrically in a generalized model. Training Ordnance is an example. In such cases, as much background data as possible is provided to allow the analyst to make an initial, reasonable estimate until program information is obtained, such as in the case of Training Ordnance, a list of weaponry and training allowances.

It should be noted that each cost or manpower reference is given on a per aircraft basis unless otherwise specified. Costs are in FY76 dollars.

## 1. Aircrew (Officers)

This is the cost of paying officer personnel who operate the squadron

aircraft. Although all pilots perform other duties in the squadron, such as maintenance supervision or squadron staff functions, their primary duty is considered to be that of aircrew and their full cost is shown in this element.

$$OA = O \times CF \times OPR$$

where,

OA = the cost of paying the officer aircrewmen

O = the number of officers per aircrew

CF = the crew factor or the number of aircrews contained in the squadron divided by the number of aircraft

OPR = the officer pay rate* (FY76 = $20,272)

2. Aircrew (Enlisted)

This is the cost of paying enlisted personnel who perform as crew-members for the aircraft. Although they may perform maintenance or other duties when not flying, their cost is shown in this element.

$$EA = E \times CF \times EPR$$

where,

EA = the cost of paying enlisted aircrewmen

E = the number of enlisted personnel per aircrew

CF = the crew factor

EPR = the enlisted pay rate* (FY76 = $8,810)

---

*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. Should it be determined that rates other than the Navy average are preferable, they may be easily input into the model as described in Appendix C.

3. Combat Command Staff

This element represents the pay of manpower necessary for management and supervision of squadron operations. It typically includes the personnel found in the Squadron Administration Department provided they are not already costed in Element 1. Aircrew (Officers) or 2. Aircrew (Enlisted).

$$CCS = (OC \times OPR) + (EC \times EPR)$$

where,

CCS = the cost of combat command staff manpower

OC = the number of combat command staff officers divided by the number of squadron aircraft

OPR = the officers pay rate

EC = the number of combat command staff enlisted divided by the number of squadron aircraft

EPR = the enlisted pay rate

4. Aviation POL

Aviation POL is the cost of petroleum, oil and lubricants (including fuel additives) consumed by aircraft in flight operations and maintenance. It is estimated with the following equation:*

$$POLF = 0.153 \times GTOW^{0.534}_{(4.38)} \times MS^{0.808}_{(8.13)}$$

$\bar{R}^2 = 0.916$

$N = 10$

$F = 50.0$

$S.E.E. = 1.88$

---

* t statistics are given in parentheses below the estimated value.

where,

POLF = the cost per flying hour of POL assuming a base price of $0.394 per gallon of JP-5

GTOW = the gross take-off weight of the aircraft in thousands of pounds

MS = the maximum speed for level flight at altitude given in miles per hour

5. Other Deployed Manpower

This is the cost of all squadron personnel who are not costed in Elements 1. Aircrew (Officers), 2. Aircrew (Enlisted), 3. Combat Command Staff, or the Maintenance Department covered by Element 7. Aircraft Maintenance Manpower. It consists primarily of the Integrated Services section of the squadron and contains commissarymen, food servicemen, laundrymen, stewards, supply clerks, pay clerks, medical technicians and other miscellaneous billets. It is calculated with the following equation:

$$ODM = -0.503 + \underset{(26.04)}{0.230} \times (SP)^{0.5}$$

$$\bar{R}^2 = 0.983$$

$$N = 13$$

$$F = 678$$

$$S.E.E. = 2.83$$

where,

ODM = the number of other deployed manpower per aircraft

SP = the total number of personnel in the squadron to be supported.

SP can be computed with the following equation:

$$SP = ((O+E) \times CF + OC + EC + MO) \times NA$$

where,

O = the number of officers per aircrew (from Element 1)

E = the number of enlisted per aircrew (from Element 2)

CF = the crew factor (from Element 1)

OC = the number of combat command staff officers per aircraft (from Element 3)

EC = the number of combat command staff enlisted per aircraft (from Element 3)

MO = the number of maintenance and operating personnel per aircraft (from Element 7)

NA = the number of aircraft per squadron

6. Air Temporary Additional Duty (TAD)

This is the cost of travel, lodging and incidental expenses incurred so that squadron personnel can receive training, usually maintenance-related. Because of its small size and insensitivity to aircraft characteristics, it is estimated outside the model and throughput. Annual TAD costs range from $2,000 to $24,000 per aircraft, but usually are in the $5,000 - $13,000 range. They can be estimated by examining the NARM data for a similar aircraft.

7. Aircraft Maintenance Manpower

This element consists of the cost of all manpower necessary to support the total preventive and corrective maintenance actions performed on the aircraft and its installed systems and equipments. This includes the squadron personnel who are assigned TAD to the Aircraft Intermediate Maintenance Department. It is estimated with the following CER:

$$AMM = \underset{(11.81)}{(1.670 + 0.018MMHMO)} \times EPR$$

$\bar{R}^2$ = 0.933

N = 11

F = 139

S.E.E. = 2.23

where,

AMM = the cost of aircraft maintenance manpower

MMHMO = the number of direct maintenance manhours per month required to support a single aircraft

EPR = the enlisted pay rate

8. Maintenance Material

This is the cost of all maintenance supplies whether acquired by the Navy Stock Fund (NSF) or any other method of funded purchase which are not repaired for reuse. The costs are incurred at both the organizational and intermediate level.

The costs of Maintenance Material and Personnel Support Supplies (Element 9) are estimated with a single equation and allocated according to the relative average costs observed in the fleet. The equation for the cost per flying hour is:

$$MM = (0.008MS^{\underset{(2.60)}{0.369}} \times MMHMO^{\underset{(5.14)}{1.098}}) \times 0.96$$

$\bar{R}^2$ = 0.809

N = 10

F = 24.0

S.E.E. = 0.26

where,

MM = the annual cost per flying hour of maintenance material

MS = the maximum speed for level flight at altitude given in miles per hour

MMHMO = the number of direct maintenance manhours per month required to support a single aircraft

9. Personnel Support Supplies

This cost element is often grouped with Element 8 in Navy data systems but is not maintenance related. The Personnel Support Supplies element is comprised of non-maintenance, aircrew-oriented supplies used by the squadron which relate to the health, safety and welfare of the crew, such as, flight suits, oxygen masks, charts, maps, in-flight meals, and others. The equation is:

$$PSS = (0.008MS^{0.369}_{(2.60)} \times MMHMO^{1.098}_{(5.14)}) \times 0.04$$

$$\bar{R}^2 = 0.809$$

$$N = 10$$

$$F = 24.0$$

$$S.E.E. = 0.26$$

where,

PSS = the cost per flying hour of personnel support supplies

MS = the maximum speed for level flight at altitude given in miles per hour

MMHMO = the number of direct maintenance manhours per month required to support a single aircraft

10. Base Operating Support

This is the cost of base manpower and operating funds necessary to provide the base services which support the squadron. Included in this cate-

gory are those personnel who are assigned to the base (not the squadron) and work in the laundry, mess, supply room and other areas. It also includes the base personnel who are permanently assigned to the AIMD of the air station. 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 an aircraft, the methodology used in the Navy Resource Model (NARM) Program Factors Manual was adopted to provide an estimate for Base Operating Support costs as well as several other elements which are similar in nature. Simply speaking,the NARM methodology identifies total support costs of specific type, such as B.O.S. costs, and allocates those costs back to the force units based on some proxy variable which is chosen to approximate that force unit's demand for support. Usually the proxy is direct manpower although not always. In each case where the NARM methodology is used in the succeeding elements, it will be identifed and the methodology, factors and proxies will be identified.

For B.O.S. the computation is done in the following manner. The costs 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 B.O.S. costs are considered variable with the forces. The one-third of the fund which is to be allocated is done so based on the number of squadron personnel (including Integrated Services) associated with the aircraft, i.e., the more personnel required to operate and support the aircraft, the more base services are required. The computation is as follows:

$$BO = 0.007 \times TSP$$

$$BE = 0.027 \times TSP$$

$$BOM = 463.712 \times TSP$$

$$BOS = (BO \times OPR) + (BE \times EPR) + BOM$$

where,

BO = the number of base operating officers necessary to support the squadron

TSP = total number of squadron personnel

BE = the number of base operating enlisted necessary to support the squadron

BOM = the O&M funds necessary to support the squadron

BOS = the total cost of base operating support

OPR = the officers pay rate

EPR = the enlisted pay rate

11. Component Rework

This is the cost of reworking or repairing components of the aircraft and its associated support equipment. This maintenance, which generally involves greater technical capability and more extensive facilities than are available at base level, is usually performed at the Naval Air Rework Facilities but can also be done by another service or by a contractor. When the work is done by another service or a contractor the cost is usually shown as a fixed price amount. When it is done by the NARF it consists of labor, material and overhead. The equation is:

$$CRF = 0.727 MMH^{1.249}_{(3.15)} \times GTOW^{0.405}_{(1.43)}$$

$\bar{R}^2 = 0.560$

N = 11

F = 6.0

S.E.E. = 0.42

where,

CRF = the component rework cost per flying hour

MMH = the number of maintenance manhours per flying hour necessary to support an aircraft

GTOW = the gross take-off weight (in thousands of pounds)

12. Airframe Rework

This is the cost including labor, material and overhead of making periodic inspections, repairs and overhaul of the airframe to assure its material condition. Since the periodic rework of an airframe does not occur every year, the model annualizes the unit cost by dividing by the rework cycle (the sum of the rework interval plus duration in months) and multiplying by 12 months. The CER given below provides an estimate of the unit cost.

$$AR = -15.078 + \underset{(3.11)}{0.130MMHMO} + \underset{(2.51)}{0.092MS}$$

$\bar{R}^2 = 0.753$

N = 12

F = 17.8

S.E.E. = 53.76

where,

AR = the unit cost of an airframe rework (in thousands)

MMHMO = the number of direct maintenance manhours per month required to support a single aircraft

MS = the maximum speed for level flight at altitude given in miles per hour

13. Engine Rework

This is the cost of repairing and overhauling aircraft engines primarily at the Naval Air Rework Facilities. Repair costs are incurred as needed and can be estimated based on historical data of aircraft with similar

engines, performance characteristics, missions, and flight profiles. Overhaul costs are incurred periodically according to maintenance policy and depend on the complexity, size, configuration, etc. of the engine. Both repair cost and overhaul cost can be expressed on a per flying hour basis. The frequency of engine repairs versus engine overhauls is assumed to be the same as the relative number of occurrences of repairs versus overhauls (1.6 for FY76) in the NARF data for the engines in the sample. The equations for estimating these costs are as follows:

$$EO = 1.093 + \underset{(7.29)}{45.064}TD + \underset{(3.63)}{1.211}D$$

$$\bar{R}^2 = 0.949$$

$$N = 9$$

$$F = 76.1$$

$$S.E.E. = 7.10$$

where,

EO = the unit cost of an engine overhaul (in thousands)

TD = turbofan dummy variable
- TD = 1 for turbofan engines
- TD = 0 otherwise

D = engine diameter in inches

$$ER = 8.469 + \underset{(2.76)}{4.138}TD + \underset{(5.22)}{0.752}T$$

$$\bar{R}^2 = 0.878$$

$$N = 9$$

$$F = 29.8$$

$$S.E.E. = 1.90$$

where,

ER = the unit cost of an engine repair (in thousands)

TD = turbofan dummy variable

TD = 1 for turbofan engines

TD = 0 otherwise

T = maximum engine thrust

$$ERT = \frac{EO + 1.6ER}{TBO} \times NE$$

where,

ERT = the total annual engine rework cost per aircraft

EO = engine overhaul cost (previously defined)

ER = engine repair cost (previously defined)

TBO = time between overhaul given in engine operating hours

NE = the number of engines per aircraft

14. Depot Supply Operations

This element represents the cost of managing the inventory of maintenance spare parts needed to support aircraft systems. When a new aircraft is introduced into the force, spare parts are procured to sustain aircraft operations. These parts are introduced into the supply system and resources are expended to manage (store, distribute, package and crate) these spares inventories. Based on past experience, factors are developed which size the cost of additional inventory management.

The NARM computed this cost by taking the cost shown in program element 71111N - Supply Depot Operations, and allocating to all ships and aircraft on the basis of direct requirements of manpower and operating funds i.e., MPN, O&M and APN. Specifically the equation is:

$$SDO = 0.025 \times (\text{total cost of elements } 1\text{-}9 + 11\text{-}13)$$

15. Technical Support

This is the cost of a number of programs, usually managed centrally, which support aircraft operations. A partial list of these programs is given below:

- Contractor Engineering Technical Services (CETS)
- Navy Engineering Technical Services (NETS)
- Depot Rework of Ground Support Equipment (GSE)
- Installation and Calibration of GSE
- Depot rework of Catapult and Arresting Gear
- Technical Publications Updates
- NAVAIRSYSCOM Representatives

The methodology for this element is quite complicated because of the large number of activities, costs, and proxy variables involved and will not be dealt with in detail here. Appendix B contains the complete, step-by-step methodology used to compute Technical Support.

16. Second Destination Transportation

This element represents the cost of shipping material needed to support the aircraft unit. Material includes: (1) spare and repair parts that are shipped between the centralized repair depots and the aircraft unit; and (2) support items that are needed by aircraft unit personnel such as food and office supplies. The NARM estimates Second Destination Transportation by allocating the costs contained in program element 78010N - Second Destination Transportation on the basis of direct requirements of operating funds. Specifically,

the equation is:

SDT = (0.057) x (cost of elements 4,8,9,12,13 and the unit cost of an airframe rework)

17. Individual Training

This is the cost of paying personnel in training who will replace unit personnel, the training staff and training operating funds. This includes all training from recruit training through undergraduate pilot and navigator training, as well as the operation and maintenance of trainers and simulators by the Fleet Aviation Specialized Operational Training Detachments (FASOTRA-DET's) and the Naval Air Maintenance Training Detachments (NAMTRADET's). This element does not include any aspect of Readiness Training which is costed as a separate squadron.

The NARM computes this cost 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 allocates to the aircraft on the basis of personnel.

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

The equations are:

TOM = 0.007(SBE) + 0.215(SBT)

TO = 0.068(SBO) + 0.004(SBT)

TE = 0.101(SBE) + 0.025(SBT)

TT = TOM + (TO x OPR) + (TE x ERR)

where,

TOM = training O&M funds

SBE = the number of squadron enlisted personnel (from Elements 2,3,4, and 7) and base operating enlisted (from Element 10)

SBT = the number of squadron enlisted personnel and officers (from Elements 2 and 3) and base operating enlisted and officers

TO = the number of officer staff required for training duties

SBO = the number of squadron officers and base operating officers

TE = the number of enlisted personnel required for training duties

TT = total training cost

OPR = officer pay rate

EPR = enlisted pay rate

18. Health Care

This is the cost of medical personnel and materials needed to provide medical support to aircraft unit personnel and to base personnel who provide direct support to the aircraft. The NARM estimates this cost by summing the variable portion (2/3) of the cost of medical operations and adding the pay of patients. The program elements used are given below:

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

The procedure used to estimate this cost using NARM methodology is as follows:

$$HOM = 0.346(SBT)$$

$$HO = 0.001(SBO) + 0.010(SBT)$$

$$HE = 0.005(SBE) + 0.081(SBT)$$

$$HT = HOM + (HO \times OPR) + (HE \times EPR)$$

where,

HOM = health care O&M funds

SBT = the number of squadron enlisted personnel and officers (from Elements 2 and 3) and base operating enlisted and officers

HO = the number of health care officers

SBO = the number of squadron officers and base operating officers

HE = the number of health care enlisted personnel

SBE = the number of squadron enlisted personnel (from Elements 2,3,4, and 7) and base operating enlisted (from Element 10)

HT = the total cost of health care

OPR = officer pay rate

EPR = enlisted pay rate

19. Personnel Activities

This is the cost of permanent change of station (PCS), recruiting and examining activities, transients and prisoners. PCS is the cost of duty station rotation for all squadron and supporting personnel. PCS rates are figured for officers and enlisted personnel by dividing the total PCS cost by the number of personnel, producing a PCS cost per person. This is multiplied by the number of personnel as shown in the following equation:

$$PCS = 1760(SBO) + 542(SBE)$$

where,

PCS = the annual cost of PCS for squadron personnel

SBO = the number of squadron officers and base operating officers

SBE = the number of squadron enlisted personnel (from Elements 2,3,4, and 7) and base operating enlisted (from Element 10)

The remainder of the cost for this element is computed by the NARM by summing two-thirds of the cost of recruiting and examining and all the cost of transients and prisoners. The program elements and computational procedures are given below:

81412N Recruiting & Examining

81411N Prisoners

81415N Transients

$$REOM = 0.102(SBE)$$

$$REO = 0.001(SBE)$$

$$REE = 0.008(SBE)$$

$$PE = 0.003(SBE)$$

$$TO = 0.058(SBO)$$

$$TE = 0.051(SBE)$$

$$TPA = PCS+REOM+(REOxOPR)+(REExEPR)+(PExEPR)+(TOxOPR)+(TExEPR)$$

where,

REOM = recruiting and examining O&M funds

SBE = the number of squadron enlisted personnel (from Elements 2,3,4, and 7) and base operating enlisted (from Element 10)

REO = recruiting and examining officers

REE = recruiting and examining enlisted

PE = enlisted prisoners

TO = the number of officer transients

SBO = the number of squadron officers and base operating officers

TE = the number of enlisted transients

TPA = the total cost of personnel activities

OPR = officer pay rate

EPR = enlisted pay rate

20. Replenishment Spares

This is the cost of procuring aircraft assemblies, spares and repair parts which are normally repaired and returned to stock. In addition, it includes procurement of stock levels that are not provided by initial spares procurement. These are centrally managed investment type items. This cost is estimated as a percentage of Component Rework cost. The same procedure is utilized by NAVAIR in preparation of their program factors and also by the NARM Program Factors Manual, although the NARM adjusts the relationship to reflect the overall relationship of Component Rework and Replenishment Spares funding. The model follows the NARM methodology and estimates with the relationship given below:

$$RSF = 0.59\ CRF$$

where,

RSF = the cost of replenishment spares per flying hour

CRF = the cost of component rework per flying hour

21. Modifications

The cost of modifying aircraft, ground equipment, and training operations to enable them to perform mission essential tasks (not new capability), and to improve reliability or reduce maintenance cost. This includes the cost of purchasing the modifications including the requisite engineering plus the cost of depot installation. There is no installation cost involved at the organizational and intermediate levels since those personnel are dedicated to support of the aircraft and their time is included in the other cost elements. This cost is estimated as a percentage of flyaway cost. The equation is:

$$M = 0.004FC$$

where,

M = the cost of aircraft safety modifications

FC = the flyaway cost per aircraft (in thousands)

22. Replacement of Ground Support Equipment

This is the cost of replacement of ground servicing equipment, maintenance and repair ship equipment, instruments and laboratory test equipment, and other miscellaneous items such as ground generators, jet engine test stands, test sets for radios, radars, and fire control systems, hand tools, compressors, and gauges. These equipment demands are generated by the need to replace common and peculiar ground support equipment that is worn out or destroyed. This cost element is also estimated as a percentage of flyaway cost. The equation is:

$$RGSE = 0.003FC$$

where,

RGSE = the cost of replacement GSE

FC = the flyaway cost per aircraft (in thousands)

23. Training Ordnance

This is the cost of all conventional expendables used in non-combat flight operations of squadron aircraft for the purpose of keeping aircrews proficient in weapons delivery techniques. It includes the cost of sonobuoys, pyrotechnics, ballistic and guided weapons, as well as all conventional ordnance. Because the cost of Training Ordnance is not related to the physical characteristics or reliability and maintainability parameters which have been used throughout the model, an estimate must be made outside the model. To do this the analyst must first determine the weaponry installed or carried on the aircraft and then find the number that must be expended annually to maintain readiness.

For the purpose of providing a guideline the following table (IV-1) provides a listing of planned ordnance expenditures for several types of aircraft. It is important to note that actual expenditures can vary significantly depending on funding considerations, war reserve stockpile considerations, and other reasons. The table also does not contain any air-launched missile costs, which should be included in an O&S analysis if there are operational launches. It is assumed, however, that the use of the Advanced Combat Maneuvering Ranges (ACMR's) will eliminate most of missile firings done simply for training purposes.

TABLE IV-1

REPRESENTATIVE ANNUAL TRAINING ORDNANCE COSTS

| | | - Annual Cost per A/C - | | |
|---|---|---|---|---|
| Weapon | Unit Cost | Attack | Fighter | ASW |
| MK-87WSF | 83 | 1,494 | 9,960 | 996 |
| MK-76 | 11 | 5,040 | 268 | 1,702 |
| MK-77 | 440 | — | — | — |
| MK-106 | 14 | 861 | — | — |
| MK-82 | 570 | 13,680 | 9,120 | — |
| MK-83 | 1,150 | 2,300 | — | — |
| MK-84 | 1,900 | 1,900 | — | — |
| 30mm | 6 | — | — | — |
| MK-12 20mm | 2 | 6,000 | — | — |
| M61 20mm | 2 | 11,750 | 5,640 | — |
| MK-24/25FLARE | 135 | 4,050 | 1,620 | 5,400 |
| ZUNI | 571 | 9,136 | 9,136 | 9,136 |
| FF 2.75(U) | 60 | 4,200 | 4,200 | 4,200 |
| AN/SSQ 41 | 160 | — | — | 12,800 |
| AN/SSQ 53 | 465 | — | — | 13,950 |
| AN/SSQ 50 | 450 | — | — | 18,000 |
| AN/SSQ 62 | 645 | — | — | 19,350 |
| AN/SSQ 47 | 450 | — | — | 18,000 |
| AN/SSQ 36 | 145 | — | — | 1,450 |
| MK-46 | 3,021 | — | — | 6,042 |
| TOTAL | | 60,411 | 39,944 | 111,026 |

# V. CONCLUSIONS

The aircraft operating and support cost model, described in detail in the preceding sections, has been used to support many analytical studies and has proven to be accurate and useful. Despite this practical endorsement it is important to continually assess the model's capabilities, to identify the weaker aspects, and to look for ways of improving them. The following areas were judged to be ones that would benefit from further study.

Fiscal 1977 Data - The data for fiscal 1977, which should be available shortly, should be obtained and used to update the equations. This is necessary to reflect the changes in the aircraft inventory, maintenance policies, prices, operational scenarios, and many other parameters.

New Data Sources - With the preparation of FY77 data, new sources become available which should enhance the capability for estimating Component Rework and Replenishment Spares costs. The primary new data source is the Visibility and Management of Operating and Support Costs (VAMOSC) System and although it began publishing data for FY75, program errors have caused notable problems so far. The FY77 VAMOSC data for Component Rework, although still algorithmic rather than historical, should provide a much improved data base for developing CER's for Component Rework and Replenishment Spares.

Modifications and Replacement of Ground Support Equipment - These two elements, which are currently being estimated as a percentage of flyaway cost, should be examined in further detail. A recent application of this model

to future aircraft highlighted the fact that maintenance costs are declining as aircraft are being designed to be more maintainable and reliable, but Modifications and Replacement GSE are becoming more costly as the costs of new hardware increase. Data should be obtained so that a CER can be developed or, at least, so the current factors can be updated or verified. In other words, these two elements promise to become increasingly prominent in the future O&S analyses, therefore it is important that the estimating precision increase accordingly. Data should be obtained to permit CER development or, at least, to permit verification or revision of the factors currently being used.

# APPENDIX A

## DATA FOR COST-ESTIMATING RELATIONSHIPS

(U) TABLE A-1

DATA BASE FOR PETROLEUM, OIL AND LUBRICANTS (POL)
COST-ESTIMATING RELATIONSHIP (U)

| Aircraft | 1<br>POL Cost<br>Per Flying Hr. | 2<br>Gross Take-off<br>Weight (Thous.lbs.) | 3<br>Max Speed (mph) |
|---|---|---|---|
| A-4F | 193.1 | 27.4 | 675 |
| A-6E | 372.3 | 58.6 | 648 |
| A-7E | 238.3 | 42.0 | 698 |
| E-1B | 64.1 | 24.0 | 243 |
| E-2B | 150.3 | 51.7 | 368 |
| F-4J | 545.1 | 54.6 | 1,717 |
| F-8H | 283.2 | 30.0 | 1,400 |
| P-3C | 271.8 | 135.0 | 471 |
| RA-5C | 527.7 | 80.0 | 1,500 |
| S-3A | 147.3 | 42.5 | 498 |

Sources:

1 Op-51C, Flying Hour Cost Report, OPNAVINST 7310.1B.

2 Jane's All the World's Aircraft, 1974-75.

3 Ibid.

(U) TABLE A-2

DATA BASE FOR OTHER DEPLOYED MANPOWER COST-ESTIMATING RELATIONSHIPS (U)

| 1<br>Other Deployed<br>Manpower (Sqn.Total) | 2<br>Number of Squadron<br>Personnel to be Supported |
|---|---|
| 0 | 0 |
| 4 | 25 |
| 10 | 50 |
| 14 | 75 |
| 18 | 100 |
| 27 | 150 |
| 33 | 200 |
| 38 | 250 |
| 43 | 300 |
| 49 | 400 |
| 54 | 500 |
| 59 | 600 |
| 64 | 700 |

Sources:

[1] OPNAVINST C5311.3G (CONFIDENTIAL)

[2] Ibid.

(U) TABLE A-3

DATA BASE FOR OPERATING CONSUMABLES
COST-ESTIMATING RELATIONSHIP (U)

| Aircraft | 1 Oper. Con. Cost per Flying Hour | 2 Direct Maint. MH per month | 3 Max Speed (mph) |
|---|---|---|---|
| A-4F | 80.2 | 462 | 675 |
| A-6E | 153.3 | 1,119 | 648 |
| A-7E | 126.4 | 734 | 698 |
| E-1B | 83.9 | 512 | 243 |
| E-2B | 177.6 | 1,339 | 368 |
| F-4J | 282.6 | 981 | 1,717 |
| F-8H | 165.8 | 780 | 1,400 |
| P-3C | 142.8 | 994 | 471 |
| RA-5C | 716.0 | 1,911 | 1,500 |
| S-3A | 221.6 | 976 | 498 |

Sources:

1 Op-51C, Flying Hour Cost Report, OPNAVINST 7310.1B

2 3-M Aircraft Maintenance Cost Report, MS04790.A2391-01 for FY1976

3 Jane's All the World's Aircraft, 1974-75

(U) TABLE A-4

DATA BASE FOR COMPONENT REWORK COST-ESTIMATING RELATIONSHIP (U)

| Aircraft | 1<br>Component Rework<br>Cost per Flying Hour | 2<br>Maint. MH<br>per Flying Hour | 3<br>Gross Take-off<br>Weight (Thous. lbs.) |
|---|---|---|---|
| A-4F | 137 | 21.1 | 27.4 |
| A-6E | 543 | 37.8 | 58.6 |
| EA-6B | 543 | 44.3 | 58.6 |
| A-7A | 203 | 31.2 | 42.0 |
| A-7E | 339 | 25.5 | 42.0 |
| E-1B | 123 | 36.1 | 24.0 |
| E-2B | 445 | 43.7 | 51.7 |
| F-4J | 270 | 43.4 | 54.6 |
| F-14A | 607 | 54.9 | 72.0 |
| P-3B | 143 | 19.1 | 135.0 |
| S-3A | 272 | 30.1 | 42.5 |

Sources:

1 "Navy Program Factors", FY1976 Naval Air Systems Command, January 1976

2 3-M Aircraft Maintenance Cost Report, MSO4790.A2391-01 for FY1976

3 Jane's All the World's Aircraft, 1974-75

(U) TABLE A-5

DATA BASE FOR AIRFRAME REWORK COST-ESTIMATING RELATIONSHIP (U)
(Costs in Thous. of FY76$)

| Aircraft | 1<br>A/C Rework<br>Unit Cost | 2<br>Direct Maintenance<br>MH per Month | 3<br>Max Speed<br>(mph) |
|---|---|---|---|
| RA-5C | 331.0 | 1,911 | 1,500 |
| F-14A | 327.0 | 930 | 1,757 |
| P-3B | 213.9 | 1,123 | 471 |
| A-6E | 142.4 | 1,119 | 648 |
| E-1B | 104.7 | 512 | 243 |
| A-4F | 73.3 | 462 | 675 |
| C-1A | 44.0 | 449 | 200 |
| S-2E | 31.2 | 335 | 265 |
| A-7E | 72.1 | 734 | 698 |
| E-2C | 245.6 | 1,024 | 368 |
| RF-8G | 207.2 | 698 | 1,352 |
| T-28B | 55.1 | 244 | 350 |

Sources:

1 Industrial Performance Summary for Naval Air Rework Facilities, FY1976

2 3-M Aircraft Maintenance Cost Report, MS04790.A2391-01 for Fy1976

3 Jane's All the World's Aircraft, 1974-1975

(U) TABLE A-6

DATA BASE FOR ENGINE REWORK COST-ESTIMATING RELATIONSHIP (U)
(Costs in Thous. of FY76$)

| Engine | 1 Average Unit Overhaul Cost | 2 Average Unit Repair Cost | 3 Turbofan Dummy | 4 Thrust (Thou.) | 5 Diameter (Inches) |
|---|---|---|---|---|---|
| J52-P8B | 37.8 | 14.9 | 0 | 9.3 | 30.2 |
| J52-P408 | 44.6 | 17.6 | 0 | 11.2 | 30.2 |
| J57-P10 | 48.8 | 14.6 | 0 | 10.5 | 38.9 |
| J79-GE8 | 42.6 | 22.8 | 0 | 17 | 38.3 |
| J79-GE10 | 42.6 | 22.4 | 0 | 17.9 | 39.1 |
| TF30-P408 | 92.3 | 24.1 | 1 | 13.4 | 42 0 |
| TF30-P412A | 118.7 | 24.5 | 1 | 20 | 50 0 |
| J85-GE4A | 25.6 | 10.3 | 0 | 3 | 17.7 |
| TF41-A2 | 85.4 | 25.6 | 1 | 15 | 37.5 |

Sources:

1 Industrial Performance Summary for Naval Air Rework Facilities, FY76

2 Ibid.

3 Jane's All the World's Aircraft, 1974-75

4 Ibid.

5 Ibid.

# APPENDIX B

## COMPUTATION METHODOLOGY FOR TECHNICAL SUPPORT (Element 18)

## COMPUTATION METHODOLOGY FOR TECHNICAL SUPPORT (Element 18)

The procedure for computing Technical Support can best be explained through the use of three tables. Table B-1 contains the list of input-cost estimates for elements 1-5, 7-9, and 11-13 which are used as proxy variables. Table B-2 contains the three computation procedures, the type aircraft which are appropriate for each procedure, and the various groups of logistics sectors which are used for each type aircraft. Table B-3 contains a listing of all the groups, the logistic sectors contained therein, the proxy variable or variables for that sector or sectors, and the cost factor to be applied to the proxy.

The procedure for generating an estimate would be as follows. First the cost estimates for elements 1-5, 7-9, and 11-13 are obtained and, with the required program data, all the costs shown in Table B-1 are obtained. Secondly, a determination is made as to which type aircraft is being estimated and the appropriate group numbers are noted from Table B-2. Finally, using the groups determined from Table B-2 and the proxy values indicated by Table B-1, the cost factors from Table B-3 are applied and the sector results are summed. The estimate is in thousands of dollars.

Example

As an example, assume the following cost estimates have been prepared for an aircraft being reviewed:

| | | |
|---|---|---|
| Total Number of Direct Officers | O = | 1.69 |
| Total Number of Direct Enlisted | E = | 16.63 |

| | | |
|---|---|---|
| Annual Replenishment Spares Cost | RS | = 64.23 |
| Annual POL Cost | P | = 124.85 |
| Annual O&I Material Cost Plus Personnel Support Supplies | OI | = 58.04 |
| Annual Engine Overhaul Cost | EO | = 41.12 |
| Annual Component Rework Cost | CR | = 101.96 |
| Annual A/C Rework Cost | AC | = 24.23 |
| Cost per A/C Rework | CA | = 96.94 |
| Flying Hours per Year | FY | = 420 |
| Aircraft Operations (P+OI) | AO | = 182.89 |
| Aircraft Maintenance (EO+CR+AC) | AM | = 167.31 |

The example aircraft is a Type 3 aircraft and therefore is computed by using groups 1,3,4,5,6, and 32 according to Table B-2. Group 1 will be computed in detail.

GROUP 1

| Proxy Variables | | Factor from Table B-3 | | Group 1 Technical Support Cost |
|---|---|---|---|---|
| AO = 182.89 | | | | |
| AM = 167.31 | | | | |
| RS = 64.23 | | | | |
| 414.43 | x | 0.0065 | = | 2.7 |

Using this procedure all valid groups are computed using the factors in Table B-3 and summed.

| Group | Proxy Value | Factor | Estimate |
|---|---|---|---|
| 1. | 414.43 | 0.0065 | 2.7 |
| 3. | 240.02 | 0.1951 | 46.8 |
| 4. | 18.32 | 0.0326 | 0.6 |
| 5. | 420 | 0.0179 | 7.5 |
| 6. | 240.02 | 0.0055 | 1.3 |
| 32. | 18.32 | 0.0046 | 0.1 |
| | | | 59.0 |

Technical Support 59.0

TABLE B-1

OPERATING AND SUPPORT COST ELEMENTS
WHICH SERVE AS PROXY VARIABLES

| Cost | Abbreviation | Source Elements |
|---|---|---|
| Total Number of Direct Officers (per A/C) | O | 1, 2 |
| Total Number of Direct Enlisted (per A/C) | E | 2, 3, 5, 7 |
| Annual Replenishment Spares Cost | RS | 22 |
| Annual POL Cost | P | 4 |
| Annual O&I Material Cost Plus Personnel Support Supplies Cost | OI | 8, 9 |
| Annual Engine Rework Cost | EO | 13 |
| Annual Component Rework Cost | CR | 11 |
| Annual A/C Rework Cost | AC | 12 |
| Cost per A/C Rework | CA | 12, Program Data |
| Flying hours/year | FY | Program Data |

For ease of use two more proxy variables will be introduced to represent the frequently used sum of several other variables.

| | |
|---|---|
| Aircraft Operations | AO = P + OI |
| Aircraft Maintenance | AM = EO+CR+AC |

TABLE B-2

COMPUTATION OF COSTS

| Type of Aircraft | Valid Groups |
|---|---|
| 1. Anti-Submarine Warfare Aircraft | 1, 2, 3, 4, 5, 6, 32 |
| 2. Non-Advanced Developed Aircraft | 1, 3, 4, 5, 6, 32, 33, 34, 35 |
| 3. All Other Aircraft | 1, 3, 4, 5, 6, 32 |

TABLE B-3

COMPUTATION OF SECTOR COSTS

| Group # | Logistic Sector | Title | Proxy Variable | Factor |
|---|---|---|---|---|
| 1 | 4 | NAVWESA PROG. MAN. OFF. | AO+AM+RS | 0.0065 |
| 2 | 15 | SONOBOUY SPT. | AO+AM+RS | 0.0289 |
| 3 | 11 | NAVAIRSYSCOM REPS. | EO+CR+CA | 0.1951 |
| | 20 | TECH. PUB. SPT. , NAESU, A/L WEAPONS R&M, CALIBRATION, GSE REWORK, Et.Al. | | |
| 4 | 89 | BASE COMM. | O+E | 0.0326 |
| | 90 | BASE OPS DIRECT | | |
| 5 | 10 | FIXED WING EVAL., TACTICS QUAL.EVAL., PHOTOG., SUS. ENGR. A/C, Et.Al. | FY | 0.0179 |
| | 21 | CATS. & ARR. GEAR, OH of A/C CAMERAS, AIRBORNE MINE COUNTERS | | |
| 6 | 26 | MAINT. ENGR. SPT. | EO+CR+CA | 0.0055 |
| 32 | 92 | BASE COMM. | O+E | 0.0046 |
| 33 | 3 | NAV. PROS. | RS | 0.0178 |
| | 6 | COMMAND | | |
| | 13 | INSTALL GSE ATE SOFTWARE | | |
| 34 | 12 | NAILSC GSE | RS | 0.0015 |
| 35 | 87 | INIT SPT-PROV. ACT. | RS | 0.0023 |

# APPENDIX C

# USER INSTRUCTIONS

# USER INSTRUCTIONS

## 1. Introduction

The aircraft model is operated at the Op-96D offices utilizing NCSS VP/CSS, a terminal oriented, dial-up system. It is written in Fortran IV and stored in file[1] AIRMODEL FORTRAN. File definitions and loading statements are stored in file AIRMODEL EXEC. In order to execute the model, one must access the system through an approved user name and password, and type AIRMODEL $fn_1$ $fn_2$, where $fn_1$ and $fn_2$ are the file names to be used by the model for data input.

$fn_1$ may be either T (for Terminal) or the name[2] of a pre-stored file. Initial input entries must be via $fn_1$.

$fn_2$ is optional. If no entry is made, all changes and/or thruput entries are assumed to be via $fn_1$ otherwise, $fn_2$ may be either T or the name[2] of a pre-stored file.
If $fn_2$ is present, all changes and/or thruput for the model execution, as well as any subsequent iterations of the model must be made via $fn_2$.
If either $fn_1$ or $fn_2$ is specified as T, the model will instruct the user to enter the appropriate data as needed. Otherwise no comments will be made by the model during the input phase.

---

[1]In the VP/CSS system all files have three identifiers; filename, filetype, and filemode. If omitted, the filemode defaults to P. All files used in connection with this model are filemode P.

[2]For the input files of this model, two filetype names have been reserved. AIRINP is the filetype associated with $fn_1$ and AIRTHRU is the filetype associated with $fn_2$.

2. Input

Whether input directly through the terminal or via a pre-stored file, the input values are entered in the same format, which is as follows:

Name

$P_1, P_2, \ldots\ldots P_{23}$

$AC_1, AC_2, \ldots\ldots AC_n$

Name is a run descriptor (8 character maximum) and $P_1$ thru $P_{23}$ are parametric values in the order listed in Table C-1. $AC_1$ is the number of aircraft in year 1, $AC_2$ is the number of aircraft in year 2, and $AC_n$ is the number of aircraft in year n, where n represents the number of years being computed in this run. The value of n is contained in $P_4$. $P_1$ thru $P_{23}$ may utilize as many lines as required, as may $AC_1$ thru $AC_n$; however, both $P_1$ and $AC_1$ must start a line. Since $P_5$ provides the capability of entering a constant number of aircraft for each year, $AC_1$ thru $AC_n$ are not always required.

Aircraft input requirements are determined as follows:

if $P_4 = 0$, no life cycle costs are computed;

if $P_4 = n \neq 0$ and $P_5 = 0$, a variable stream of aircraft per year, $AC_1 \ldots\ldots AC_n$, is required;

if $P_4 = n \neq 0$ and $P_5 = m$, no aircraft stream is input, since a constant stream, $AC_i \ldots\ldots AC_n$, is computed such that all $AC_i = m$.

Changes to Input - Should the user desire to test the results of variations in the basic input, a capability for revising any of the values has been included.

TABLE C-1

REQUIRED INPUT

| INDEX | DESCRIPTION |
|---|---|
| 1 | MPN RATE (OFF) |
| 2 | MPN RATE (ENL) |
| 3 | STARTING FY |
| 4 | # OF YEARS |
| 5 | # A/C PER YR(EACH) |
| 6 | GROUND OFFICERS |
| 7 | OFF CREW ALLOW |
| 8 | ENL CREW ALLOW |
| 9 | MAINT MHR/MO |
| 10 | FLYING HRS/MO |
| 11 | AIR TAD (000$) |
| 12 | GROSS TAKEOFF WT |
| 13 | MAX SPEED(ALT MPH) |
| 14 | EMPTY WT (000LBS) |
| 15 | THRUST/ENG(000LBS) |
| 16 | TIME-B-OVHL (HRS) |
| 17 | ENGINE DIAMETER |
| 18 | ENG TYP(0JET 1FAN) |
| 19 | # OF ENGINES |
| 20 | A/C RW CYCLE (MOS) |
| 21 | FLYAWAY COST (MIL) |
| 22 | TRNG ORDN (THOUS) |
| 23 | A/C TYPE (1 2 3) |

The change format is as follows:

$i, P_i$

: :

$j, P_j$

0, 0

$i, AC_i$

: :

$j, AC_j$

0, 0

where,

$i,j$ = index numbers

$P_i, P_j$ = revised values for the $i^{th}$ and $j^{th}$ parameters

$AC_i, AC_j$ = revised values for the $i^{th}$ and $j^{th}$ years

and 0, 0 terminates each set of changes. Each change pair must be entered on a separate line.

Thruput - In some instances annual costs may be known for a specified element. Therefore, a capability for entering average annual costs directly has been provided. Should any other element cost be dependent on the item selected for thruput, that cost will be computed from the thruput cost. The thruput format is as follows:

$i, e_i$

: :

$j, e_j$

0, 0

where,

$i,j$ = element index numbers (see Table C-2)

$e_i, e_j$ = thruput values for the $i^{th}$ and $j^{th}$ average annualcost

and 0,0 terminates the set of thruputs.

3. Model Execution

Input Print Options - Prior to the execution of the model, the user has the option of printing the input to be used, in one of two formats.

a. The program queries the user with DESCRIBE INPUT?, and the user responds with Y or N. If the user answers Y, an input parameter table (Table C-3), and a computed value table (Table C-4), complete with index, value and descriptive text are printed. Next, the string of $AC_i$ values for the required number of years is printed and the model queries the user OK TO GO?. If the user responds Y, the model is executed. If the user responds N and the terminal input mode is in effect, the user will again be instructed to enter changes and thruput as described in preceeding paragraphs. If the terminal input mode is not in effect, the run will terminate and the user must make the required file changes.

b. If the user answered N to DESCRIBE INPUT?, the program query PRINT INPUT? is displayed. If the user responds Y, the input parameter values and the computed values, devoid of descriptive text, and the string of AC values are printed and the program proceeds exactly as described above. The OK TO GO? interrogatory is included to give the user an opportunity to review and confirm input, thruput, and computed values before lengthy output is printed.

TABLE C-2

COST ELEMENTS STRUCTURE WITH INDEX NUMBERS

OPERATING AND SUPPORT COST

| INDEX | ELEMENTS |
|---|---|
| 1 | DEPLOYED UNIT OPS |
| 2 | AIRCREWS(OFFICERS) |
| 3 | AIRCREWS(ENLISTED) |
| 4 | COMBAT COMMAND STF |
| 5 | POL |
| 6 | OTHER DEPLOYED MPN |
| 7 | AIR TAD |
| 8 | BELOW-DEPOT MAINT |
| 9 | A/C MAINT MPN |
| 10 | MAINTENANCE MAT'L |
| 11 | PERS SUP SUPPLIES |
| 12 | INSTALLATIONS SUP |
| 13 | BASE OPS SUPPORT |
| 14 | O&M BASE OPS |
| 15 | MPN BASE OPS |
| 16 | DEPOT MAINTENANCE |
| 17 | COMPONENT REWORK |
| 18 | AIRFRAME REWORK |
| 19 | ENGINE REWORK |
| 20 | DEPOT SUPPLY |
| 21 | DEPOT SUPPLY OPS |
| 22 | TECHNICAL SUPPORT |
| 23 | 2ND DEST TRANS |
| 24 | 2ND DEST TRANS |

TABLE C-2 (cont'd.)

COST ELEMENTS STRUCTURE WITH INDEX NUMBERS

| | |
|---|---|
| 25 | PERS SUP & TRAIN |
| 26 | INDIVIDUAL TRAIN |
| 27 | O&M |
| 28 | MPN |
| 29 | HEALTH CARE |
| 30 | O&M |
| 31 | MPN |
| 32 | PERS ACTIVITIES |
| 33 | O&M |
| 34 | MPN |
| 35 | SUS INVESTMENTS |
| 36 | REPLEN SPARES |
| 37 | MODIFICATIONS |
| 38 | REPLEN GSE |
| 39 | TRAINING ORDNANCE |

TABLE C-3

INPUT PARAMETER TABLE

```
DESCRIBE INPUT ? Y

   SAMPLE

   INDEX          DESCRIPTION

       1          MPN RATE (OFF)
       2          MPN RATE (ENL)
       3          STARTING FY
       4          # OF YEARS
       5          # A/C PER YR(EACH)
       6          GROUND OFFICERS
       7          OFF CREW ALLOW
       8          ENL CREW ALLOW
       9          MAINT MHR/MO
      10          FLYING HRS/MO
      11          AIR TAD (000$)
      12          GROSS TAKEOFF WT
      13          MAX SPEED(ALT MPH)
      14          EMPTY WT (000LBS)
      15          THRUST/ENG(000LBS)
      16          TIME-B-OVHL (HRS)
      17          ENGINE DIAMETER
      18          ENG TYP(0JET 1FAN)
      19          # OF ENGINES
      20          A/C RW CYCLE (MOS)
      21          FLYAWAY COST (MIL)
      22          TRNG ORDN (THOUS)
      23          A/C TYPE (1 2 3)
```

TABLE C-4

COMPUTED VALUES

| COMPUTED INDEX | DESCRIPTION |
|---|---|
| 1 | A/C MAINT MPWR |
| 2 | OTHER DEPL MPWR |
| 3 | TOTAL DIRECT MPWR |
| 4 | DIRECT & B-OP OFF |
| 5 | DIRECT & B-OP ENL |
| 6 | POL ($/FH) |
| 7 | MM & PSS ($/FH) |
| 8 | COMP REW (000$/FH) |
| 9 | A/C REW (000$/REW) |
| 10 | ENG OVHL (000$/ENG) |
| 11 | ENG REP (000$/ENG) |

Computation - The model then computes average annual cost per UE, for each element, the total program cost for each element for each specified year, and costs by appropriation.

4. Output

Output is printed at the end of each execution of the model. The average annual cost per UE, by element and by appropriation is displayed in the first column. Subsequent columns provide total program costs by year in the same CES. Sample output is provided in Appendix D.

5. Iteration

At the conclusion of each output set, the program queries the user with MORE?. If the user responds with N, the program terminates. If the user responds with Y, the program is ready to accept further variations on input and produce another set of results.

# APPENDIX D

# SAMPLE RUNS

STORED FILE FOR RUN

```
PRINTF SAMPLE AIRINP

SAMPLE
 20.272 3.810 1980 11 0
 .25 1.6 1.6 720 30 5 29.7 681 12.3 21.5 1000 40 0 1 30 3.4 40 3
7 19 40 73 105 135 164 192 219 243 268
```

STORED FILE INPUT RUN 1

```
13.22.04 >AIRMODEL SAMPLE T
DISK FILE ASSUMED
EXECUTION:


          ENTER PARAMETER CHANGES (INDEX,VALUE)
                                  DELIMITOR = 0,0
>0,0

          ENTER AC BY YR CHANGES (YR,VALUE)
            WHERE YR=1 THRU 11 AND DELIMITOR = 0,0

>0,0

          ENTER THRUPUT VALUES (INDEX,VALUE)
                                  DELIMITOR = 0,0
>0,0
```

RUN 1 (cont'd.)

DESCRIBE INPUT ?
>Y



SAMPLE

| INDEX | VALUE | DESCRIPTION |
|---|---|---|
| 1 | 20.27 | MPN RATE (OFF) |
| 2 | 8.81 | MPN RATE (ENL) |
| 3 | 1980.00 | STARTING FY |
| 4 | 11.00 | # OF YEARS |
| 5 | 0.0 | # A/C PER YR |
| 6 | 0.25 | GROUND OFFICERS |
| 7 | 1.60 | OFF CREW ALLOWANCE |
| 8 | 1.60 | ENL CREW ALLOWANCE |
| 9 | 720.00 | MAINT MHR/MO |
| 10 | 30.00 | FLYING HRS/MO |
| 11 | 5.00 | AIR TAD (000$) |
| 12 | 29.70 | GROSS TAKEOFF WT |
| 13 | 681.00 | MAX SPEED(ALT MPH) |
| 14 | 12.30 | EMPTY WT (000LBS) |
| 15 | 21.50 | THRUST/ENG(000LBS) |
| 16 | 1000.00 | TIME-B-OVHL (HRS) |
| 17 | 40.00 | ENGINE DIAMETER |
| 18 | 0.0 | ENG TYP(0JET 1FAN) |
| 19 | 1.00 | # OF ENGINES |
| 20 | 30.00 | A/C RW CYCLE (MOS) |
| 21 | 3.49 | FLYAWAY COST (MIL) |
| 22 | 40.00 | TRNG ORDN (THOUS) |
| 23 | 3.00 | A/C TYPE (1 2 3) |

COMPUTED

| INDEX | VALUE | DESCRIPTION |
|---|---|---|
| 1 | 14.64 | A/C MAINT MPWR |
| 2 | 2.78 | OTHER DEPL MPWR |
| 3 | 20.87 | TOTAL DIRECT MPWR |
| 4 | 1.89 | DIRECT & 3-OP OFF |
| 5 | 19.53 | DIRECT & 3-OP ENL |
| 6 | 131.91 | POL ($/FH) |
| 7 | 134.53 | MM & PSS ($/FH) |
| 8 | 151.65 | COMP REW (000$/FH) |
| 9 | 141.45 | A/C REW (000$/REW) |
| 10 | 49.54 | ENG OVHL(000$/ENG) |
| 11 | 24.63 | ENG REP (000$/ENG) |

AC PER YR 7.0 19.0 40.0 73.0 105.0 135.0 164.0 192.0 219.0 243.0
268.0

? TO GO ?
>Y

RUN 1 (cont'd.)

SAMPLE

OPERATING AND SUPPORT COST ESTIMATE
(THOUSANDS OF FY76$)

| | AVERAGE ANNUAL COST PER UE | FY80 | FY81 | FY82 | FY83 | FY84 | FY85 |
|---|---|---|---|---|---|---|---|
| AC PER YR | | 7.0 | 19.0 | 40.0 | 73.0 | 105.0 | 135.0 |
| TOTAL | 730 | 4490 | 12188 | 26279 | 48510 | 70393 | 93065 |
| O&M | 362 | 1916 | 5199 | 11566 | 21660 | 32278 | 43411 |
| MPN | 273 | 1912 | 5190 | 10926 | 19940 | 28681 | 36876 |
| APN | 55 | 383 | 1038 | 2186 | 3990 | 5733 | 7373 |
| WPN | 40 | 280 | 760 | 1600 | 2920 | 4200 | 5400 |
| DEPLOYED UNIT OPS | 147 | 1026 | 2786 | 5865 | 10703 | 15395 | 19793 |
| AIRCREWS(OFFICERS) | 32 | 227 | 616 | 1297 | 2363 | 3406 | 4379 |
| AIRCREWS(ENLISTED) | 14 | 99 | 268 | 564 | 1029 | 1480 | 1903 |
| COMBAT COMMAND STF | 5 | 35 | 96 | 203 | 370 | 532 | 684 |
| POL | 65 | 458 | 1244 | 2620 | 4781 | 6876 | 8841 |
| OTHER DEPLOYED MPN | 25 | 172 | 466 | 981 | 1790 | 2575 | 3311 |
| AIR TAD | 5 | 35 | 95 | 200 | 365 | 525 | 675 |
| BELOW-DEPOT MAINT | 177 | 1242 | 3370 | 7095 | 12948 | 18624 | 23946 |
| A/C MAINT MPN | 129 | 903 | 2450 | 5158 | 9413 | 13539 | 17408 |
| MAINTENANCE MAT'L | 46 | 319 | 865 | 1821 | 3323 | 4780 | 6146 |
| PERS SUP SUPPLIES | 3 | 20 | 55 | 116 | 212 | 305 | 392 |
| INSTALLATIONS SUP | 16 | 109 | 296 | 622 | 1136 | 1633 | 2100 |
| BASE OPS SUPPORT | 16 | 109 | 296 | 622 | 1136 | 1633 | 2100 |
| O&M BASE OPS | 10 | 68 | 184 | 387 | 706 | 1016 | 1306 |
| MPN BASE OPS | 6 | 41 | 112 | 235 | 429 | 617 | 794 |
| DEPOT MAINTENANCE | 143 | 332 | 1037 | 2304 | 5669 | 9276 | 13333 |
| COMPONENT REWORK | 55 | 332 | 1037 | 2134 | 3935 | 5732 | 7370 |
| AIRFRAME REWORK | 57 | 0 | 0 | 396 | 1075 | 2263 | 4130 |
| ENGINE REWORK | 32 | 0 | 0 | 224 | 608 | 1281 | 2337 |
| DEPOT SUPPLY | 55 | 334 | 1042 | 2194 | 4003 | 5758 | 7403 |
| DEPOT SUPPLY OPS | 12 | 81 | 219 | 461 | 841 | 1209 | 1555 |
| TECHNICAL SUPPORT | 43 | 303 | 823 | 1733 | 3162 | 4548 | 5848 |
| 2ND DEST TRANS | 21 | 150 | 407 | 857 | 1564 | 2249 | 2892 |
| 2ND DEST TRANS | 21 | 150 | 407 | 857 | 1564 | 2249 | 2892 |

RUN 1 (cont'd.)

| | AVERAGE ANNUAL COST PER UE | FY80 | FY81 | FY82 | FY83 | FY84 | FY85 |
|---|---|---|---|---|---|---|---|
| PERS SUP & TRAIN | 76 | 535 | 1452 | 3057 | 5578 | 8024 | 10316 |
| INDIVIDUL TRAIN | 31 | 220 | 597 | 1256 | 2293 | 3298 | 4240 |
| O&M | 5 | 33 | 91 | 191 | 349 | 501 | 645 |
| MPN | 27 | 186 | 506 | 1065 | 1944 | 2796 | 3595 |
| HEALTH CARE | 16 | 111 | 301 | 634 | 1156 | 1663 | 2138 |
| O&M | 7 | 52 | 141 | 297 | 542 | 780 | 1002 |
| MPN | 8 | 59 | 160 | 337 | 614 | 883 | 1136 |
| PERS ACTIVITIES | 29 | 204 | 554 | 1167 | 2129 | 3063 | 3938 |
| O&M | 2 | 14 | 38 | 80 | 146 | 211 | 271 |
| MPN | 27 | 190 | 516 | 1086 | 1983 | 2852 | 3667 |
| SUS INVESTMENTS | 95 | 663 | 1798 | 3786 | 6910 | 9938 | 12778 |
| REPLEN SPARES | 32 | 225 | 612 | 1288 | 2351 | 3382 | 4348 |
| MODIFICATIONS | 14 | 98 | 265 | 558 | 1018 | 1464 | 1882 |
| REPLEN GSE | 8 | 59 | 161 | 340 | 620 | 892 | 1147 |
| TRAINING ORDNANCE | 40 | 280 | 760 | 1600 | 2920 | 4200 | 5400 |

RUN 1 (cont'd.)

| | FY86 | FY87 | FY88 | FY89 | FY90 | TOTAL |
|---|---|---|---|---|---|---|
| AC PER YR | 164.0 | 192.0 | 219.0 | 243.0 | 268.0 | 1465.0 |
| TOTAL | 114503 | 135122 | 155011 | 172887 | 191315 | 1024268 |
| O&M | 54183 | 64503 | 74461 | 83510 | 92743 | 435431 |
| MPN | 44798 | 52446 | 59821 | 66377 | 73206 | 400174 |
| APN | 8963 | 10493 | 11969 | 13230 | 14646 | 80064 |
| WPN | 6560 | 7680 | 8760 | 9720 | 10720 | 58600 |
| DEPLOYED UNIT OPS | 24045 | 28150 | 32109 | 35627 | 39293 | 214790 |
| AIRCREWS(OFFICERS) | 5319 | 6228 | 7103 | 7882 | 8693 | 47519 |
| AIRCREWS(ENLISTED) | 2312 | 2706 | 3087 | 3425 | 3778 | 20651 |
| COMBAT COMMAND STF | 831 | 973 | 1110 | 1232 | 1358 | 7425 |
| POL | 10740 | 12574 | 14342 | 15914 | 17551 | 95942 |
| OTHER DEPLOYED MPN | 4022 | 4709 | 5371 | 5960 | 6573 | 35931 |
| AIR TAD | 820 | 960 | 1095 | 1215 | 1340 | 7325 |
| BELOW-DEPOT MAINT | 29090 | 34056 | 38845 | 43102 | 47537 | 259854 |
| A/C MAINT MPN | 21147 | 24757 | 28239 | 31334 | 34557 | 188904 |
| MAINTENANCE MAT'L | 7466 | 8741 | 9970 | 11062 | 12200 | 66693 |
| PERS SUP SUPPLIES | 477 | 558 | 636 | 706 | 779 | 4257 |
| INSTALLATIONS SUP | 2551 | 2987 | 3407 | 3780 | 4169 | 22789 |
| BASE OPS SUPPORT | 2551 | 2987 | 3407 | 3780 | 4169 | 22789 |
| O&M BASE OPS | 1587 | 1858 | 2119 | 2352 | 2594 | 14177 |
| MPN BASE OPS | 964 | 1129 | 1287 | 1428 | 1575 | 8612 |
| DEPOT MAINTENANCE | 18256 | 22443 | 26487 | 30278 | 34035 | 164505 |
| COMPONENT REWORK | 8954 | 10482 | 11956 | 13267 | 14631 | 79932 |
| AIRFRAME REWORK | 5941 | 7633 | 9279 | 10863 | 12391 | 53976 |
| ENGINE REWORK | 3362 | 4323 | 5251 | 6143 | 7012 | 30547 |
| DEPOT SUPPLY | 8993 | 10529 | 12009 | 13326 | 14697 | 80337 |
| DEPOT SUPPLY OPS | 1889 | 2212 | 2523 | 2799 | 3087 | 16875 |
| TECHNICAL SUPPORT | 7104 | 8317 | 9487 | 10526 | 11609 | 63462 |
| 2ND DEST TRANS | 3513 | 4113 | 4691 | 5205 | 5741 | 31380 |
| 2ND DEST TRANS | 3513 | 4113 | 4691 | 5205 | 5741 | 31380 |

RUN 1 (cont'd.)

| | FY86 | FY87 | FY88 | FY89 | FY90 | TOTAL |
|---|---|---|---|---|---|---|
| PERS SUP & TRAIN | 12532 | 14672 | 16735 | 18569 | 20479 | 111949 |
| INDIVIDUL TRAIN | 5151 | 6030 | 6878 | 7632 | 8417 | 46011 |
| O&M | 783 | 917 | 1046 | 1161 | 1280 | 6997 |
| MPN | 4367 | 5113 | 5832 | 6471 | 7137 | 39014 |
| HEALTH CARE | 2598 | 3041 | 3469 | 3849 | 4245 | 23206 |
| O&M | 1218 | 1426 | 1626 | 1804 | 1990 | 10879 |
| MPN | 1380 | 1616 | 1843 | 2045 | 2255 | 12327 |
| PERS ACTIVITIES | 4784 | 5600 | 6388 | 7088 | 7817 | 42732 |
| O&M | 329 | 385 | 439 | 487 | 538 | 2939 |
| MPN | 4455 | 5215 | 5949 | 6600 | 7280 | 39793 |
| SUS INVESTMENTS | 15523 | 18173 | 20729 | 23000 | 25366 | 138664 |
| REPLEN SPARES | 5283 | 6185 | 7054 | 7827 | 8633 | 47189 |
| MODIFICATIONS | 2286 | 2676 | 3053 | 3387 | 3736 | 20422 |
| REPLEN GSE | 1394 | 1632 | 1861 | 2065 | 2278 | 12452 |
| TRAINING ORDNANCE | 6560 | 7680 | 8760 | 9720 | 10720 | 58600 |

MORE ?
>Y

TERMINAL CHANGES RUN 2

Assume that the user wants to investigate the O&S impact of a maintainability improvement. A typical one might be: lower DMMH/MO (#9) to 630, raise GTOW (#12) to 30.4, raise EW (#14) to 12.7, and raise flyaway cost (#21) to 3.9. The changes are input as follows:

```
          ENTER PARAMETER CHANGES (INDEX,VALUE)
                                  DELIMITOR = 0,0
>9,630
>12,30.4
>14,12.7
>21,3.9
>0,0

          ENTER AC BY YR CHANGES (YR,VALUE)
            WHERE YR=1 THRU 11 AND DELIMITOR = 0,0

>0,0

          ENTER THRUPUT VALUES (INDEX,VALUE)
                                  DELIMITOR = 0,0
>0,0


   DESCRIBE INPUT ?
>N
   PRINT INPUT?
>Y


      SAMPLE              20.27      8.81    1980.       11.        0.
                0.25       1.60      1.60     630.00     30.00      5.00
               30.40     681.00     12.70      21.50   1000.00     40.00
                0.0        1.00     30.00       3.90     40.00      3.00

        COMPUTED          13.02      2.63      19.10      1.89     17.77
             184.19     116.18     129.58     129.71     49.54     24.63


      AC PER YR     7.0  19.0  40.0  73.0 105.0 135.0 164.0 192.0 219.0 243.0
                  268.0


   OK TO GO ?
>Y
```

RUN 2 (cont'd.)

SAMPLE

OPERATING AND SUPPORT COST ESTIMATE
(THOUSANDS OF FY76$)

| | AVERAGE ANNUAL COST PER UE | FY80 | FY81 | FY82 | FY83 | FY84 | FY85 |
|---|---|---|---|---|---|---|---|
| AC PER YR | | 7.0 | 19.0 | 40.0 | 73.0 | 105.0 | 135.0 |
| TOTAL | 681 | 4182 | 11350 | 24482 | 45203 | 66031 | 86771 |
| O&M | 336 | 1764 | 4788 | 10667 | 19989 | 29315 | 40144 |
| MPN | 252 | 1765 | 4790 | 10085 | 18405 | 26473 | 34037 |
| APN | 53 | 373 | 1012 | 2131 | 3888 | 5593 | 7190 |
| WPN | 40 | 280 | 760 | 1600 | 2920 | 4200 | 5400 |
| DEPLOYED UNIT OPS | 146 | 1023 | 2776 | 5844 | 10666 | 15341 | 19724 |
| AIRCREWS(OFFICERS) | 32 | 227 | 616 | 1297 | 2368 | 3406 | 4379 |
| AIRCREWS(ENLISTED) | 14 | 99 | 268 | 564 | 1029 | 1480 | 1903 |
| COMBAT COMMAND STF | 5 | 35 | 96 | 203 | 370 | 532 | 684 |
| POL | 66 | 464 | 1260 | 2652 | 4841 | 6962 | 8952 |
| OTHER DEPLOYED MPN | 23 | 162 | 441 | 928 | 1693 | 2436 | 3132 |
| AIR TAD | 5 | 35 | 95 | 200 | 365 | 525 | 675 |
| BELOW-DEPOT MAINT | 156 | 1095 | 2973 | 6260 | 11424 | 16431 | 21126 |
| A/C MAINT MPN | 115 | 808 | 2179 | 4587 | 8371 | 12040 | 15480 |
| MAINTENANCE MAT'L | 39 | 275 | 747 | 1573 | 2870 | 4128 | 5308 |
| PERS SUP SUPPLIES | 3 | 18 | 48 | 100 | 183 | 263 | 339 |
| INSTALLATIONS SUP | 14 | 100 | 270 | 569 | 1039 | 1495 | 1922 |
| BASE OPS SUPPORT | 14 | 100 | 270 | 569 | 1039 | 1495 | 1922 |
| O&M BASE OPS | 9 | 62 | 168 | 354 | 646 | 930 | 1196 |
| MPN BASE OPS | 5 | 38 | 102 | 215 | 393 | 565 | 726 |
| DEPOT MAINTENANCE | 131 | 927 | 986 | 2453 | 5000 | 8254 | 12123 |
| COMPONENT REWORK | 47 | 327 | 886 | 1866 | 3403 | 4393 | 6298 |
| AIRFRAME REWORK | 52 | 0 | 0 | 363 | 986 | 2075 | 3738 |
| ENGINE REWORK | 32 | 0 | 0 | 224 | 608 | 1281 | 2337 |
| DEPOT SUPPLY | 51 | 355 | 963 | 2027 | 3699 | 5321 | 6841 |
| DEPOT SUPPLY OPS | 11 | 75 | 203 | 427 | 780 | 1121 | 1442 |
| TECHNICAL SUPPORT | 40 | 280 | 760 | 1600 | 2919 | 4199 | 5399 |
| 2ND DEST TRANS | 20 | 138 | 374 | 788 | 1438 | 2068 | 2659 |
| 2ND DEST TRANS | 20 | 138 | 374 | 788 | 1438 | 2068 | 2659 |

RUN 2 (cont'd.)

| | AVERAGE ANNUAL COST PER UE | FY80 | FY81 | FY82 | FY83 | FY84 | FY85 |
|---|---|---|---|---|---|---|---|
| PERS SUP & TRAIN | 70 | 492 | 1335 | 2811 | 5129 | 7378 | 9486 |
| INDIVIDUL TRAIN | 29 | 202 | 547 | 1152 | 2103 | 3025 | 3890 |
| O&M | 4 | 31 | 83 | 175 | 319 | 459 | 590 |
| MPN | 24 | 171 | 464 | 978 | 1784 | 2566 | 3300 |
| HEALTH CARE | 14 | 101 | 275 | 580 | 1058 | 1522 | 1956 |
| O&M | 7 | 48 | 129 | 272 | 496 | 714 | 917 |
| MPN | 8 | 54 | 146 | 308 | 562 | 808 | 1039 |
| PERS ACTIVITIES | 27 | 189 | 512 | 1079 | 1968 | 2831 | 3640 |
| O&M | 2 | 13 | 35 | 73 | 133 | 191 | 246 |
| MPN | 25 | 176 | 478 | 1006 | 1835 | 2640 | 3394 |
| SUS INVESTMENTS | 93 | 653 | 1772 | 3731 | 6808 | 9793 | 12590 |
| REPLEN SPARES | 28 | 193 | 523 | 1101 | 2009 | 2890 | 3716 |
| MODIFICATIONS | 16 | 112 | 304 | 640 | 1167 | 1679 | 2159 |
| REPLEN GSE | 10 | 68 | 185 | 390 | 712 | 1024 | 1316 |
| TRAINING ORDNANCE | 40 | 280 | 760 | 1600 | 2920 | 4200 | 5400 |

RUN 2 (cont'd.)

| | FY86 | FY87 | FY88 | FY89 | FY90 | TOTAL |
|---|---|---|---|---|---|---|
| AC PER YR | 164.0 | 192.0 | 219.0 | 243.0 | 268.0 | 1465.0 |
| TOTAL | 106780 | 126023 | 144536 | 161272 | 178472 | 955201 |
| O&M | 50136 | 59709 | 68946 | 77343 | 85908 | 449209 |
| MPN | 41348 | 48408 | 55215 | 61266 | 67569 | 369362 |
| APN | 8735 | 10226 | 11665 | 12943 | 14274 | 78030 |
| WPN | 6560 | 7680 | 8760 | 9720 | 10720 | 58600 |
| DEPLOYED UNIT OPS | 23962 | 28053 | 31997 | 35504 | 39157 | 214046 |
| AIRCREWS(OFFICERS) | 5319 | 6228 | 7103 | 7882 | 8693 | 47518 |
| AIRCREWS(ENLISTED) | 2312 | 2706 | 3087 | 3425 | 3778 | 20651 |
| COMBAT COMMAND STF | 831 | 973 | 1110 | 1232 | 1358 | 7425 |
| POL | 10875 | 12731 | 14522 | 16113 | 17771 | 97143 |
| OTHER DEPLOYED MPN | 3805 | 4454 | 5080 | 5637 | 6217 | 33985 |
| AIR TAD | 820 | 960 | 1095 | 1215 | 1340 | 7325 |
| BELOW-DEPOT MAINT | 25664 | 30046 | 34271 | 38027 | 41939 | 229258 |
| A/C MAINT MPN | 18805 | 22016 | 25112 | 27864 | 30730 | 167985 |
| MAINTENANCE MAT'L | 6448 | 7549 | 3610 | 9554 | 10536 | 57597 |
| PERS SUP SUPPLIES | 412 | 482 | 550 | 610 | 673 | 3676 |
| INSTALLATIONS SUP | 2335 | 2733 | 3118 | 3459 | 3815 | 20355 |
| BASE OPS SUPPORT | 2335 | 2733 | 3118 | 3459 | 3815 | 20355 |
| O&M BASE OPS | 1452 | 1700 | 1939 | 2152 | 2373 | 12974 |
| MPN BASE OPS | 882 | 1033 | 1178 | 1307 | 1442 | 7881 |
| DEPOT MAINTENANCE | 16460 | 20284 | 23976 | 27445 | 30877 | 148384 |
| COMPONENT REWORK | 7650 | 9957 | 10216 | 11336 | 12502 | 68340 |
| AIRFRAME REWORK | 5443 | 7004 | 8509 | 9932 | 11363 | 49193 |
| ENGINE REWORK | 3362 | 4323 | 5251 | 6148 | 7012 | 30347 |
| DEPOT SUPPLY | 8310 | 9729 | 11097 | 12313 | 13580 | 74236 |
| DEPOT SUPPLY OPS | 1751 | 2051 | 2339 | 2595 | 2862 | 15646 |
| TECHNICAL SUPPORT | 6559 | 7679 | 8758 | 9718 | 10718 | 58590 |
| 2ND DEST TRANS | 3230 | 3781 | 4313 | 4786 | 5278 | 28851 |
| 2ND DEST TRANS | 3230 | 3781 | 4313 | 4786 | 5278 | 28851 |

RUN 2 (cont'd.)

| | FY86 | FY87 | FY88 | FY89 | FY90 | TOTAL |
|---|---|---|---|---|---|---|
| PERS SUP & TRAIN | 11524 | 13491 | 15388 | 17075 | 18831 | 102941 |
| INDIVIDUL TRAIN | 4725 | 5532 | 6310 | 7001 | 7722 | 42210 |
| O&M | 717 | 839 | 957 | 1062 | 1171 | 6401 |
| MPN | 4009 | 4693 | 5353 | 5940 | 6551 | 35809 |
| HEALTH CARE | 2377 | 2782 | 3174 | 3521 | 3884 | 21229 |
| O&M | 1114 | 1305 | 1488 | 1651 | 1821 | 9955 |
| MPN | 1262 | 1478 | 1685 | 1870 | 2062 | 11274 |
| PERS ACTIVITIES | 4422 | 5177 | 5905 | 6552 | 7226 | 39502 |
| O&M | 298 | 349 | 399 | 442 | 488 | 2666 |
| MPN | 4124 | 4828 | 5506 | 6110 | 6739 | 36836 |
| SUS INVESTMENTS | 15295 | 17906 | 20425 | 22663 | 24994 | 136630 |
| REPLEN SPARES | 4514 | 5284 | 6027 | 6688 | 7376 | 40321 |
| MODIFICATIONS | 2622 | 3070 | 3502 | 3886 | 4285 | 23425 |
| REPLEN GSE | 1599 | 1872 | 2135 | 2369 | 2613 | 14284 |
| TRAINING ORDNANCE | 6560 | 7680 | 8760 | 9720 | 10720 | 58600 |

MORE ?
>N

13.36.18 >LOGOUT

# APPENDIX E

# PROGRAM CODE

```
PRINTF AIRMODEL EXEC

&TYPE OFF
&F1 = 3
&IF &1 NE T &SKIP 2
&F1 = 5
&SKIP 1
FILEDEF FT03F001 &1 AIRINP
&IF &INDEX EQ 2 &SKIP 2
&F2 = &F1
&GOTO -REST
&F2 = 4
&IF &2 NE T &SKIP 2
&F2 = 5
&SKIP 1
FILEDEF FT04F001 &2 AIRTHRU
-REST
FILEDEF FT05F001 CONI
FILEDEF FT05F002 CONI
FILEDEF FT05F003 CONI
FILEDEF FT05F004 CONI
FILEDEF FT05F005 CONI
FILEDEF FT05F006 CONI
FILEDEF FT05F007 CONI
FILEDEF FT05F008 CONI
FILEDEF FT05F009 CONI
FILEDEF FT05F010 CONI
FILEDEF FT05F011 CONI
FILEDEF FT05F012 CONI
FILEDEF FT03F001 CONO
&STACK &F1 &F2
LOAD AIRMODEL
START
```

```
C:          AIRMODL FORTRAN
      COMMON /DAT/ SDAT(20,40), STOT(20,5), ACY(20)
      COMMON /PAR/ APIN(30), APCM(20),   JP,JT,KT,   IN1, IN2
      COMMON /UTL/ ISC(40), ISQ(40), ISV(40), ISX(40)
      COMMON /WRD/ SNAM, SWD(5,39), PWD(5,34)
C:
      REAL*8  SNAM, COMP
      DIMENSION    PIN(23), PCM(11)
      EQUIVALENCE  (PIN,APIN), (PCM,APCM)
      DATA   COMP/'COMPUTED'/, NYES/'Y'/, NONO/'N'/
C:
    5 FORMAT(A1)
    9 FORMAT(10X,'** ? ? ? **')
   20 FORMAT(//4X,'DESCRIBE INPUT ? ')
   22 FORMAT(//5X,A8//5X,'INDEX',7X,'VALUE',6X,'DESCRIPTION'//
     1    (8X,I2,F12.2,6X,4A4,A2) )
   30 FORMAT(4X,'PRINT INPUT? ')
   32 FORMAT(//6X,A8,5X,2F10.2,F8.0,2F10.0/(9X,6F10.2) )
   34 FORMAT(/8X,A8,3X,5F10.2/(9X,6F10.2) )
   38 FORMAT(//6X,'AC PER YR',1X,10F6.1/16X,10F6.1)
   40 FORMAT(//4X,'OK TO GO ? ')
   60 FORMAT(/4X,'MORE ? ')
C:
      CALL PIKFIL (IN1,IN2)
      IF (IN1.EQ.0)      RETURN
      CALL RDINP (IERR)
      IF (IERR.EQ.1)     RETURN
  100 CALL RDTHRU (IERR)
C:
      IF (KY.EQ.1.OR.PIN(5).EQ.0)    GO TO 200
      DO 152  I=2,KT
  152    ACY(I) = PIN(5)
C:
  200 CALL DOEQ
         JC = 11
  220 WRITE (8,20)
      READ (5,5)    NYN
      IF (NYN.EQ.NONO)  GO TO 230
      IF (NYN.EQ.NYES)  GO TO 224
      WRITE (8,9)
      GO TO 220
  224 WRITE (8,22)  SNAM, (J,PIN(J),(PWD(I,J), I=1,5), J=1,JP)
      WRITE (8,22)  COMP, (J,PCM(J),(PWD(I,J+JP), I=1,5), J=1,JC)
      GO TO 238
C:
  230 WRITE (8,30)
      READ (5,5)    NYN
      IF (NYN.EQ.NONO)  GO TO 240
      IF (NYN.EQ.NYES)  GO TO 234
      WRITE (8,9)
```

```
      GO TO 230
  234 WRITE (8,32)  SNAM, PIN
      WRITE (8,34)  COMP, PCM
  238 WRITE (8,38)  (ACY(I), I=2,KT)
  240 WRITE (8,40)
      READ (5,5)  NYN
      IF (NYN.EQ.NYES)  GO TO 250
      IF (IN2.EQ.5)     GO TO 100
      GO TO 400
C:
  250 DO 298  JJ=1,JT
         J = ISQ(JJ)
      DO 298  I=1,KT
         ANS = SDAT(I,J)
      IF (ISV(J).EQ.0.OR.I.GT.1)  CALL ESTM (I,J,ANS)
         SDAT(I,J) = ANS
      IF (ISC(J).EQ.0)  GO TO 270
         SDAT(I,ISC(J)) = SDAT(I,ISC(J)) + ANS
      IF (ISX(J).GT.1)  STOT(I,ISX(J)) = STOT(I,ISX(J)) + ANS
      GO TO 298
  270    STOT(I,1) = STOT(I,1) + ANS
  298 CONTINUE
C:
      DO 318  I=2,KT
         ACY(KT+1) = ACY(KT+1) + ACY(I)
      DO 308  J=1,5
  308    STOT(KT+1,J) = STOT(KT+1,J) + STOT(I,J)
      DO 318  J=1,JT
  318    SDAT(KT+1,J) = SDAT(KT+1,J) + SDAT(I,J)
C:
      CALL ACPRN
      IF (IERR.EQ.9)    GO TO 400
  320 WRITE (8,60)
      READ (5,5)  NYN
      IF (NYN.EQ.NONO)  GO TO 400
      IF (NYN.EQ.NYES)  GO TO 324
      WRITE (8,9)
      GO TO 320
  324    KTT = KT+1
      DO 333  I=1,KTT
      DO 328  J=1,5
  328    STOT(I,J) = 0
      DO 333  J=1,JT
      IF (ISV(J).EQ.0)  SDAT(I,J) = 0
      IF (I.EQ.KT+1)    SDAT(I,J) = 0
  333 CONTINUE
         ACY(KT+1) = 0
      GO TO 100
  400 RETURN
      END
```

```
      SUBROUTINE PIKFIL (IN1,IN2)
      REAL*8  KN1,KN2
      INTEGER*2   LN1(4), LN2(4), NN(3)
      EQUIVALENCE   (KN1,LN1), (KN2,LN2)
      DATA     NN/'3', '4', '5'/
    1 FORMAT(2A8)
   30 FORMAT(//10X,'FILE ID ERROR - RUN ABORTS',20X,2I2//)
   32 FORMAT(//10X,'EOF ON 5'//)
C:
      READ (5,1,END=112)  KN1, KN2
C:    WRITE (8,1)   KN1,KN2
         IN1 = 0
         IN2 = 0
      DO 102  N=1,3
      IF (LN1(1).EQ.NN(N))    IN1 = N+2
      IF (LN2(1).EQ.NN(N))    IN2 = N+2
  102 CONTINUE
      IF (IN1.EQ.3.OR.IN1.EQ.5)   GO TO 120
  110 WRITE (8,30)   IN1,IN2
         IN1 = 0
       RETURN
  112 WRITE (8,32)
      RETURN
  120 IF (IN2.LT.3.OR.IN2.GT.5)  GO TO 110
      RETURN
      END
      SUBROUTINE RDINP (IERR)
      COMMON /DAT/ SDAT(20,40), STOT(20,5), ACY(20)
      COMMON /PAR/ APIN(30), APCM(20),   JP,JT,KT,   IN1, IN2
      COMMON /UTL/ ISC(40), IS0(40), ISV(40), ISX(40)
      COMMON /WRD/ SNAM, SWD(5,39)
C:
      REAL*8  SNAM
      DIMENSION    PIN(23), PCM(11)
      EQUIVALENCE  (PIN,APIN), (PCM,APCM)
C:
    1 FORMAT(///)
    2 FORMAT(A8)
   40 FORMAT(//10X,'ENTER ID (8 CHAR MAX)'/)
   42 FORMAT(//10X,'ENTER',I2,'PARAMETER VALUES'/)
   44 FORMAT(//10X,'ENTER AC VALUES FOR EACH YR (',I2,' VALUES)'/)
C:
      IF (IN1.EQ.5)      GO TO 200
      READ (IN1,2,END=113)   SNAM
      READ (IN1,*,END=118)   PIN
         KT = PIN(4)+1
      IF (KT.EQ.1.OR.PIN(5).GT.0)   GO TO 110
      READ (IN1,*,END=118)   (ACY(I), I=2,KT)
  110 RETURN
  113 WRITE (8,32)
```

```
   32 FORMAT(//10X,'INSUFFICIENT DATA IN INPUT FILE - RUN ABORTS'//)
         IERR = 1
      RETURN
C:
  200 WRITE (8,1)
      WRITE (8,40)
      READ (5,2)    SNAM
      WRITE (8,42)  JP
      READ (5,*)    PIN
         KT = PIN(4)+1
      IF (KT.EQ.1.OR.PIN(5).GT.0)    GO TO 290
         KTT = KT-1
      WRITE (8,44)    KTT
      READ (5,*)    (ACY(I), I=2,KT)
  290 RETURN
      END
      SUBROUTINE RDTHRU (IERR)
      COMMON /DAT/ SDAT(20,40), STOT(20,5), ACY(20)
      COMMON /PAR/ APIN(30), APCM(20),   JP,JT,KT,   IN1, IN2
      COMMON /UTL/ ISC(40), ISQ(40), ISV(40), ISK(40)
      COMMON /WRD/ SNAM, SWD(5,39)
C:
      REAL*8  SNAM
      DIMENSION    PIN(23), PCM(11)
      EQUIVALENCE  (PIN,APIN), (PCM,APCM)
C:
    1 FORMAT(///)
   50 FORMAT(/10X,'ENTER PARAMETER CHANGES (INDEX,VALUE)'/
     1              35X,'DELIMITOR = 0,0' )
   52 FORMAT(/10X,'ENTER AC BY YR CHANGES (YR,VALUE)'/
     1    12X,'WHERE YR=1 THRU ',I2,' AND DELIMITOR = 0,0'/)
   54 FORMAT(/10X,'ENTER THRUPUT VALUES (INDEX,VALUE)'/
     1              35X,'DELIMITOR = 0,0' )
   58 FORMAT(4X,'** ? ? ? **')
C:
      IF (IN2.EQ.5)      GO TO 200
C:    CHECK CHANGES
      DO 112  J=1,JP
      READ (IN2,*,END=114)    JX, TMP
      IF (JX.EQ.0) GO TO 120
  112    PIN(JX) = TMP
  114    KT = PIN(4)+1
      GO TO 140
C:    CHECK AC CHANGES
  120    KT = PIN(4)+1
      IF (KT.EQ.1.OR.PIN(5).GT.0)    GO TO 130
      DO 122  I=2,KT
      READ (IN2,*,END=140)    IX, TMP
      IF (IX.EQ.0)    GO TO 130
  122    ACY(IX+1) = TMP
>
```

```
C:    CHECK THRUPUT
  130 DO 132  J=1,JT
      READ (IN2,*,END=140)    JX, TMP
      IF (JX.EQ.0) GO TO 138
         SDAT(1,JX) = TMP
  132    ISV(JX) = 1
  138 RETURN
  140    IERR = 9
      RETURN
C:
  200 WRITE (8,1)
  202 WRITE (8,50)
  204 CONTINUE
      READ (5,*,END=220)      JX, TMP
      IF (JX.GE.0.AND.JX.LE.JP)   GO TO 210
  208 WRITE (8,58)
      GO TO 202
  210 IF (JX.EQ.0) GO TO 220
         PIN(JX) = TMP
      GO TO 204
C:    AC CHANGES
  220    KT = PIN(4)+1
         KTT = PIN(4)
      IF (KT.EQ.1.OR.PIN(5).GT.0)   GO TO 240
  222 WRITE (8,52) KTT
  224 CONTINUE
      READ (5,*,END=240)    IX, TMP
      IF (IX.GE.0.AND.IX.LT.KT)   GO TO 230
  228 WRITE (8,58)
      GO TO 222
  230 IF (IX.EQ.0) GO TO 240
         ACY(IX+1) = TMP
      GO TO 224
C:    THRUPUT
  240 WRITE (8,54)
  244 CONTINUE
      READ (5,*,END=260)    JX, TMP
      IF (JX.GE.0.AND.JX.LE.JT)   GO TO 250
  248 WRITE (8,58)
      GO TO 244
  250 IF (JX.EQ.0) GO TO 260
         SDAT(1,JX) = TMP
         ISV(JX) = 1
      GO TO 244
  260 RETURN
      END
      SUBROUTINE DOEQ
      COMMON /PAR/ FP,EP,FY,YRS,AC, DOP,DCA,ECA,PMO,FM, AT,GT,SA,EW,TE
     1    ,TB,DE,TD,EN,P, FC,TO,TYP,    XTI(7)
     2    ,PMT,DEP,PAL,POF,PEN,POL, DOC,CR,AR,ERO,ERM,    XTC(9)
```

```
      DATA    NA/12/
C:
         PMT = 1.66975 + .018009*PMD
         DEP = (-6.03260 + 2.6771*SQRT((DDP+DCA+PMT+ECA)*NA))/NA
         PAL = DDP + DCA + DEP + ECA + PMT
         PDF = DDP + DCA + .0021348*PAL
         PEN = DEP + ECA + PMT + .027058*PAL
         PDL = EXP(-1.87782 + .53428*ALOG(GT) + .80777*ALOG(SA))
         DDC = EXP(-4.72801 + .36868*ALOG(SA) + 1.0931*ALOG(PMD))
         CR  = EXP(-.31909 + 1.2486*ALOG(PMD/FM) + .40475*ALOG(GT))
         AR  = -15.07819 + .13041*PMD + .091969*SA
         ERD = 1.09326 + 45.664*TD + 1.2111*DE
         ERM = 8.46857 + 4.1382*TD + .75165*TE
      RETURN
      END
      SUBROUTINE ESTM (I,J,ANS)
      COMMON /DAT/ SDAT(20,40), STOT(20,5), ACY(20)
      COMMON /PAR/ FP,EP,FY,YRS,AC, DDP,DCA,ECA,PMD,FM, AT,GT,SA,EW,TE
     1   ,TB,DE,TD,EN,P, FC,TD,TYP,    XTI(7)
     2   ,PMT,DEP,PAL,PDF,PEN,PDL, DDC,CR,AR,ERD,ERM,    XTC(9)
C:
         XTR = ANS
         ANS = 0.0
         LAG = 0
      IF (I.EQ.1)  GO TO 90
      GO TO (9,80,80,80,80,80,80,9,80,80,80,9,9,80,80,9,80,53,59
     1     ,9,80,80,9,80,9,9,80,80,9,80,80,9,80,80,9,80,80,80,80),  J
   53    LAG = P/12
      GO TO 80
   59    LAG = INT (TB/(12*FM) )
   80 IF (LAG.GE.I)      GO TO 9900
         ANS = SDAT(1,J)*ACY(I-LAG)
      GO TO 9900
C:
   90 GO TO (9,200,300,400,500,600,700,9,900,1000,1100,9,9,1400,1500,9
     1   ,1700,1800,1900,9,2100,2200,9,2400,9,9,2700,2800,9,3000
     2   ,3100,9,3300,3400,9,3600,3700,3800,3900),  J
    9    ANS = XTR
      GO TO 9900
C:
  200    ANS = FP*DCA
      GO TO 9900
  300    ANS = EP*ECA
      GO TO 9900
  400    ANS = FP*DDP
      GO TO 9900
  500    ANS = PDL
      GO TO 9300
  600    ANS = EP*DEP
      GO TO 9900
      >
```

```
  700     ANS = AT
          GO TO 9900
C:
  900     ANS = EP*PMT
          GO TO 9900
 1000     ANS = 0.940*DDC
          GO TO 9800
 1100     ANS = 0.060*DDC
          GO TO 9800
C:
 1400     ANS = .4637*PAL
          GO TO 9900
 1500     ANS = (.0021348*FP + .027058*EP)*PAL
          GO TO 9900
C:
 1700     ANS = CR
          GO TO 9800
 1800     ANS = AR*12/P
          GO TO 9900
 1900     ANS = EN*(ERD + 1.6*ERM)*1000./TB
          GO TO 9800
C:
 2100     ANS = .024656*(SDAT(1,5)+SDAT(1,10)+SDAT(1,11)+SDAT(1,16)+AT)
          ANS = ANS + .024656*(FP*(DDP+DCA)+EP*(DEP+ECA+PMT))
          GO TO 9900
 2200     SUM = .006528 + .02890*MAX1(2.0-TYP,0.0)
          ANS = SUM*(SDAT(1,5)+SDAT(1,10)+SDAT(1,11)+SDAT(1,16)
     1          +SDAT(1,36))
          SUM = .19507 + .005512
          ANS = ANS + SUM*(SDAT(1,17)+SDAT(1,19)+AR)
          ANS = ANS + (.032606+.004631)*PAL + .017852*12*FM
          ANS = ANS + .021512*(1.0-ABS(2.0-TYP))*SDAT(1,36)
          ANS = ANS - SDAT(1,21)
          GO TO 9900
C:
 2400     ANS = .057243*(SDAT(1,5)+SDAT(1,10)+SDAT(1,11)+SDAT(1,17)
     1          +SDAT(1,19)+AR+SDAT(1,36))
          GO TO 9900
C:
 2700     ANS = .215823*(POF+PEN) + .007169*PEN
          GO TO 9900
 2800     ANS = FP*(.003891*(POF+PEN) + .000186*PEN + .066930*POF)
          ANS = ANS + EP*(.025270*(POF+PEN) + .101485*PEN)
          GO TO 9900
C:
 3000     ANS = .345716*(POF+PEN)
          GO TO 9900
 3100     ANS = FP*(.009431*(POF+PEN) + .0008335*POF)
          ANS = ANS + EP*(.0130166*(POF+PEN) + .005021*PEN)
          GO TO 9900
      >
```

```
C:
 3300     ANS = .102434*PEN
          GO TO 9900
 3400     ANS = FP*(.000948*PEN + .057745*POF)
          ANS = ANS + EP*(.007972+.050742+.00288)*PEN
          ANS = ANS + 1.760356*POF + .541521*PEN
          GO TO 9900
C:
 3600     ANS = 0.59*SDAT(1,17)
          GO TO 9900
 3700     ANS = 4.1 * FC
          GO TO 9900
 3800     ANS = 2.5 * FC
          GO TO 9900
 3900     ANS = TO
          GO TO 9900
C:
 9800     ANS = ANS * 12*FM/1000.
 9900 RETURN
      END
      SUBROUTINE ACPRN
      COMMON /DAT/ SDAT(20,40), STOT(20,5), ACY(20)
      COMMON /PAR/ APIN(30), APCM(20),   JP,JT,KT,   IN1, IN2
      COMMON /UTL/ ISC(40), ISQ(40), ISV(40), ISX(40)
      COMMON /WRD/ SNAM, SWD(5,39)
C:
      REAL*8  SNAM, WTOT(5), FY(20), SY(30)
      DIMENSION    PIN(23), PCM(11), IDAT(20)
      EQUIVALENCE  (PIN,APIN), (PCM,APCM)
C:
      DATA    WTOT/'TOTAL','  O&M','  MPN','  APN','  WPN'/
      DATA    SY/' FY71',' FY72',' FY73',' FY74',' FY75',' FY76',' FY77'
     1   ,' FY78',' FY79',' FY80',' FY81',' FY82',' FY83',' FY84'
     2   ,' FY85',' FY86',' FY87',' FY88',' FY89',' FY90',' FY91'
     3   ,' FY92',' FY93',' FY94',' FY95',' FY96',' FY97',' FY98'
     4   ,' FY99','TOTAL'/
C:
    1 FORMAT(/)
    2 FORMAT(////)
    3 FORMAT(1H )
   10 FORMAT(//35X,A8//20X,'OPERATING AND SUPPORT COST ESTIMATE'/
     1        27X,'(THOUSANDS OF FY76$)'//)
   12 FORMAT(20X,'AVERAGE ANNUAL'/29X,'COST'/28X,'PER UE',6(2X,A5))
   13 FORMAT(27X,7(2X,A5))
   18 FORMAT(/12X,'AC PER YR',13X,6F7.1)
   19 FORMAT(/12X,'AC PER YR',6X,7F7.1)
   20 FORMAT(12X,A5,10X,7I7)
   32 FORMAT(/4X,4A4,A2,5X,7I7)
   34 FORMAT(6X,4A4,A2,3X,7I7)
   36 FORMAT(8X,4A4,A2,1X,7I7)
```

```
C:
      IFY = PIN(3)-1972
      DO 128  I=2,KT
  128    FY(I) = SY(I+IFY)
      FY(KT+1) = WTOT(1)
      WRITE (8,1)
      WRITE (8,10)  SNAM
      IT = 0
  150    IB = IT+1
      IT = MIN0(IB+6,KT+1)
      ITT = MIN0(IT,KT)
      JB = 1
      JTT = 24
  160 IF (IB.EQ.1) WRITE (8,12)  (FY(I), I=2,IT)
      IF (IB.GT.1) WRITE (8,13)  (FY(I), I=IB,IT)
      IF (JB.GT.1) GO TO 250
      IF (IB.EQ.1) WRITE (8,18)  (ACY(I), I=2,IT)
      IF (IB.GT.1) WRITE (8,19)  (ACY(I), I=IB,IT)
      WRITE (8,3)
      DO 218  J=1,5
      DO 212  I=IB,IT
  212    IDAT(I) = STOT(I,J)+0.5
  218 WRITE (8,20)  WTOT(J), (IDAT(I), I=IB,IT)
C:
  250 DO 278  J=JB,JTT
      NS = J
      DO 252  N=1,3
      IF (ISC(NS).EQ.0) GO TO 260
  252    NS = ISC(NS)
      N = 3
  260 DO 262  I=IB,IT
  262    IDAT(I) = SDAT(I,J)+0.5
      GO TO (272,274,276),  N
  272 WRITE (8,32)  (SWD(I,J), I=1,5), (IDAT(I), I=IB,IT)
      WRITE (8,3)
      GO TO 278
  274 WRITE (8,34)  (SWD(I,J), I=1,5), (IDAT(I), I=IB,IT)
      GO TO 278
  276 WRITE (8,36)  (SWD(I,J), I=1,5), (IDAT(I), I=IB,IT)
  278 CONTINUE
      WRITE (8,2)
      IF (JTT.EQ.JT)     GO TO 300
      JB = JTT+1
      JTT = JT
      GO TO 160
  300 IF (IT.LT.KT)      GO TO 150
      RETURN
      END
```

```
      BLOCK DATA
      COMMON /DAT/ SDAT(20,40), STOT(20,5), ACY(20)
      COMMON /PAR/ APIN(30), APCM(20),   JP,JT,KT,   IN1, IN2
      COMMON /UTL/ ISC(40), ISQ(40), ISV(40), ISX(40)
      COMMON /WRD/ SNAM, SD1(5,19), SD2(5,5), SD3(5,15)
     +      ,PD1(5,19), PD2(5,15)
C:
      REAL*8  SNAM
C:
      DATA   SDAT/800*0.0/, STOT/100*0.0/, ACY/20*0.0/
     1   ,APIN/30*0.0/, APCM/20*0.0/
      DATA   JP/23/, JT/39/, KT/0/, IN1/0/, IN2/0/
      DATA   ISC/0,6*1, 0,3*8, 0,12,2*13, 0,3*16, 0,2*20, 0,23
     +   ,0,25,2*26,25,2*29,25,2*32, 0,4*35/
      DATA   ISQ/19,18,17,16,15,14,13,12,11,10,9,8,7,6,5,4,3,2,1, 39,38
     1    ,37,36,35,34,33,32,31,30,29,28,27,26,25,24,23,21,22,20/
      DATA   ISX/1,3*3,2,3,2, 1,3,2,2, 1,1,2,3, 1,3*2, 1,2*2, 1,2
     1    ,1,1,2,3,1,2,3,1,2,3, 1,3*4,5/,   ISV/40*0/
C:
      DATA    PD1/'MPN','RATE',' (OF','F)',' '
     2   ,'MPN','RATE',' (EN','L)',' '
     3   ,'STAR','TING',' FY',' ',' '
     4   ,'# OF',' YEA','RS',' ',' '
     5   ,'# A/','C PE','R YR',' (',' '
     6   ,'GROU','ND O','FFIC','ERS',' '
     7   ,'OFF','CREW',' ALL','OWAN','CE'
     8   ,'ENL','CREW',' ALL','OWAN','CE'
     9   ,'MAIN','T MH','R/MO',' ',' '
     *   ,'FLYI','NG H','RS/M','O',' '
     1   ,'AIR','TAD','(000','$)',' '
     2   ,'GROS','S TA','KEOF','F WT',' '
     3   ,'MAX','SPEE','D(AL','T MP','H)'
     4   ,'EMPT','Y WT',' (00','0LBS',')'
     5   ,'THRU','ST/E','NG(0','00LB','S)'
     6   ,'TIME','-B-O','VHL',' (HRS',')'
     7   ,'ENGI','NE D','IAME','TER',' '
     8   ,'ENG','TYP(','OJET',' 1FA','N)'
     9   ,'# OF',' ENG','INES',' ',' '/
      DATA    PD2/'A/C','RW C','YCLE',' (MO','S)'
     1   ,'FLYA','WAY','COST',' (MI','L)'
     2   ,'TRNG',' ORD','N (T','HOUS',')'
     3   ,'A/C','TYPE',' (1 ','2 3)',' '
     1   ,'A/C','MAIN','T MP','WR',' '
     2   ,'OTHE','R DE','PL M','PWR',' '
     3   ,'TOTA','L DI','RECT',' MPW','R'
     4   ,'DIRE','CT $',' B-O','P OF','F'
     5   ,'DIRE','CT $',' B-O','P EN','L'
     6   ,'POL','($/F','H)',' ',' '
     7   ,'MM $',' PSS',' ($/','FH)',' '
     8   ,'COMP',' REW',' (00','0$/F','H)'
```

```
     9    ,'A/C','REW','(000','$/RE','W)'
     *    ,'ENG','OVHL','(000','$/EN','G)'
     1    ,'ENG','REP','(000','$/EN','G)'/
C:
      DATA   SD1/'DEPL','OYED',' UNI','T OP','S'
     2    ,'AIRC','REWS',' (OFF','ICER','S)'
     3    ,'AIRC','REWS',' (ENL','ISTE','D)'
     4    ,'COMB','AT C','OMMA','ND S','TF'
     5    ,'POL',' ',' ',' ',' '
     6    ,'OTHE','R DE','PLOY','ED M','PN'
     7    ,'AIR','TAD',' ',' ',' '
     8    ,'BELO','W-DE','POT','MAIN','T'
     9    ,'A/C','MAIN','T MP','N',' '
     *    ,'MAIN','TENA','NCE',4HMAT','L'
     1    ,'PERS',' SUP',' SUP','PLIE','S'
     2    ,'INST','ALLA','TION','S SU','P'
     3    ,'BASE',' OPS',' SUP','PORT',' '
     4    ,'O&M','BASE',' OPS',' ',' '
     5    ,'MPN','BASE',' OPS',' ',' '
     6    ,'DEPO','T MA','INTE','NANC','E'
     7    ,'COMP','ONEN','T RE','WORK',' '
     8    ,'AIRF','RAME',' REW','ORK',' '
     9    ,'ENGI','NE R','EWOR','K',' '/
C:
      DATA   SD2/'DEPO','T SU','PPLY',' ',' '
     1    ,'DEPO','T SU','PPLY',' OPS',' '
     2    ,'TECH','NICA','L SU','PPOR','T'
     3    ,'2ND','DEST',' TRA','NS',' '
     4    ,'2ND','DEST',' TRA','NS',' '/
C:
      DATA   SD3/'PERS',' SUP',' & T','RAIN',' '
     5    ,'INDI','VIDU','L TR','AIN',' '
     6    ,'O&M',' ',' ',' ',' '
     7    ,'MPN',' ',' ',' ',' '
     8    ,'HEAL','TH C','ARE',' ',' '
     9    ,'O&M',' ',' ',' ',' '
     *    ,'MPN',' ',' ',' ',' '
     1    ,'PERS',' ACT','IVIT','IES',' '
     2    ,'O&M',' ',' ',' ',' '
     3    ,'MPN',' ',' ',' ',' '
     4    ,'SUS','INVE','STME','NTS',' '
     5    ,'REPL','EN S','PARE','S',' '
     6    ,'MODI','FICA','TION','S',' '
     7    ,'REPL','EN G','SE',' ',' '
     8    ,'TRAI','NING',' ORD','NANC','E'/
      END
EOF:
>
```