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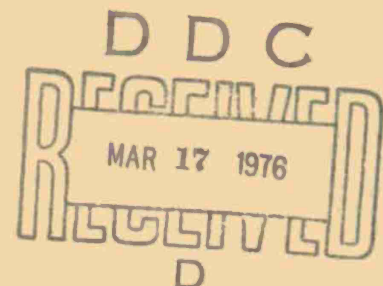
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ARMY LIFE CYCLE COST MODEL
USER'S GUIDE, VOLUME I

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FOREWORD

The Army Life Cycle Cost Model (ALLCM) documented in this User's Guide, is a time-sharing system which produces both static and time-phased parametric cost estimates for major Army weapons systems. The output reports conform to the latest Research and Development, Investment and Operating and Support pamphlets. Comments, questions or requests for programs should be directed to: DACA-CAS, Room 2B 679, the Pentagon, Washington, DC 20310, ATTN: Mr. Rich Brannon, AUTOVON 8-225-1118.

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CHAPTER 1

INTRODUCTION

1.1 Purpose. This guide records in one place the information the analyst needs to understand and operate the Army Life Cycle Cost Model.

1.2 Scope. Volume I (User's Guide) gives a general description of the model together with the specific details on how to run the model. Program listings and other technical information are in Volume II (Programmer's Guide).

1.3 Objectives. The first objective of this guide is to enable the analyst, assumed to be a non-programmer working alone, to operate the Army Life Cycle Cost Model. A second objective is to provide documentation which can serve as a starting point for developing future cost models.

1.4 How to Use This Guide. This guide can be used in three ways --

a. General Philosophy. To understand some of the philosophy of doing Independent Parametric Cost Estimates (IPCE) and how the Army Life Cycle Cost Model (ALCCM) helps in making these estimates, the analyst should read Chapters 1, 2 and 3. Some instructional material on composite indices, sensitivity analysis and uncertainty is at Appendices B and C.

b. Preparation of Inputs. To learn what specific data inputs are required and how they must be entered, the analyst should read Chapter 4, where illustrative samples of all types of data input files are provided. Sample output reports resulting from these input files are provided at Appendix A. The analyst can get a good understanding of how the data input files work by comparing the sample inputs to the sample output reports. Blank input forms for all file types are in Chapter 4.

c. Error Correction. To correct data input errors the computer program has discovered and reported, the analyst should first list the file containing the error. If the problem and its solution are not obvious, the analyst should turn to the explanation in Chapter 4.

CHAPTER 2

BACKGROUND

2.1 Cost Analysis in the Acquisition Process. Cost Analysis (See AR 11-18, "Army Programs, The Cost Analysis Program," October, 1975) assists the acquisition process in several ways --

a. Input to cost effectiveness studies. By estimating accurately the cost of several alternative weapons systems, cost analysis enables planners to make a realistic cost-effectiveness study.

b. Perspective. Cost analysis puts costs in proper perspective by comparing the new system to the various alternatives, including the "do nothing" alternative, which can also be very expensive.

c. Credibility. By the rigor and logic of its approach cost analysis can provide credibility to the cost estimate of a future system. When the Army asks OSD or the Congress for funding, the credibility of the cost estimate, or the lack of it, can be a determining factor. Documentation, described below, helps ensure credibility.

2.2 Independent Parametric Cost Estimates (IPCE's) in Cost Analysis. Each proposed weapon system has a sponsor, or proponent agency. This agency often has the best cost data base and the most knowledgeable staff in the world for that type of system, and the new system will be managed based on this agency's cost estimate. There are several reasons, however, why it is necessary to take a second look at the cost estimate.

a. Downward Bias of Proponent's Estimate. The proponent's cost estimates have often turned out to be lower than the actual cost, even after inflation has been taken into account (See "Should Cost/Will Cost/Must Cost," Wayne M. Allen, June 1972, (AD-758 820). One reason for a low cost estimate is the uncoupling of system requirements and their corresponding costs. A second reason is the practice of costing only the visible pieces (for example, the parts list and the manager's staff). Historically, most systems have experienced schedule slips, direction changes and other events which drive up the cost, even though they are not mentioned in the parts list. Other reasons for a low estimate are an overly optimistic attitude on the manager's staff and an organizational pressure to achieve a low cost. The process of taking a second look tends to couple the requirements and costs again, in both the proponent agency and the one doing the independent estimate. If the second estimate is statistical (or parametric) it links the requirements directly to the costs of historical systems. The resulting estimate automatically reflects the schedule slips and other events which have driven up the cost on historical systems. Finally, an independent agency can be more objective and free from organizational pressure than the sponsor.

b. Need for Completeness and Quality. A second look allows several questions to be answered. Is Operating and Support (O&S) cost addressed? Is the cost of Government-Furnished Equipment (GFE)

included? Are all relevant costs included regardless of how they are funded? Are the numbers documented? It is important to have completeness and quality both in the proponent's estimate and the independent estimate (See "Standards for Presentation and Documentation of Life Cycle Cost Estimates for Army Weapon Systems," November 1975, Draft Pamphlet).

c. Identification of Areas of Uncertainty. A second estimate makes areas of uncertainty visible to management so that problems can be resolved or at least identified before making large funding commitments.

d. Increased Understanding. By making his own estimate the analyst develops a depth of understanding that is not obtainable in any other way. He can know and explain to management what is being given up (for example greater quantities, other mission equipment) for the new capabilities.

2.3 Tools Developed for IPCE's. This section gives a general description of some of the tools developed for making IPCE's. Some of the philosophy and objectives for the tools are also presented to make the tools more easily understood and to provide a starting point for future revisions of the tools.

2.3.1 Matrix. The most important tool is the Army Life Cycle Cost Matrix, shown at Figure 1. It is much more than an aid to communication,

THE ARMY LIFE CYCLE COST MATRIX

ROW	PRIME APPRO	DEFN REF	COST ELEMENT	(1) FRAME	(2) PROPULSION	(3) GUIDANCE CONTROL/ COMMUNICATIONS	(4) FIRE CONTROL	(5) ARMAMENT	(6) PAYLOAD/ AMMUNITION	(7) (TO BE SPECIFIED)	(8) PECULIAR SUPPORT EQUIPMENT	(9) COMMON SUPPORT EQUIPMENT	(10) OTHER	(11) TOTAL
1	----	1.0	RESEARCH AND DEVELOPMENT											
2	RDTE	1.01	DEVELOPMENT ENGINEERING											
3	RDTE	1.02	PRODUCIBILITY ENGINEERING AND PLANNING (PEP)											
4	RDTE	1.03	TOOLING											
5	RDTE	1.04	PROTOTYPE MANUFACTURING	1)	2)									
6	RDTE	1.05	DATA											
7	RDTE	1.06	SYSTEM TEST AND EVALUATION											
8	RD/OM	1.07	SYSTEM/PROJECT MANAGEMENT											
9	RD/OM	1.08	TRAINING											
10	RD/MC	1.09	FACILITIES											
11	RDTE	1.10	OTHER											
12	----	2.0	INVESTMENT											
13	PR/MC	2.01	NON-RECURRING INVESTMENT											
14	PROC	2.02	PRODUCTION											
15	PROC	2.03	ENGINEERING CHANGES											
16	PR/OM	2.04	SYSTEM TEST AND EVALUATION											
17	PR/OM	2.05	DATA											
18	PR/OM	2.06	SYSTEM/PROJECT MANAGEMENT											
19	PR/MC	2.07	OPERATIONAL/SITE ACTIVATION											
20	PR/OM	2.08	TRAINING											
21	PR/OM	2.09	INITIAL SPARES AND REPAIR PARTS											
22	PR/OM	2.10	TRANSPORTATION											
23	PR/OM	2.11	OTHER											
24	----	3.0	OPERATING AND SUPPORT COST											
25	----	3.01	MILITARY PERSONNEL											
26	MPA	3.011	CREW PAY AND ALLOWANCES											
27	MPA	3.012	MAINTENANCE PAY AND ALLOWANCES											
28	MPA	3.013	INDIRECT PAY AND ALLOWANCES											
29	MPA	3.014	PERMANENT CHANGE OF STATION											
30	----	3.02	CONSUMPTION											
31	PR/OM	3.021	REPLENISHMENT SPARES											
32	OMA	3.022	PETROLEUM, OIL AND LUBRICANTS											
33	PROC	3.023	UNIT TRAINING, AMMUNITION AND MISSILES											
34	----	3.03	DEPOT MAINTENANCE											
35	OMA	3.031	LABOR											
36	PR/OM	3.032	MATERIEL											
37	OMA	3.033	TRANSPORTATION											
38	PROC	3.04	MODIFICATIONS, MATERIEL											
39	----	3.05	OTHER DIRECT SUPPORT OPERATIONS											
40	OMA	3.051	MAINTENANCE, CIVILIAN LABOR											
41	OMA	3.052	OTHER DIRECT											
42	----	3.06	INDIRECT SUPPORT OPERATIONS											
43	MP/OM	3.061	PERSONNEL REPLACEMENT											
44	MPA	3.062	TRANSIENTS, PATIENTS AND PRISONERS											
45	OMA	3.063	QUARTERS, MAINTENANCE AND UTILITIES											
46	MP/OM	3.064	MEDICAL SUPPORT											
47	OMA	3.065	OTHER INDIRECT											
48	----	----	TOTAL SYSTEM COST (LESS ERDA)											
49	ERDA	4.0	ERDA COST											
50	----	----	TOTAL SYSTEM COST (WITH ERDA)											

(1) Primary cost cell (contains equation, must be documented).

(2) Secondary cost cell (contains total, subtotal, or percent, need not be documented).

FIGURE 1

because it determines the way the problem is conceptualized, both to the analyst and to management. A good framework has several characteristics. It is --

a. Complete. The matrix has to present 100% of the Life Cycle Cost Estimate without the need for footnotes explaining costs that do not fit into the structure. A complete structure also serves as a checklist to the analyst to ensure that nothing is overlooked, and communicates to the manager better than a lengthy narrative.

b. Parametric. The basic cost cells of the matrix (i.e. the intersections of rows with columns) should define things that can be estimated by a statistical relationship. This requirement leads to an emphasis on what is costed, and a corresponding deemphasis of other important, but not necessarily parametric considerations such as how costs are funded, whether the work is done by contract or in-house, how much has been spent so far, etc. Later, when it is necessary to address these issues, additional structures and formats are provided, but the primary matrix has not been compromised.

c. Manageable. The consideration of too much detail can preclude meaningful analysis and does not increase the quality of the estimate.

d. Compatible. It must recognize the reality of the existing data base on the one hand, and the needs of management on the other.

e. Comparable. It must be comparable to the different formats produced and required by different Army agencies, for example funding categories over time. Instead of compromising the main objectives by

changing the matrix, however, additional structures are provided.

f. Flexible. It can be redefined, depending on need; has "other" rows and columns available for use as catch-alls; can still be used even in the event that some rows or columns do not apply (collapsible).

2.3.2 Cost Data Sheets. The rows and columns of the matrix intersect each other in cost cells. Some cells are used for totals and percents and are called "secondary cells". Other cells contain equations and are called "primary cells". Each primary cost cell contains an equation with requirements factors expressing "how many" and "what" is costed in that cell, together with cost factors expressing the corresponding cost. In order to record how an estimate was made, a Cost Data Sheet is used. It shows the equation used, and defines each of the variables in the equation. When all the Cost Data Sheets are complete, there can be no question about the clerical part of how an estimate was calculated, and the discussion can proceed to more important matters, such as why certain first unit costs and slopes were used, or why so many operating personnel were charged to the system. These "why" questions are answered separately on the Variable Explanation Sheets described next. A sample Cost Data Sheet is at Figure 2.

COST DATA SHEET

ITEM: Development Engineering, Frame

COST DATA EXPRESSION:

$$\text{Cost} = (\text{Number of Man-Years}) \times (\text{Cost per Man-Year})$$

INCLUDES:

Development engineering, frame and integration.

EXCLUDES:

Mission equipment package.

FINAL COST MODEL EXPRESSION:

$$A(2,1) = XN(1) * AC(1) * SF(1)$$

VARIABLES ARE:

$XN(1)$ = Number of Engineering Man-Years = 100.0

$AC(1)$ = Cost per Engineering Man-Year = .05 (M \$ 72)

$SF(1)$ = Constant Dollar Shift Factor, RDT&E = 1.1

FIGURE 2

2.3.3 Variable Explanation Sheets. After recording on the Cost Data Sheet how the factors are to be defined and multiplied together, the analyst must record why he uses the value chosen. This is done using Variable Explanation Sheets. Each variable used has one or more sheets explaining how the variable was defined for the system being costed, the value (or values) finally selected, and all the documentation supporting this choice, including the data base for the Cost Estimating Relationship (CER), the statistics for the CER and other pertinent information. A sample Variable Explanation Sheet is at Figure 3.

2.3.4 Computerized Model. The Army Life Cycle Cost Model, described more fully in Chapter 3, brings together the results of the statistical analysis (documented on the Variable Explanation Sheets), the equations in the cost cells (documented on the Cost Data Sheets) and generates the reports. While some models combine statistics, report generating and documentation in one computer program, this model uses a modular system in which the separate functions are coordinated with each other but are handled separately. Thus the statistics are done using a commercial statistical package designed to be flexible and convenient. The Army Life Cycle Cost Model takes the results of the statistical analysis (for example, first unit costs) calculates the total cost, and generates the reports. Documentation of each Cost Estimating Relationship (CER) is so unique that the Variable

VARIABLE
EXPLANATION SHEET

ITEM: XN(1), Number of MY, Engineering Development

<u>SYSTEM</u>	<u>AMPR WT</u>	<u>NUMBER MY</u>
1	X	Y
2	X	Y
3	X	Y
4	X	Y
5	X	Y

CER: $MY = 10.5 + 39(WT)$

Statistics: $R^2 = .99$

-

-

-

etc

DATA SOURCE: Jane's All the Worlds Aircraft, 1974, pp 99-125

FIGURE 3

Explanation Sheets are done individually. The data input files which drive the program provide documentation of each cost estimate. Figure 4 shows the relationship between the tools available.

DOCUMENTATION PHILOSOPHY

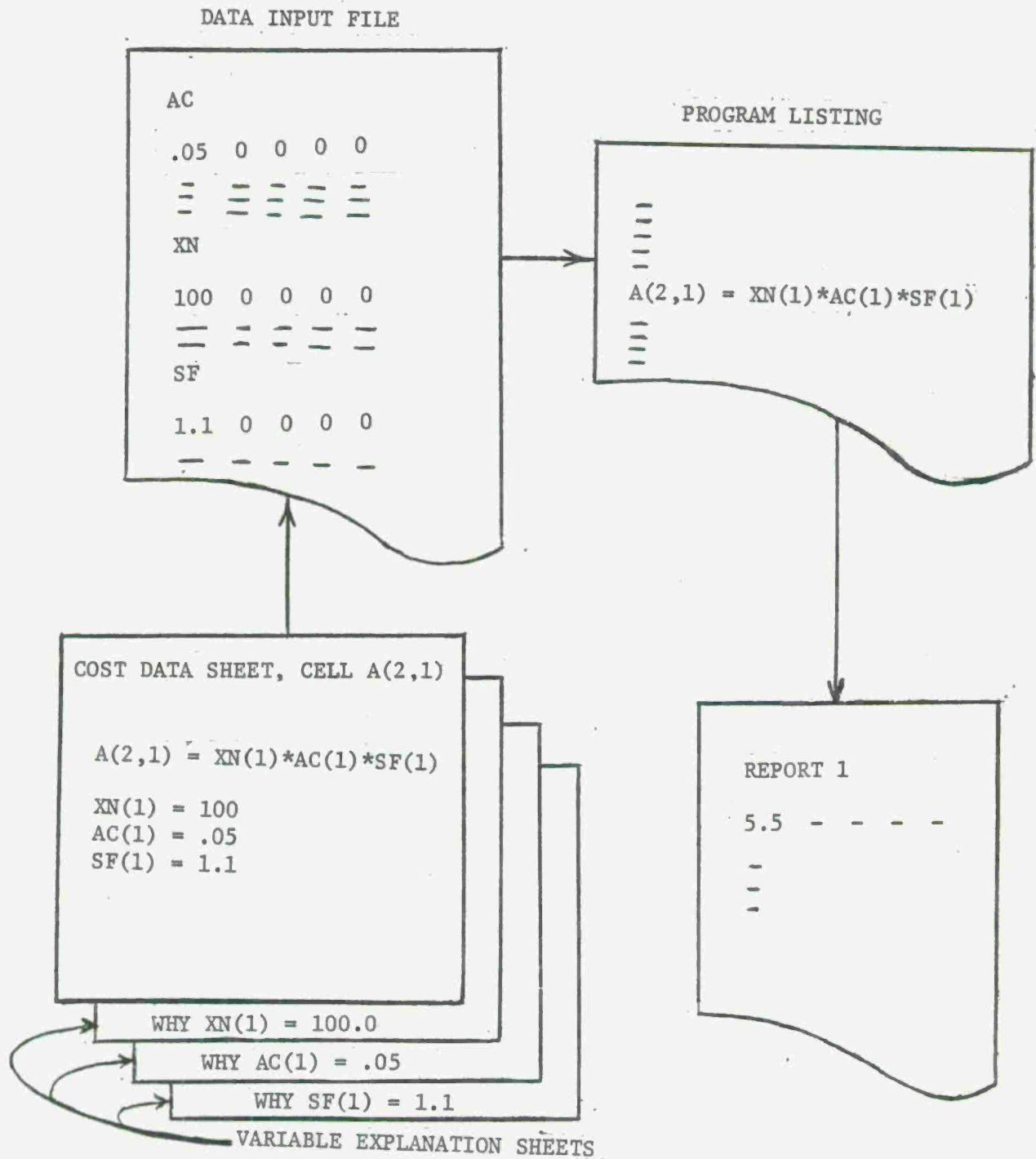


FIGURE 4

CHAPTER 3

THE ARMY LIFE CYCLE COST MODEL

3.1 Objectives of Model. Some of the objectives designed into the model are --

a. Convenience. The model is designed for the analyst's use, not for programming efficiency. Any tradeoff here is made in favor of the analyst.

b. Manageability. The model uses only the minimum number of inputs. The use of too much detail can interfere with meaningful analysis and does not improve the quality.

c. Responsiveness. The model uses a time sharing computer for fast response. Programming changes are handled within the office, as needed. There is no dependence on outside agencies for programming support.

d. Standard Language. The model is programmed in Fortran IV. Statements and subroutines are limited to those which are widely available among commercial vendors.

e. Error Checks. The model checks the analyst's input files for errors. If an error is detected, the program prints the name of the file containing the error and the number of the last line correctly read. Also, when the analyst uses percentages, the program checks to see that the percentages add to 100%.

f. Flexibility. The model can be redefined by the analyst. He can redefine and relabel the rows and columns, and he can change the standard equations in the model.

3.2 Capabilities of Model. The Army Life Cycle Cost Model produces static and time-phased reports as listed in Table 1 and shown in Appendix A. Each report is calculated based on information the analyst provides in an input file. The program asks only for those files actually required, depending on what reports the analyst requests. The rest of this section discusses specific capabilities and how to use them.

a. Change of Base Year. It is easy to change the base year in which costs are expressed. Each primary cost cell is provided with a factor (called a "shift factor" and abbreviated SF) which can be set to 1.00 for no change, or to some other appropriate price index for expressing costs in dollars of another base year. Different shift factors are used for different cells, depending on the most likely appropriation for that cell. To use this feature the analyst first chooses an input base year. For example, if his statistical data base is in Fiscal Year (FY) 72 dollars, a convenient input base year would be FY 72. Having chosen an input base year, the analyst must enter all average costs, first unit costs and thru-puts in millions of dollars of that base year. The inflation of the out-year costs will be discussed later, but it is emphasized that all average costs, first unit costs and thru-puts must be entered in millions of dollars of the selected input base year. Next, the analyst selects an output base year. For example, during FY 76 management would be interested in FY 77 dollars. The

ARMY LIFE CYCLE COST MODEL REPORTS

REPORT	REPORT NAME	TYPE \$	X Data Input File	X Definition File	X Appropriations File	X Time Phasing File	X Composite Index File	X Header File
1	Cost Element by System Structure	Constant	X					X
2	Key Cost Definitions	Constant	X	X				X
3	Appropriations by Life Cycle Phase	Constant	X		X			X
4	Appropriations by Year (RD, Inv, O&S)	Constant	X		X	X	X	X
5	Appropriations by Year (Total)	Constant	X		X	X	X	X
6	Appropriations by Year (RD, Inv, O&S)	Current	X		X	X	X	X
7	Appropriations by Year (Total)	Current	X		X	X	X	X
8	Appropriations by Life Cycle Phase	Current	X		X	X	X	X

TABLE 1

analyst then enters the shift factors which will convert the costs from FY 72 dollars to FY 77 dollars. The program multiplies the FY 72 dollar amounts by the correct shift factor and the result is an amount in FY 77 dollars.

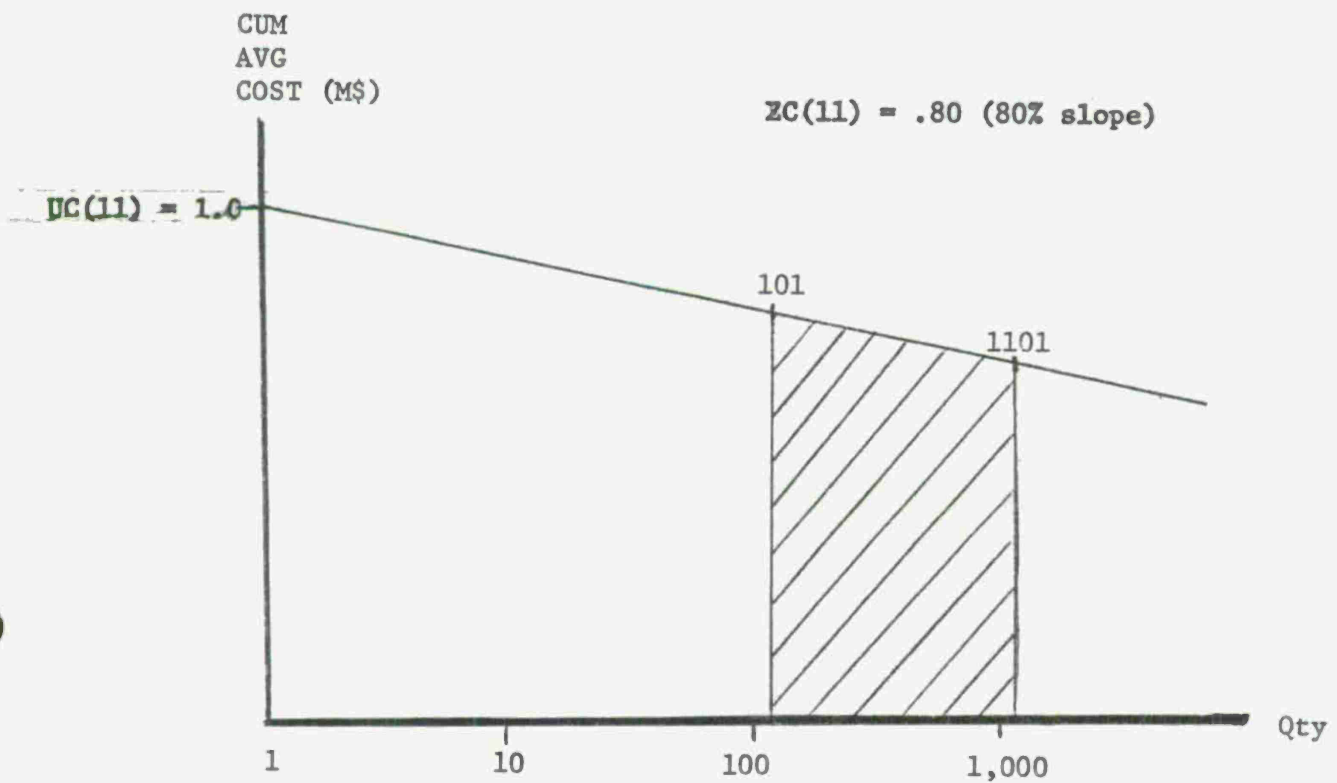
b. Thru-puts. The analyst can add an amount to the results of any primary cost cell. He can use this capability in place of the existing equation (by setting one of the variables in the equation to zero), or he can use the capability in addition to the existing equation (by using both the equation and the thru-put). Thru-puts must be entered in millions of dollars of the input base year, since they will be multiplied by the correct shift factor. One common use of thru-puts is when the result is known, for example if the R&D phase is complete and the final cost is available.

c. Learning Curves and Previous Buys. The Army Life Cycle Cost Model uses the cumulative average learning curve theory (as opposed to the unit curve theory). This theory is often expressed using the formula $Y = aX^b$, where Y is the cumulative average cost over a quantity of X units, a is the theoretical first unit cost, X is the quantity, and b is the logarithm of the experience curve slope divided by the logarithm of 2. In the model the notation becomes UC for theoretical first unit costs, XN for quantities, B for $\log(\text{slope})/\log(2)$, and EC for the experience curve slopes. The variable B is calculated by the program, so the analyst only has to

enter the variables UC, XN and EC. When using learning curve theory, it is sometimes necessary to consider the existence of a previous buy. This occurs, for example, when another service has already purchased some production lots. To begin counting from some unit other than unit one, simply set the correct PB variable to the number of units to be skipped. Figure 5 shows an example where the Army will buy 1,000 airframes, after another service has already bought 100 airframes. Thus, the Army buys airframes numbered 101 through 1101. To develop the correct cost, the analyst sets the PB variable to 100, then enters the UC, XN and EC as he would normally (i.e., as if there was no previous buy). The program does all the required calculations.

d. Time-Phasing. The model produces time-phased reports both in constant and in current dollars. In order to use this capability the analyst must understand how the program calculates the reports based on the time-phased data inputs. For each type of appropriation (RDT&E, MCA, OMA, etc) and for each life cycle phase (R&D, INV, O&S) which he wants to use, the analyst must specify the time-phased flow of funds. He does this by giving ten years of current dollar amounts and up to 28 constant dollar percentages. The program was designed to accept current dollar amounts because the analyst usually has available the actual dollar amounts for this year and for several previous years. The analyst inputs what he has, and the computer calculates constant or current dollars, as needed. In order to

USE OF PB VARIABLE



Input:

$XN(101) = 1000$
 $PB(11) = 100$
 $UC(11) = 1.0$
 $EC(11) = .80$

Result:

Model calculates total cost of
 1,000 units, starting at unit 101.

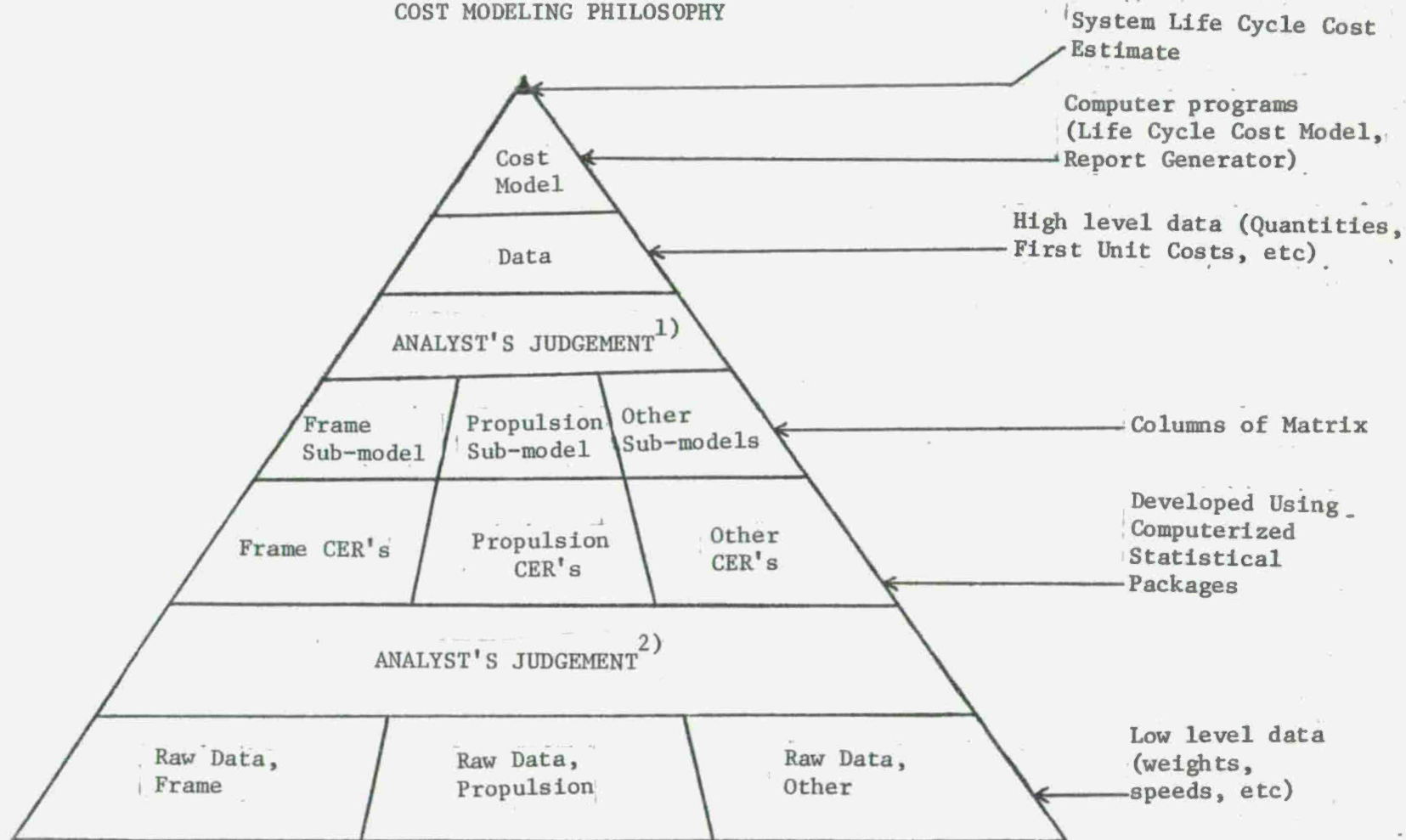
FIGURE 5

compute the cost streams the model first changes all the current dollar amounts entered by the analyst to constant dollar amounts using the composite inflation indices discussed in Appendix B. These ten amounts are then subtracted from the total constant dollar amount for that appropriation and phase (taken from Report 3) to give a residue. This residue is distributed over the future years, based on the percentage distribution which the analyst specifies. The results to this point are constant dollar cost streams (Reports 4 and 5). The program calculates the current dollar cost streams from the constant dollar cost streams by applying the composite inflation indices discussed in Appendix B. The results are Reports 6 and 7.

3.3 System Description of Model. This section first discusses the cost modeling philosophy and then describes the model as a set of computer programs.

a. Cost Modeling Philosophy. Figure 6 shows the computer model as the last part of a total system that transforms raw data on historical systems into a life cycle cost estimate of a future system. An important part of the cost modeling philosophy is to insert the analyst at the two critical places where judgement is required. Judgement is required first to select appropriate historical systems for the data base, and further judgement is required to create parametric CER's from this data base. Later, judgement and a knowledge of the proposed weapon system is required to make the system fit into

COST MODELING PHILOSOPHY



- 1) Analyst makes judgements, records decisions on Cost Data Sheets and Variable Explanation Sheets.
- 2) Analyst selects appropriate historical systems for data base, gathers and normalizes data.

FIGURE 6

the cost matrix and to evaluate and choose among the various CER's developed. The Army Life Cycle Cost Model, pictured at the top of Figure 6, is a set of computer programs that take high level data such as quantities, first unit costs, etc, and calculate and print the various life cycle cost reports. The same set of programs are applicable to all Army weapons systems including aircraft systems, missile systems, track and wheeled vehicle systems.

b. Computerized System. Figure 7 is a diagram of the Army Life Cycle Cost Model as a set of computer programs. The first program contains all the equations on the cost data sheets. The program reads a data input file, previously typed in by the analyst, then calculates the life cycle cost for the weapon system. Finally, this program writes the cost results to an output file whose name is supplied by the analyst at run time. If this output file were listed, it would look much like Report 1, but without row labels or column headings. When preparing the data input file, the analyst should refer to Chapter 4.2. The second program reads the output file created by the first program and prints the final reports. A series of interactive questions guides the user through the program. It always asks which reports are required, and the name of the output file created by the first program. Depending on which reports are requested, it then asks for the name of the other required input files, which must have been previously typed in. For each file type required (see Table 1), the user should turn to the appropriate section of Chapter 4 for instructions on how to prepare that file.

THE ARMY LIFE CYCLE COST MODEL AND REPORT GENERATOR

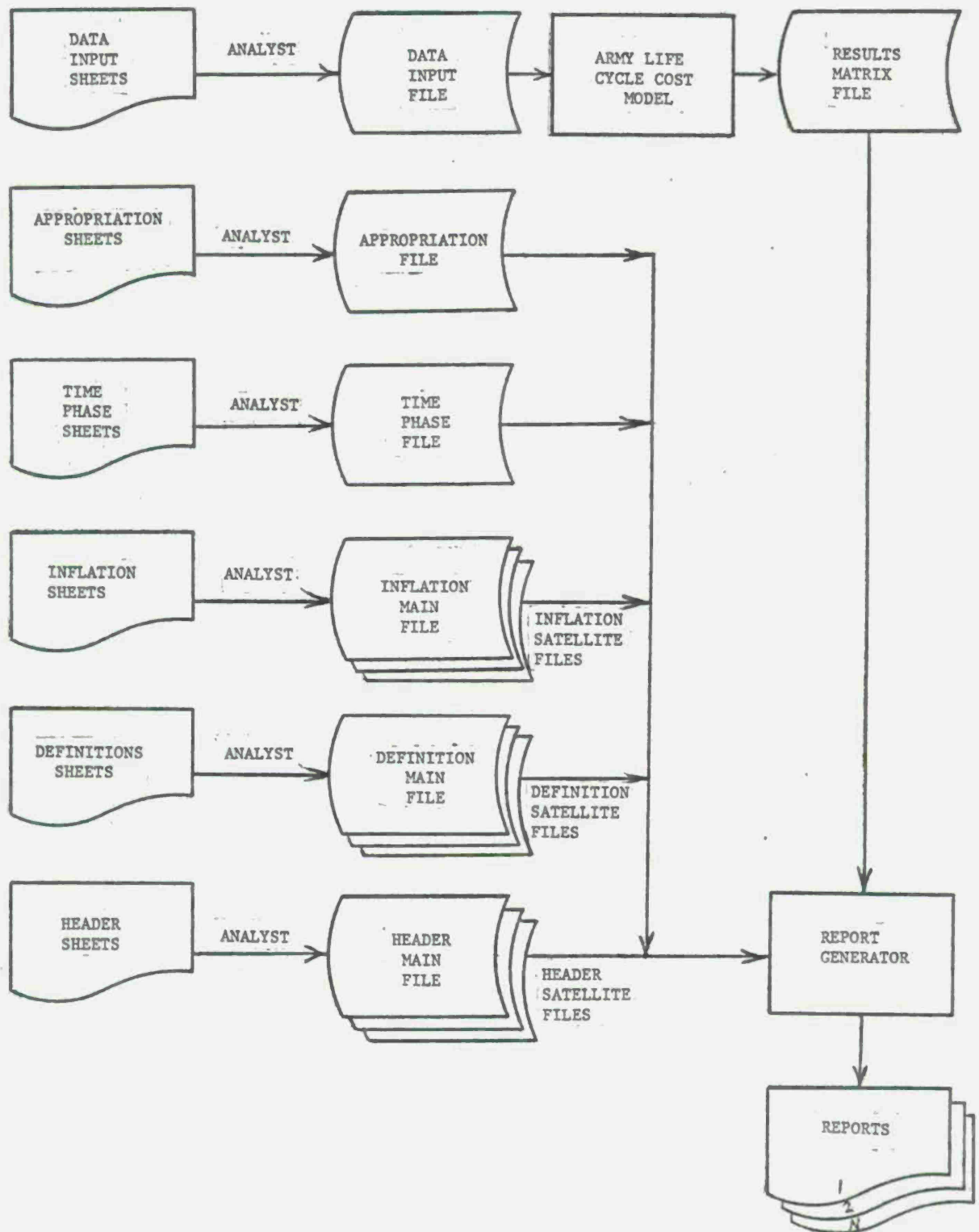


FIGURE 7

CHAPTER 4

HOW TO USE THE MODEL

4.1 General. This chapter explains how to create the required input files, how to enter the present time-sharing system, how to run the model and report generator, and how to use some of the time-sharing commands on the present system. Before reading this chapter the analyst should read Chapter 3 to get a general overview of the model. The line numbers used in all examples are for reference only, and the analyst may choose any line numbers he wishes.

4.2 Requirements Data and Cost Data Input. There are nine types of input variables, as listed in Table 2. The values for these variables are entered on the blank data input sheets and then typed into an on line file using the format of Figure 8. After the input variables are entered, the analyst may choose to add an amount (called a thruput) to the results of any primary cost cell. He can use this capability in place of the existing equation (by setting one of the equation's variables to zero), or he can use the capability in addition to the existing equation (by adding the thruput to the results calculated by the equation). When entering thruputs the analyst must enter the amount in millions of dollars of the input base year, because these amounts will be multiplied by the correct shift factor. Each of the nine types of variables and the thruputs

INPUT VARIABLES

<u>Variable</u>	<u>Description</u>
SF --	Shift Factors (change the base year of the constant dollar life cycle cost estimate from the input base year to the output base year. Inflation of cost streams is handled separately).
XN --	Quantities (numbers of equipment, number of engineering manyears required, etc).
YN --	Numbers of years (operating life, etc).
AC --	Average Costs (average cost per manyear, etc).
CF --	Cost Factors (one element is calculated as a percent of another element).
UC --	Theoretical First Unit Cost (the model uses the cumulative average learning curve theory).
EC --	Experience Curve Slope (expressed as a decimal; e.g., 95% learning is entered as .95).
PB --	Previous Buys (used when the first unit to the Army is not the first unit to the manufacturer, for example, the case of an airframe previously brought by the Navy).
PC --	Physical or Performance Characteristic (Number of miles between overhauls, etc).

TABLE 2

are entered in a variable block consisting of a top line (containing a line number and the variable type identifier) and several data lines (containing a line number and five data values). The program reads the data values line by line, so that the first data line in each block is interpreted as data values one through five, the second line as data values six through ten, etc. It is important to have the correct number of lines for each data block used. There must be exactly five data values on each data line. The data blocks may be entered in any order, since the top line identifies the type. Any data block may be deleted, in which case all the values for that type are set to zero. If the shift factors are deleted, for example, the whole matrix would be zero. A sample Data Input File and preprinted forms follow.

SAMPLE DATA INPUT FILE

INPUTS

```
100 BASE YEAR 77
110 MODEL MICO
120 SF
130 1.1 1.1 1.1 1.1 1.1
140 1.1 1.1 1.1 1.1 1.1
150 1.1 1.1 1.1 1.1 1.1
160 THRUPUTS
170 ROW COL AMT
180 2 1 1000.0
190 2 1 200
200 2 2 300
210 3 1 400
220 3 2 500
```

Notes:

1. Line 100. Must be entered as shown, except that in place of 77 enter the selected output base year (the year describing the costs after applying shift factors).
2. Line 110. Must be entered as shown, except that in place of MICO enter AIRCO, MICO or TRACO to designate the aircraft, missile or track model.
3. Lines 120-150. This is a sample variable block. Even variables not used must be entered (as zero).
4. Lines 160-170. The thruputs block, if used, must be last. The first two lines of the thruput block must be exactly like lines 160 and 170.
5. Line 180. The first and second pieces of data designate the row and column to receive the thruput. The last entry is the amount (in millions of dollars of the input base year). The amount will be multiplied by the correct shift factor.
6. Line 190. Notice that more than one thruput may be added to the same cell, in this case cell A(2,1).
7. Line 220. Any number of thruputs may be used.

FIGURE 8

DATA INPUT SHEETS

<u>LINE NO.</u>	<u>VALUE</u>	<u>VARIABLE</u>	<u>CELL</u>	<u>DESCRIPTION</u>
100	AC			
105		1	2,1	Devel Engr, Frame, M\$/MY
		2	2,2	" Propulsion, M\$/MY
		3	2,3	" Guid/Control "
		4	2,4	" Fire Control "
		5	2,5	" Armament "
110		6	2,6	" Payload/Ammo "
		7	2,7	" TBS "
		8	2,8	" Pec Spt "
		9	2,9	" Com Spt "
		10	2,10	" Other "
115		11	7,1	Syst Test/Eval, Frame, M\$/Period
		12	7,2	" Propulsion "
		13	7,3	" Guid/Control "
		14	7,4	" Fire Control "
		15	7,5	" Armament "
120		16	7,6	" Payload/Ammo "
		17	7,7	" TBS "
		18	7,8	" Pec Spt "
		19	7,9	" Com Spt "
		20	7,10	" Other "

FIGURE 9

AVERAGE COSTS

<u>LINE NO.</u>	<u>VALUE</u>	<u>VARIABLE</u>	<u>CELL</u>	<u>DESCRIPTION</u>
125		21	8,1	Syst/Proj Mgt, Frame, M\$/MY, gov't
		22	8,1	" Frame " contr
		23	8,2	" Propulsion, M\$/MY, gov't
		24	8,2	" Propulsion " contr
		25	8,3	" Guid/Control " gov't
130		26	8,3	" Guid/Control " contr
		27	8,4	" Fire Control " gov't
		28	8,4	" Fire Control " contr
		29	8,5	" Armament " gov't
		30	8,5	" Armament " contr
135		31	8,6	" Payload/Ammo " gov't
		32	8,6	" " " contr
		33	8,7	" TBS " gov't
		34	8,7	" " " contr
		35	8,8	" Pec Spt " gov't
140		36	8,8	" Pec Spt " contr
		37	8,9	" Com Spt " gov't
		38	8,9	" Com Spt " contr
		39	8,10	" Other " gov't
		40	8,10	" Other " contr

AVERAGE COSTS

LINE NO.	VALUE	VARIABLE	CELL	DESCRIPTION
145		41	9,1	Training, Frame, M\$/MY
		42	9,1	" " M\$/SET
		43	9,2	" Propulsion, M\$/MY
		44	9,2	" " M\$/SET
		45	9,3	" Guid/Control, M\$/MY
150		46	9,3	" " M\$/SET
		47	9,4	" Fire Control, M\$/MY
		48	9,4	" " M\$/SET
		49	9,5	" Armament, M\$/MY
		50	9,5	" " M\$/SET
155		51	9,6	" Payload/Ammo, M\$/MY
		52	9,6	" " M\$/SET
		53	9,7	" TBS, M\$/MY
		54	9,7	" " M\$/SET
		55	9,8	" Pec Spt, M\$/MY
160		56	9,8	" " M\$/SET
		57	9,9	" Com Spt, M\$/MY
		58	9,9	" " M\$/SET
		59	9,10	" Other, M\$/MY
		60	9,10	" " M\$/SET

AVERAGE COSTS

<u>LINE NO.</u>	<u>VALUE</u>	<u>VARIABLE</u>	<u>CELL</u>	<u>DESCRIPTION</u>
165		61		Reserved (R)
		62		R
		63		R
		64		R
		65		R
170		66		R
		67		R
		68		R
		69		R
		70		R
175		71	14,1	Production, Rec Engr, Frame, M\$/MY
		72	14,2	" " Propulsion, M\$/MY
		73	14,3	" " Guid/Control "
		74	14,4	" " Fire Control "
		75	14,5	" " Armament "
180		76	14,6	" " Payload/Ammo "
		77	14,7	" " TBS "
		78	14,8	" " Pec Spt "
		79	14,9	" " Com Spt "
		80	14,10	" " Other "

AVERAGE COSTS

LINE NO.	VALUE	VARIABLE	CELL	DESCRIPTION
185		81	14,1	Production, QC, Frame, M\$/MY
		82	14,2	" Propulsion, M\$/MY
		83	14,3	" Guid/Control "
		84	14,4	" Fire Control "
		85	14,5	" Armament "
190		86	14,6	" Payload/Ammo "
		87	14,7	" TBS "
		88	14,8	" Pec Spt "
		89	14,9	" Com Spt "
		90	14,10	" Other "
195		91	16,1	Syst Test/Eval, Frame, M\$/Period
		92	16,2	" Propulsion "
		93	16,3	" Guid/Control "
		94	16,4	" Fire Control "
		95	16,5	" Armament "
200		96	16,6	" Payload/Ammo "
		97	16,7	" TBS "
		98	16,8	" Pec Spt "
		99	16,9	" Com Spt "
		100	16,10	" Other "

AVERAGE COSTS

LINE NO.	VALUE	VARIABLE	CELL	DESCRIPTION	
205		101	18,1	Syst/Proj Mgt, Frame,	M\$/MY, Gov't
		102	18,1	" Frame	Contr
		103	18,2	" Propulsior.	Gov't
		104	18,2	" Propulsion	Contr
		105	18,3	" Guid/Control	Gov't
210		106	18,3	" "	" Contr
		107	18,4	" Fire Control	" Gov't
		108	18,4	" "	" Contr
		109	18,5	" Armament	" Gov't
		110	18,5	" "	" Contr
215		111	18,6	" Payload/Ammc	" Gov't
		112	18,6	" "	" Contr
		113	18,7	" TBS	" Gov't
		114	18,7	" "	" Contr
		115	18,8	" Pec Spt	" Gov't
220		116	18,8	" "	" Contr
		117	18,9	" Com Spt	" Gov't
		118	18,9	" "	" Contr
		119	18,10	" Other	" Gov't
		120	18,10	" "	" Contr

AVERAGE COSTS

LINE NO.	VALUE	VARIABLE	CELL	DESCRIPTION
225		121	20,1	Training Services, Frame, M\$/MY
		122	20,2	" " Propulsion, M\$/MY
		123	20,3	" " Guid/Control "
		124	20,4	" " Fire Control "
		125	20,5	" " Armament "
230		126	20,6	Payload/Ammo, "
		127	20,7	TBS "
		128	20,8	Pec Spt "
		129	20,9	Com Spt "
		130	20,10	Other "
235		131	20,1	Training Sets, Frame, M\$/Tng Set
		132	20,2	" Propulsion "
		133	20,3	" Guid/Control "
		134	20,4	" Fire Control "
		135	20,5	" Armament "
240		136	20,6	" Payload/Ammo "
		137	20,7	" TBS "
		138	20,8	" Pec Spt "
		139	20,9	" Com Spt "
		140	20,10	" Other "

AVERAGE COSTS

<u>LINE NO.</u>	<u>VALUE</u>	<u>VARIABLE</u>	<u>CELL</u>	<u>DESCRIPTION</u>	
245		141	22,1	Transportation (1st & 2nd dest), Frame, M\$/Unit	
		142	22,2	"	Propulsion "
		143	22,3	"	Guid/Contr "
		144	22,4	"	Fire Contr "
		145	22,5	"	Armament "
250		146	22,6	"	Payload/Ammo "
		147	22,7	"	TBS "
		148	22,8	"	Pec Spt "
		149	22,9	"	Com Spt "
		150	22,10	"	Other "
255		151	31,1	Replenishment Spares, Frame, \$/unit of activity	
		152	31,2	"	Propulsion "
		153	31,3	"	Guid/Contr "
		154	31,4	"	Fire Contr "
		155	31,5	"	Armament "
260		156	31,6	"	Payload/Ammo "
		157	31,7	"	TBS "
		158	31,8	"	Pec Spt "
		159	31,9	"	Com Spt "
		160	31,10	"	Other "

AVERAGE COSTS

<u>LINE NO.</u>	<u>VALUE</u>	<u>VARIABLE</u>	<u>CELL</u>	<u>DESCRIPTION</u>
265		161	32,1	POL, Frame, \$/Unit of Activity
		162	32,2	" Propulsion, "
		163	32,3	" Guid/Contr, "
		164	32,4	" Fire Contr, "
		165	32,5	" Armament, "
270		166	32,6	" Payload/Ammo, "
		167	32,7	" TBS, "
		168	32,8	" Pec Spt, "
		169	32,9	" Com Spt, "
		170	32,10	" Other, "
275		171	35,1	Labor Cost, OH, Frame, M\$/OH
		172	35,2	" Propulsion, M\$/OH
		173	35,3	" Guid/Contr, "
		174	35,4	" Fire Contr, "
		175	35,5	" Armament, "
280		176	35,6	" Payload/Ammo, "
		177	35,7	" TBS, "
		178	35,8	" Pec Spt, "
		179	35,9	" Com Spt, "
		180	35,10	" Other, "

AVERAGE COSTS

<u>LINE NO.</u>	<u>VALUE</u>	<u>VARIABLE</u>	<u>CELL</u>	<u>DESCRIPTION</u>	
285		181	36,1	Materiel Cost, OH, Frame, M\$/OH	
		182	36,2	"	Propulsion, M\$/OH
		183	36,3	"	Guid/Contr "
		184	36,4	"	Fire Contr "
		185	36,5	"	Armament "
290		186	36,6	"	Payload/Ammo "
		187	36,7	"	TBS "
		188	36,8	"	Pec Spt "
		189	36,9	"	Com Spt "
		190	36,10	"	Other "
295		191	37,1	Transportation Cost, OH, Frame, \$/Ton-Mile	
		192	37,2	"	Propulsion "
		193	37,3	"	Guid/Contr "
		194	37,4	"	Fire Contr "
		195	37,5	"	Armament "
300		196	37,6	"	Payload/Ammo "
		197	37,7	"	TBS "
		198	37,8	"	Pec Sp+ "
		199	37,9	"	Com Spl "
		200	37,10	"	Other "

AVERAGE COSTS

LINE NO.	VALUE	VARIABLE	CELL	DESCRIPTION
305		201	40,1	Maint, Civ Labor, Frame, M\$/MAN
		202	40,2	" " Propulsion, M\$/MAN
		203	40,3	" " Guid/Contr "
		204	40,4	" " Fire Contr "
		205	40,5	" " Armament "
310		206	40,6	" " Payload/Ammo "
		207	40,7	" " TBS "
		208	40,8	" " Pec Spt "
		209	40,9	" " Com Spt "
		210	40,10	" " Other "
315		211	41,1	Other Direct Cost, Frame, M\$/YR
		212	41,2	" " Propulsion, M\$/YR
		213	41,3	" " Guid/Contr "
		214	41,4	" " Fire Contr "
		215	41,5	" " Armament "
320		216	41,6	" " Payload/Ammo "
		217	41,7	" " TBS "
		218	41,8	" " Pec Spt "
		219	41,9	" " Com Spt "
		220	41,10	" " Other "

AVERAGE COSTS

LINE NO.	VALUE	VARIABLE	CELL	DESCRIPTION
325		221	43,7	Personnel Repl Cost, TBS, M\$/MAN
		222	43,10	" " Other, "
		223		R
		224		R
		225	45,7	Qtr, Maint, Util Cost, TBS, M\$/MAN
330		226	45,10	" " Other "
		227		R
		228		R
		229	46,7	Medical Spt Cost, TBS, M\$/MAN
		230	46,10	" " Other "
335		231	47,1	Other Indirect Cost, Frame, M\$/YR
		232	47,2	" " Propulsion, M\$/YR
		233	47,3	" " Guid/Contr "
		234	47,4	" " Fire Contr "
		235	47,5	" " Armament "
340		236	47,6	" " Payload/Ammo "
		237	47,7	" " TBS, "
		238	47,8	" " Pec Spt "
		239	47,9	" " Com Spt "
		240	47,10	" " Other "

AVERAGE COSTS

<u>LINE NO.</u>	<u>VALUE</u>	<u>VARIABLE</u>	<u>CELL</u>	<u>DESCRIPTION</u>
345		241	R	
		242	R	
		243	R	
		244	R	
		245	R	
350		246	33,6	Unit Tng, Ammo, Missiles, Payload/Ammo, \$/Unit Ed
		247	33,7	" " TBS, "
		248	R	
		249	R	
		250	33,10	Unit Tng, Ammo, Missiles, Other "
355		251	R	
		252	R	
		253	R	
		254	R	
		255		
360		256	26,7	Crew Base P & A, TBS, M\$/MY
		257	26,10	" - Other, M\$/MY
		258	27,7	Maint Base P & A, TBS "
		259	27,10	" Other "
		260	28,7	Indirect Base P & A, TBS "

AVERAGE COSTS

LINE NO.	VALUE	VARIABLE	CELL	DESCRIPTION
365		261	28,10	Indirect Base P & A, Other, M\$/MY
		262	26,7	Crew Theater Cost, TBS
		263	26,10	" Other
		264	27,7	Maint Theater Cost, TBS
		265	27,10	" Other
370		266	28,7	Indirect Theater Cost, TBS
		267	28,10	" Other
		268	26,7	Crew Flight Pay, TBS
		269	26,10	" Other
		270	27,7	Maint Flight Pay, TBS
375		271	27,10	" Other
		272		R
		273		R
		274	29,7	PCS Cost, TBS
		275	29,10	" Other
380		276		R
		277		R
		278		R
		279		R
		280		R
385		281		R
		282		R
		283		R
		284		R
		285		

QUANTITIES

<u>LINE NO.</u>	<u>VALUE</u>	<u>VARIABLE</u>	<u>CELL</u>	<u>DESCRIPTION</u>
400	XN			
405		1	2,1	Devel Engr, Frame, Number of MY
		2	2,2	" Propulsion "
		3	2,3	" Guid/Contr "
		4	2,4	" Fire Control "
		5	2,5	" Armament "
410		6	2,6	" Payload/Ammo "
		7	2,7	" TBS, "
		8	2,8	" Pec Spt "
		9	2,9	" Com Spt "
		10	2,10	" Other "
415		11	5,1	Proto Mfg, Frame, QTY PROTO
		12	5,2	" Propulsion, QTY PROTO
		13	5,3	" Guid/Contr "
		14	5,4	" Fire Control "
		15	5,5	" Armament "
420		16	5,6	" Payload/Ammo "
		17	5,7	" TBS "
		18	5,8	" Pec Spt "
		19	5,9	" Com Spt "
		20	5,10	" Other "

QUANTITIES

<u>LINE NO.</u>	<u>VALUE</u>	<u>VARIABLE</u>	<u>CELL</u>	<u>DESCRIPTION</u>
425		21	7,1	Syst, Test, Eval, Frame, QTY TEST PERIODS
		22	7,2	" Propulsion "
		23	7,3	" Guid/Contr "
		24	7,4	" Fire Control "
		25	7,5	" Armament "
430		26	7,6	" Payload/Ammo "
		27	7,7	" TBS "
		28	7,8	" Pec Spt "
		29	7,9	" Com Spt "
		30	7,10	" Other "

QUANTITIES

<u>LINE NO.</u>	<u>VALUE</u>	<u>VARIABLE</u>	<u>CELL</u>	<u>DESCRIPTION</u>	
435		31	8,1	Syst/Proj Mgt, Frame, Number of MY,	Govt
		32	8,1	" Frame "	Contr
		33	8,2	" Propulsion "	Govt
		34	8,2	" Propulsion "	Contr
		35	8,3	" Guid/Contr "	Govt
440		36	8,3	" Guid/Contr "	Contr
		37	8,4	" Fire Control "	Govt
		38	8,4	" Fire Control "	Contr
		39	8,5	" Armament "	Govt
		40	8,5	" Armament "	Contr
445		41	8,6	" Payload/Ammo "	Govt
		42	8,6	" Payload/Ammo "	Contr
		43	8,7	" TBS "	Govt
		44	8,7	" TBS "	Contr
		45	8,8	" Pec Spt "	Govt
450		46	8,8	" Pec Spt "	Contr
		47	8,9	" Com Spt "	Govt
		48	8,9	" Com Spt "	Contr
		49	8,10	" Other "	Govt
		50	8,10	" Other "	Contr

QUANTITIES

<u>LINE NO.</u>	<u>VALUE</u>	<u>VARIABLE</u>	<u>CELL</u>	<u>DESCRIPTION</u>
455		51	9,1	Training, Frame, Number MY
		52	9,1	" Frame, Qty Tng Sets
		53	9,2	" Propulsion, Number MY
		54	9,2	" Propulsion, Qty Tng Sets
		55	9,3	" Guid/Contr, Number MY
460		56	9,3	" Guid/Contr, Qty Tng Sets
		57	9,4	" Fire Control, Number MY
		58	9,4	" Fire Control, Qty Tng Sets
		59	9,5	" Armament, Number MY
		60	9,5	" Armament, Qty Tng Sets
465		61	9,6	" Payload/Ammo, Number MY
		62	9,6	" Payload/Ammo, Qty Tng Sets
		63	9,7	" TBS, Number MY
		64	9,7	" TBS, Qty Tng Sets
		65	9,8	" Pec Spt, Number MY
470		66	9,8	" Pec Spt, Qty Tng Sets
		67	9,9	" Com Spt, Number MY
		68	9,9	" Com Spt, Qty Tng Sets
		69	9,10	" Other, Number My
		70	9,10	" Other, Qty Tng Sets

<u>LINE NO.</u>	<u>VALUE</u>	<u>VARIABLE</u>	<u>CELL</u>	<u>DESCRIPTION</u>
475		71	R	
		72	R	
		73	R	
		74	R	
		75	R	
480		76	R	
		77	R	
		78	R	
		79	R	
		80	R	
485		81	14,1	Production, Frame, NO. OF MY, Engr
		82	14,2	" Propulsion "
		83	14,3	" Guid/Contr "
		84	14,4	" Fire Control "
		85	14,5	" Armament "
490		86	14,6	" Payload/Ammo "
		87	14,7	" TBS "
		88	14,8	" Pec Spt "
		89	14,9	" Com Spt "
		90	14,10	" Other "

QUANTITIES

LINE NO.	VALUE	VARIABLE	CELL	DESCRIPTION
495		91	14,1	Production, Frame, No. of MY, QC
		92	14,2	" Propulsion "
		93	14,3	" Guid/Contr "
		94	14,4	" Fire Contr "
		95	14,5	" Armament "
500		96	14,6	" Payload/Ammo "
		97	14,7	" TBS "
		98	14,8	" Pec Spt "
		99	14,9	" Com Spt "
		100	14,10	" Other "
505		101	14,1	" Frame, QTY MF'D (see note)
		102	14,2	" Propulsion "
		103	14,3	" Guid/Contr "
		104	14,4	" Fire Contr "
		105	14,5	" Armament "
510		106	14,6	" Payload/Ammo "
		107	14,7	" TBS "
		108	14,8	" Pec Spt "
		109	14,9	" Com Spt "
		110	14,10	" Other "
515		111	16,1	Syst Test, Eval, Frame, QTY TEST PERIODS
		112	16,2	" Propulsion "
		113	16,3	" Guid/Contr "
		114	16,4	" Fire Contr "
		115	16,5	" Armament "

NOTE: Variables XN(101) through XN(110) are for the quantity to the Army, not including previous buys.

EXAMPLE: Army buys 1,000 airframes, after another service has already bought 100 airframes. Thus, the Army buys airframes numbered 101 through 1101.

SOLUTION: XN(101) = 1000
PB(11) = 100

(See Figure 5 of User's Guide Volume 1)

QUANTITIES

<u>LINE NO.</u>	<u>VALUE</u>	<u>VARIABLE</u>	<u>CELL</u>	<u>DESCRIPTION</u>
520		116	16,6	Syst Test, Eval, Payload/Ammo, QTY TEST PERIODS
		117	16,7	" TBS "
		118	16,8	" Pec Spt "
		119	16,9	" Com Spt "
		120	16,10	" Other "
525		121	18,1	Syst/Proj Mgt, Frame, QTY GOV MY
		122	18,1	" Frame, QTY CONTR MY
		123	18,2	" Propulsion, QTY GOV MY
		124	18,2	" Propulsion, QTY CONTR MY
		125	18,3	" Guid/Contr, QTY GOV MY
530		126	18,3	" Guid/Contr, QTY CONTR MY
		127	18,4	" Fire Contr, QTY GOV MY
		128	18,4	" Fire Contr, QTY CONTR MY
		129	18,5	" Armament, QTY GOV MY
		130	18,5	" Armament, QTY CONTR MY
535		131	18,6	" Payload/Ammo, QTY GOV MY
		132	18,6	" Payload/Ammo, QTY CONTR MY
		133	18,7	" TBS, QTY GOV MY
		134	18,7	" TBS, QTY CONTR MY
		135	18,8	" Pec Spt, QTY GOV MY
540		136	18,8	" Pec Spt, QTY CONTR MY
		137	18,9	" Com Spt, QTY GOV MY
		138	18,9	" Com Spt, QTY CONTR MY
		139	18,10	" Other, QTY GOV MY
		140	18,10	" Other, QTY CONTR MY

QUANTITIES

<u>LINE NO.</u>	<u>VALUE</u>	<u>VARIABLE</u>	<u>CELL</u>	<u>DESCRIPTION</u>
545		141	20,1	Training, Frame, Number MY
		142	20,2	" Propulsion "
		143	20,3	" Guid/Contr "
		144	20,4	" Fire Contr "
		145	20,5	" Armament "
550		146	20,6	" Payload/Ammo "
		147	20,7	" TBS "
		148	20,8	" Pec Spt "
		149	20,9	" Com Spt "
		150	20,10	" Other "
555		151	20,1	Training, Frame, Qty Tng Sets
		152	20,2	" Propulsion "
		153	20,3	" Guid/Contr "
		154	20,4	" Fire Contr "
		155	20,5	" Armament "
560		156	20,6	" Payload/Ammo "
		157	20,7	" TBS "
		158	20,8	" Pec Spt "
		159	20,9	" Com Spt "
		160	20,10	" Other "

QUANTITIES

<u>LINE NO.</u>	<u>VALUE</u>	<u>VARIABLE</u>	<u>CELL</u>	<u>DESCRIPTION</u>
565		161	22,1	Transportation, Frame, Qty Transported
		162	22,2	" Propulsion "
		163	22,3	" Guid/Contr "
		164	22,4	" Fire Contr "
		165	22,5	" Armament "
570		166	22,6	" Payload/Ammo "
		167	22,7	" TBS "
		168	22,8	" Pec Spt "
		169	22,9	" Com Spt "
		170	22,10	" Other "
575		171		R
		172		R
		173		R
		174		R
		175		R
580		176		R
		177		R
		178		R
		179		R
		180		R

QUANTITIES

<u>LINE NO.</u>	<u>VALUE</u>	<u>VARIABLE</u>	<u>CELL</u>	<u>DESCRIPTION</u>
				(Also, other O&S cells in
585		181	31,1	Qty Opn'l, Frames same column)
		182	31,2	" Propulsion
		183	31,3	" Guid/Contr
		184	31,4	" Fire Control
		185	31,5	" Armament
590		186	31,6	" Payload/Ammo
		187	26,7	" TBS
		188	31,8	" Pec Spt
		189	31,9	" Com Spt
		190	26,10	" Other
595		191	26,7	Number Crew per TBS
		192	26,10	Number Crew per Other
		193	27,7	Number Maint Men, TBS
		194	27,10	Number Maint Men, Other
		195	28,7	Number of Indirect Men, TBS
600		196	28,10	Number of Indirect Men, Other
		197	R	
		198	R	
		199	R	
		200	R	

<u>LINE NO.</u>	<u>VALUE</u>	<u>VARIABLE</u>	<u>CELL</u>	<u>DESCRIPTION</u>
605		201	31,1	Yearly activity (FH, miles, etc), Frame
		202	31,2	" Propulsion
		203	31,3	" Guid/Contr
		204	31,4	" Fire Contr
		205	31,5	" Armament
610		206	31,6	" Payload/Ammo
		207	31,7	" TBS
		208	31,8	" Pec Spt
		209	31,9	" Com Spt
		210	31,10	" Other
615		211	40,1	No. Civ Maint Men per Opn'l Frame
		212	40,2	" Propulsion
		213	40,3	" Guid/Contr
		214	40,4	" Fire Control
		215	40,5	" Armament
620		216	40,6	" Payload/Ammo
		217	40,7	" TBS
		218	40,8	" Pec Spt
		219	40,9	" Com Spt
		220	40,10	" Other
625		221		R
		222		R
		223		R
		224		R
		225		R

<u>LINE NO.</u>	<u>VALUE</u>	<u>VARIABLE</u>	<u>CELL</u>	<u>DESCRIPTION</u>
700	UC			
705		1	5,1	1st unit cost, Proto Mfg, Frame, M\$
		2	5,2	" Propulsion, M\$
		3	5,3	" Guid/Contr "
		4	5,4	" Fire Control "
		5	5,5	" Armament "
710		6	5,6	" Payload/Ammo "
		7	5,7	" TBS "
		8	5,8	" Pec Spt "
		9	5,9	" Com Spt "
		10	5,10	" Other "
715		11	14,1	1st unit cost production, Frame, M\$
		12	14,2	" Propulsion, M\$
		13	14,3	" Guid/Contr "
		14	14,4	" Fire Control "
		15	14,5	" Armament "
720		16	14,6	" Payload/Ammo "
		17	14,7	" TBS "
		18	14,8	" Pec Spt "
		19	14,9	" Com Spt "
		20	14,10	" Other "

EXAMPLE: A CER predicts the cumulative average cost of airframes at unit 1000. The cum avg theory is used: $Y = aX^b$ where Y = cum avg cost at quantity X , a = first unit cost, X = cumulative quantity, and $b = \log(\text{slope})/\log(2)$. If the CER estimates a cum avg cost (at unit 1000) of .25 million dollars, find the first unit cost. Assume a slope of 90%.

SOLUTION: $Y = aX^b$
 $a = Y/X^b$
 $a = .25/1000^b$
 $a = .25/1000^{-.1521}$ ← $\left\{ \begin{array}{l} \log(.90) = -.1054 \\ \log(2) = .6931 \\ b = -.1054/.6931 \\ b = -.1521 \end{array} \right.$
 $a = .715 \text{ million dollars}$

EXPERIENCE CURVES

<u>LINE NO.</u>	<u>VALUE</u>	<u>VARIABLE</u>	<u>CELL</u>	<u>DESCRIPTION</u>	
725	EC				
730		1	5,1	Slope, Proto Mfg, Frame, as decimal fraction	
		2	5,2	" Propulsion	"
		3	5,3	" Guid/Contr	"
		4	5,4	" Fire Control	"
		5	5,5	" Armament	"
735		6	5,6	" Payload/Ammo	"
		7	5,7	" TBS	"
		8	5,8	" Pec Spt	"
		9	5,9	" Com Spt	"
		10	5,10	" Other	"
740		11	14,1	Slope, Prod Mfg, Frame	"
		12	14,2	" Propulsion	"
		13	14,3	" Guid/Contr	"
		14	14,4	" Fire Control	"
		15	14,5	" Armament	"
745		16	14,6	" Payload/Ammo	"
		17	14,7	" TBS	"
		18	14,8	" Pec Spt	"
		19	14,9	" Com Spt	"
		20	14,10	" Other	"

<u>LINE NO.</u>	<u>VALUE</u>	<u>VARIABLE</u>	<u>CELL</u>	<u>DESCRIPTION</u>
750	PB			
755		1	R	
		2	R	
		3	R	
		4	R	
		5	R	
760		6	R	
		7	R	
		8	R	
		9	R	
		10	R	
765		11	14,1	Prev Buy Prod, Frame
		12	14,2	" Propulsion
		13	14,3	" Guid/Contr
		14	14,4	" Fire Control
		15	14,5	" Armament
770		16	14,6	" Payload/Ammo
		17	14,7	" TBS
		18	14,8	" Pec Spt
		19	14,9	" Com Spt
		20	14,10	" Other

NOTE: This block, like any data block, may be deleted entirely. But if any part is used, the whole block must be present.

EXAMPLE: Army buys 1,000 airframes, after another service has already bought 100 airframes. Thus, the Army buys airframes numbered 101 through 1101.

SOLUTION: $XN(101) = 1000$

$PB(11) = 100$

(See Figure 5 of User's Guide, Vol I)

COST FACTORS

<u>LINE NO.</u>	<u>VALUE</u>	<u>VARIABLE</u>	<u>CELL</u>	<u>DESCRIPTION</u>
800	CF			
805		1	17,1	Data, percent of all other inv cost, Frame
		2	17,2	" Propulsion
		3	17,3	" Guid/Contr
		4	17,4	" Fire Control
		5	17,5	" Armament
810		6	17,6	" Payload/Ammo
		7	17,7	" TBS
		8	17,8	" Pec Spt
		9	17,9	" Com Spt
		10	17,10	" Other
815		11	14,1	Tooling, Frame, percent of Mfg
		12	14,2	" Propulsion "
		13	14,3	" Guid/Contr "
		14	14,4	" Fire Control "
		15	14,5	" Armament "
820		16	14,6	" Payload/Ammo "
		17	14,7	" TBS "
		18	14,8	" Pec Spt "
		19	14,9	" Com Spt "
		20	14,10	" Other "

COST FACTORS

<u>LINE NO.</u>	<u>VALUE</u>	<u>VARIABLE</u>	<u>CELL</u>	<u>DESCRIPTION</u>	
825		21	15,1	Engineering changes, Frame, percent of row 14	
		22	15,2	" Propulsion	"
		23	15,3	" Guid Contr	"
		24	15,4	" Fire Control	"
		25	15,5	" Armament	"
830		26	15,6	" Payload/Ammo	"
		27	15,7	" TBS	"
		28	15,8	" Pec Spt	"
		29	15,9	" Com Spt	"
		30	15,10	" Other	"
835		31	20,1	Training, Spares, Frame, percent of Sets cost	
		32	20,2	" Propulsion	"
		33	20,3	" Guid Contr	"
		34	20,4	" Fire Control	"
		35	20,5	" Armament	"
840		36	20,6	" Payload/Ammo	"
		37	20,7	" TBS	"
		38	20,8	" Pec Spt	"
		39	20,9	" Com Spt	"
		40	20,10	" Other	"

COST FACTORS

<u>LINE NO.</u>	<u>VALUE</u>	<u>VARIABLE</u>	<u>CELL</u>	<u>DESCRIPTION</u>
845		41	21,1	Initial Spares & Repair Parts, Frame, % of Prod
		42	21,2	" Propulsion "
		43	21,3	" Guid Contr "
		44	21,4	" Fire Contr "
		45	21,5	" Armament "
850		46	21,6	" Payload/Ammo, "
		47	21,7	" TBS "
		48	21,8	" Pec Spt "
		49	21,9	" Com Spt "
		50	21,10	" Other "
855		51		R
		52		R
		53		R
		54		R
		55		R
860		56		R
		57		R
		58		R
		59		R
		60		R

COST FACTORS

LINE NO.	VALUE	VARIABLE	CELL	DESCRIPTION
865		61	38,1	Modifications, Frame, annual % of prod cost
		62	38,2	" Propulsion
		63	38,3	" Guid/Contr
		64	38,4	" Fire Contr
		65	38,5	" Armament
870		66	38,6	" Payload/Ammo
		67	38,7	" TBS
		68	38,8	" Pec Spt
		69	38,9	" Com Spt
		70	38,10	" Other
875		71		R
		72		R
		73	43,7	Personnel Replacement, TBS, Annual attrition rate
		74	43,10	" Other
		75	44,7	TPP Factor, TBS
880		76	44,10	TPP Factor, Other
		77		R
		78		R
		79		R
		80		R

PERFORMANCE CHARACTERISTICS

<u>LINE NO.</u>	<u>VALUE</u>	<u>VARIABLE</u>	<u>CELL</u>	<u>DESCRIPTION</u>
900	PC			
905		1	R	
		2	R	
		3	R	
		4	R	
		5	R	
910		6	R	
		7	R	
		8	R	
		9	R	
		10	R	
915		11	35,1	Act (FH,miles,etc) between overhauls, Frame
		12	35,2	" Propulsion
		13	35,3	" Guid/Contr
		14	35,4	" Fire Contro
		15	35,5	" Armament
920		16	35,6	" Payload/Amn
		17	35,7	" TBS
		18	35,8	" Pec Spt
		19	35,9	" Com Spt
		20	35,10	" Other

(Note: Same PC's also used, rows 36 and 37)

PERFORMANCE CHARACTERISTICS

LINE NO.	VALUE	VARIABLE	CELL	DESCRIPTION
925		21	37,1	Transportation to depot, Frame, Tons
		22	37,2	" Propulsion
		23	37,3	" Guid/Contr
		24	37,4	" Fire Control
		25	37,5	" Armament
930		26	37,6	" Payload/Ammo
		27	37,7	" TBS
		28	37,8	" Pec Spt
		29	37,9	" Com Spt
		30	37,10	" Other
935		31	37,1	Transp to depot, distance in miles, Frame
		32	37,2	" Propulsion
		33	37,3	" Guid/Contr
		34	37,4	" Fire Control
		35	37,5	" Armament
940		36	37,6	" Payload/Ammo
		37	37,7	" TBS
		38	37,8	" Pec Spt
		39	37,9	" Com Spt
		40	37,10	" Other
945		41		R
		42		R
		43		R
		44		R
		45		R

<u>LINE NO.</u>	<u>VALUE</u>	<u>VARIABLE</u>	<u>CELL</u>	<u>DESCRIPTION</u>
955	YN			
960		1		Number of years buildup, O&S phase
		2		Number of years level operation, O&S phase
		3		Number of years phasedown, O&S phase
		4		R
		5		Service life, years

Note: Use either a) YN(1) and YN(2) and YN(3), or b) YN(5), not both.

SHIFT FACTORS

<u>LINE NO.</u>	<u>VALUE</u>	<u>VARIABLE</u>	<u>CELL</u>	<u>DESCRIPTION</u>
970	SF			
975		1		Constant Dollar Shift Factor, RDT&E
		2		" Proc Acft
		3		" Proc Missiles
		4		" Proc Weapons
		5		" Proc Ammo
980		6		" Proc Other
		7		" OMA
		8		" MPA
		9		" MCA
		10		" FHMA
985		11		" ERDA
		12	R	
		13	R	
		14	R	
		15	R	

LINE NO.DESCRIPTION

1000	THRUPUTS		
1010	ROW	COL	AMT
1020	---	---	---
1030	---	---	---
1040	---	---	---
1050	---	---	---
1060	---	---	---

(To be defined by analyst)

NOTE: Enter amounts in millions of dollars of the input base year. The amounts will be multiplied by the shift factors.

4.3 Cost Definitions Input. If the analyst asks for Report 2, the program will ask for the name of the definition main file. This main file works together with definition satellite files to produce Hardware Cost, Flyaway Cost, or any other aggregation the analyst may choose to define. The main file (shown in Figure 10), tells the program what satellite files to use (shown in Figure 11). Thus, the analyst only has to name one file at run time, even though up to 15 different definition satellite files may be used. All files must follow the rules shown on the figures, and all files must be prepared before running the program. The line numbers on the samples are illustrative only, and the analyst can use any line numbers he wishes. Preprinted forms are at Figures 12 and 13.

SAMPLE DEFINITION MAIN FILE

KEYCOST

```
100 LABEL LOCATION
110 HARDWARE FILEAA
120 FLYAWAY FILEBB
130 WEAP-SYS FILECC
140 PROCMN'T FILEDD
150 PROGRAM FILEEE
```

Notes:

1. Line 100. Must be entered as shown.
2. Lines 110-150. Enter two alphanumeric words, each word up to eight characters. The first word appears as a label on the output. The second word identifies the definition satellite file which tells how to calculate the cost.
3. Line 150. Up to 15 different definitions may be used.

FIGURE 10

SAMPLE DEFINITION SATELLITE FILE

FILEAA

```
100 QTY 1000
110 ROW COL FRACTION
120 3 1 1.0
130 3 2 .5
```

Notes:

1. Line 100. Must be entered as shown, except that in place of 1000 enter the quantity you want to divide by.
2. Line 110. Must be entered as shown.
3. Lines 120-130. The first and second pieces of data designate the row and column containing the desired cost. The last entry is the fractional amount of that cost to take.
4. Line 130. Any number of data lines may be used.

FIGURE 11

DEFINITION MAIN FILE INPUT FORM

```
100 LABEL LOCATION
110 _____
120 _____
etc.
```

FIGURE 12

DEFINITION SATELLITE FILE INPUT FORM

```
100 QTY _____
110 ROW COL FRACTION
120 _____
130 _____
etc.
```

FIGURE 13

4.4 Appropriation Input. If the analyst asks for reports 3,4,5,6,7 or 8, the program will ask at run time for the name of the appropriation file. This file specifies which budget funding category will pay for each cost element in the Army Life Cycle Cost Matrix. For convenience, the model assigns appropriations row by row (using column 11, total), rather than cell by cell. If a cost element requires several appropriations (for example, row 31, Replenishment Spares), then that row may be split among several appropriations by assigning fractions of the row to each of the required appropriations, as shown in Figure 14. For example, row 1, (Total R&D) may be assigned to appropriation 1, RDT&E, while row 47 (Other Indirect) may be split fractionally among OMA, MPA and FHMA. The input form lists the appropriations recognized by the model and their respective codes. Figure 14 is a sample appropriation file in which row 1 (total R&D) has been split into appropriations 1 and 3. The analyst could have obtained the same result by assigning appropriations to each of rows 2 through 11. Whether the analyst assigns appropriations to total rows or to primary rows, he must account for exactly 100% of the life cycle cost. A preprinted form follows at Figure 15.

SAMPLE APPROPRIATION FILE

FUNDING

100	ROW	CODE	FRACTION
110	1	1	.50
120	1	3	.50

Notes:

1. Line 100. Must be entered as shown.
2. Line 110. The first data entry names the row containing the cost. The second data entry gives the appropriation, using the following codes:

CODE - APPROPRIATION

1	RDT&E
2	PROC, AC
3	PROC, MSL
4	PROC, WPN
5	PROC, AMMO
6	PROC, OTHER
7	OMA
8	MPA
9	MCA
10	FHMA
11	NOT USED
12	ERDA

The third data entry gives the fraction of the total cost (of the named row) which is to be assigned to the given appropriation. Line 110 assigns 50% of the cost of row 1 (total R&D) to appropriation code 1, (RDT&E).

3. Line 120. Line 120 assigns 50% of the cost of row 1 (total R&D) to appropriation code 3 (Procurement of Missiles). The analyst can address any rows (either totals or primary rows) as long as exactly 100% of the life cycle cost is accounted for. The analyst may use as many data lines as he needs to accomplish this.

FIGURE 14

APPROPRIATION INPUT FORM

<u>LINE NO.</u>				CODE - APPROPRIATION	
100	ROW	CODE	FRACTION	1	RDT&E
110	—	—	—	2	PROC, AC
120	—	—	—	3	PROC, MSL
130	—	—	—	4	PROC, WPN
140	—	—	—	5	PROC, AMMO
150	—	—	—	6	PROC, OTHER
160	—	—	—	7	OMA
170	—	—	—	8	MPA
180	—	—	—	9	MCA
etc				10	FHMA
				11	NOT USED
				12	ERDA

FIGURE 15

4.5 Time Phasing Input. If the analyst asks for reports 4,5,6,7 or 8, the program will ask at run time for the name of the time phasing file (also the inflation file and the appropriation file). The time phasing file instructs the computer how to spread over time the constant dollar amounts of Report 3 (Appropriation by Life Cycle Phase), giving time phased reports in constant dollars (Reports 4 and 5) and current dollars (Reports 6 and 7). It is important for the analyst to understand how the program calculates the constant dollar Reports 4 and 5 from Report 3, and then how the program calculates the current dollar Reports 6 and 7 from the constant dollar Reports 4 and 5. This is explained in Chapter 3. The analyst also will have to study Figure 16 and the sample outputs in Appendix A to understand time phasing. At Figure 17 is a time phasing input form for one data block.

SAMPLE TIME PHASING INPUT FILE

SPREAD

```

100 PHASE 1
110 CODE 1
120 YEAR AMOUNT
130 65 100
140 66 0
150 67 110.
160 68 0.
170 69 120.
180 70 0
190 71 120
200 72 0
210 73 120
220 74 0
230 YEAR PERCENT
240 75 .10
250 76 .20
260 77 .05
270 78 .25
280 79 .20
290 80 .10
300 81 .05
310 82 .05
320 CODE 3
330 YEAR AMOUNT
340 65 0
350 66 0
360 67 0
370 68 0
380 69 0
390 70 0
400 71 0
410 72 0
420 73 0
430 74 0
440 YEAR PERCENT
450 75 0
460 76 0
470 77 0
480 78 .1
490 79 .1
500 80 .1
510 81 .1
520 82 .2
530 83 .1
540 84 .1
550 85 .05
560 86 .05
570 87 .05

```

Notes:

1. Lines 100-570. These lines illustrate one phase data block for life cycle phase 1 (R&D). The first line of a phase data block must be entered as in line 100, except that instead of 1, enter 1,2,3 or 4 for R&D, INV, O&S, or ERDA, respectively.
2. Lines 110-310. These lines illustrate one appropriation data block for code 1 (RDT&E). Within each phase data block the analyst must have an appropriation data block for every appropriation used in that phase. The first line of an appropriation data block must be entered as in line 110, except that instead of 1, enter the correct appropriation code (see Figure 17 for the codes).
3. Lines 120-220. These lines illustrate the amount section of an appropriation data block. The first line of the amount section must be entered as in line 120. Exactly ten data lines must follow as in lines 130-220. The first year must be the same in every amount section in the whole file. The amounts are in millions of current dollars.
4. Lines 230-310. These lines illustrate the percent section of an appropriation data block. The first line of the percent section must be entered as in line 230. Up to 28 data lines may follow as in lines 240-310, but the constant dollar percents in decimal form must add to 1.00.

FIGURE 16

TIME PHASING INPUT FORM
(For One Data Block)

			CODE - APPROPRIATION
_____	CODE	_____	1 RDT&E
_____	YEAR	AMOUNT	2 PROC, AC
_____	_____	_____	3 PROC, MSL
_____	_____	_____	4 PROC, WPN
_____	_____	_____	5 PROC, AMMO
_____	_____	_____	6 PROC, OTHER
_____	_____	_____	7 OMA
_____	_____	_____	8 MPA
_____	_____	_____	9 MCA
_____	_____	_____	10 FHMA
_____	_____	_____	11 NOT USED
_____	_____	_____	12 ERDA
_____	YEAR	PERCENT	
_____	_____	_____	
_____	_____	_____	
etc			

FIGURE 17

4.6 Inflation Input. If the analyst asks for reports 4,5,6,7 or 8 the program will ask at run time for the name of the inflation main file. This file specifies, for each appropriation code used, the location of the inflation satellite file containing the composite indices for that appropriation. Figure 18 is a sample inflation main file and Figure 19 is a sample inflation satellite file. Figures 20 and 21 are the corresponding blank input forms. A utility program normally writes the inflation satellite files, based on price indices and outlay rates. This program is described in Appendix B together with a discussion of composite indices, price indices and outlay rates. The input forms are provided in case the analyst chooses to create his own inflation satellite files.

SAMPLE INFLATION MAIN FILE

INDICES

100 APPROP LOCATION
110 1 RDFILE
120 3 PROCFILE

Notes:

1. Line 100. The first line must be entered as shown.
2. Lines 110-120. The first data entry gives the appropriation code using the following codes:

CODE - APPROPRIATION

1 RDT&E
2 PROC, AC
3 PROC, MSL
4 PROC, WPN
5 PROC, AMMO
6 PROC, OTHER
7 OMA
8 MPA
9 MCA
10 FHMA
11 NOT USED
12 ERDA

The second data entry names the file containing the composite indices for the given appropriation. Line 110 says that the composite indices for appropriation code 1 (RDT&E) are found in the file named "RDFILE". There must be one data line for every appropriation used.

FIGURE 18

SAMPLE INFLATION SATELLITE FILE

RDFILE

100 65 .70
110 66 .75
120 67 .80
130 68 .85
140 69 .90
150 70 .95
160 71 1.00
170 72 1.05

Notes:

1. Line 100. The first data entry identifies the year and is alpha-numeric ("7T" is acceptable). The second data entry is the composite index.
2. Line 170. Any number of data lines may be entered (at least two are required). Missing indices are calculated by the program.

FIGURE 19

INFLATION MAIN FILE INPUT FORM

CODE - APPROPRIATION

100 APPROP LOCATION
 110 _____
 120 _____
 etc

1 RDT&E
 2 PROC, AC
 3 PROC, MSL
 4 PROC, WPN
 5 PROC, AMMO
 6 PROC, OTHER
 7 OMA
 8 MPA
 9 MCA
 10 FHMA
 11 NOT USED
 12 ERDA

FIGURE 20

INFLATION SATELLITE FILE INPUT FORM

100 _____
 110 _____
 etc

FIGURE 21

4.7 Changing Row and Column Headings. Standard headings normally are used. If the analyst is satisfied with the standard headings he need not read this section. In case he wishes to change the labels on the cost elements, appropriations or column headings, he must create a substitute file for ROWST*, APPST* or COLST*, respectively, as described below. For each model (AIRCO, MICO and TRACO), a file is required, named AIRHD*, MICHD* or TRAHD*, respectively. This file has only one line, so it can be easily changed. Figure 22 shows the standard file for all models. The one line has a line number, the name of the file containing the row headings, the name of the file containing the appropriation headings, and the name of the file containing the column headings. The files containing the standard headings are named ROWST*, APPST* and COLST*. These files already exist and need not be created by the analyst. At run time the program reads AIRHD*, MICHD*, or TRAHD*, (depending on the model) then locates and reads the three files it names. Each of the three files must conform to its own exact format as described on the sample figures. The file containing the row headers must have exactly 50 lines, each with the format described on Figure 23. Leading and trailing blanks (in front of and in back of the words) must be entered. Figure 23 is the standard file and serves as a sample for row headers. The file containing the appropriation headers must have exactly 14 lines, each in the format described on Figure 24. Figure 24 is the standard file and serves as a sample file for appropriation headers. The file containing the column headings must have exactly 6 lines, each in the

format of Figure 25. Leading and trailing blanks (in front of and in back of the words) must be entered. Lines 1-4 will appear as column headings on Report 1 and lines 5 and 6 will appear as the early years and the later years, respectively, on the time-phased reports. Figure 25 is the standard file and serves as an example for column headers. Preprinted input forms follow at Figures 26, 27, 28 and 29.

SAMPLE MAIN HEADER FILE

```
100 ROWST* APPST* COLST*
```

Notes:

1. Line 100. Only one line. First data entry gives the name of the file containing row headers (standard file is named ROWST*. Second data entry gives the name of the file containing appropriation headers (standard file is named APPST*). Third data entry gives the name of the file containing column headers (standard file is named COLST*). Any or all data entries may be changed.

FIGURE 22

SAMPLE ROW HEADERS FILE

101	RES & DEVELOPMENT	124	OPERATING AND SPT
102	DEVELOPMENT ENGR	125	MIL PERSONNEL
103	PEP	126	CREW P&A
104	TOOLING	127	MAINT P&A
105	PROTOTYPE MANUF	128	INDIRECT P&A
106	DATA	129	PCS
107	SYS TEST & EVAL	130	CONSUMPTION
108	SYS/PROJECT MGT	131	REPL SPARES
109	TRAINING	132	POL
110	FACILITIES	133	UNT TNG AMMO/MSL
111	OTHER	134	DEPOT MAINTENANCE
112	INVESTMENT	135	LABOR
113	NON-RECURRING INV	136	MATERIEL
114	PRODUCTION	137	TRANSPORTATION
115	ENGR CHANGES	138	MODIFICATIONS
116	SYS TEST & EVAL	139	OTHER DIR SPT OPNS
117	DATA	140	MAINT, CIV LABOR
118	SYS/PROJECT MGT	141	OTHER DIRECT
119	OPN'L/SITE ACT	142	INDIRECT SPT OPNS
120	TRAINING	143	PERSONNEL REPL
121	INIT SP & REP PTS	144	TPP
122	TRANSPORTATION	145	QTRS, MAINT/UTIL
123	OTHER	146	MEDICAL SUPPORT
		147	OTHER INDIRECT
		148	TOTAL, LESS ERDA
		149	ERDA
		150	TOTAL

Notes:

1. All lines. Must conform to following format: 3 integers, 1 blank, and 24 alphanumeric.

FIGURE 23

SAMPLE APPROPRIATION HEADERS FILE

```

101 RDT&E.....
102 PROC, AC.....
103 PROC, MSL.....
104 PROC, WPN.....
105 PROC, AMMO.....
106 PROC, OTHER.....
107 OMA.....
108 MPA.....
109 MCA.....
110 FHMA.....
111 TOTAL, LESS ERDA.....
112 ERDA.....
113 TOTAL.....
114 PERCENT.....

```

Notes:

1. All lines. Must conform to following format: 3 integers, 1 blank, and 24 alphanumeric.

FIGURE 24

SAMPLE COLUMN HEADERS FILE

```

COLSI*
1
2 SYSTEM
3 \STRUC-
4 COST ELEMENT \ (1) PRO- PULSION (2) GUID CONTR/ FIRE ARMA- PAYLOAD SPECI- PEC COMMON
5 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 TOTAL PER-
6 79 80 81 82 83 84 85 86 87 88 89 90 91 92 TOTAL

```

Notes:

1. All lines. Must conform to following format: 1 integer, 1 blank space, 116 alphanumeric characters. First four lines appear on Report 1 and last two lines appear on all time-phasing reports.

FIGURE 25

MAIN HEADER INPUT FORM

100 _____

FIGURE 26

ROW HEADERS INPUT FORM

Counter: 123456789012345678901234	Counter: 123456789012345678901234
101Ø-----	126Ø-----
102Ø-----	127Ø-----
103Ø-----	128Ø-----
104Ø-----	129Ø-----
105Ø-----	130Ø-----
106Ø-----	131Ø-----
107Ø-----	132Ø-----
108Ø-----	133Ø-----
109Ø-----	134Ø-----
110Ø-----	135Ø-----
111Ø-----	136Ø-----
112Ø-----	137Ø-----
113Ø-----	138Ø-----
114Ø-----	139Ø-----
115Ø-----	140Ø-----
116Ø-----	141Ø-----
117Ø-----	142Ø-----
118Ø-----	143Ø-----
119Ø-----	144Ø-----
120Ø-----	145Ø-----
121Ø-----	146Ø-----
122Ø-----	147Ø-----
123Ø-----	148Ø-----
124Ø-----	149Ø-----
125Ø-----	150Ø-----

Notes:

1. The symbol "Ø" denotes a blank.
2. All characters, including blanks, must be typed into the file.

FIGURE 27

APPROPRIATION HEADERS INPUT FORM

Counter:

123456789012345678901234

101Ø-----
102Ø-----
103Ø-----
104Ø-----
105Ø-----
106Ø-----
107Ø-----
108Ø-----
109Ø-----
110Ø-----
111Ø-----
112Ø-----
113Ø-----
114Ø-----

Notes:

1. The symbol "Ø" denotes a blank character.
2. All characters, including blank characters, must be typed into the file.

FIGURE 28

COLUMN HEADERS INPUT FORM

Counter:

12345678901234567890123456789012345678901234567890

1~~0~~-----

2~~0~~-----

3~~0~~-----

4~~0~~-----

5~~0~~-----

6~~0~~-----

Notes:

1. The symbol "~~0~~" denotes a blank character.
2. All characters, including all blanks, must be typed into the file.

FIGURE 29

4.8 Run Time Procedures. This section gives detailed procedures for entering the time sharing system, and a brief description of some of the commands available. A sign-on with a program run is shown at Figure 30. Sign-on procedures are as follows:

- a. Turn machine on, using the white switch at the right rear.
- b. Put on STANDBY, set speed at 30, transparency at OFF, inhibit at NORM, line space at 1 and auto LF at OFF.
- c. Verify that the telephone cradle clamp is in a raised position.
- d. Dial 9-340-4800.
- e. At the sound of the high-pitched tone, clamp the phone into the coupler with the earpiece at the top.
- f. Quickly (within 5 seconds) type HH and give RETURN.
- g. The computer will ask for your user number by printing "U#=". Type in your user number (see the division programmer for the latest one) and give RETURN.
- h. The computer will ask for your password by printing "PASSWORD" followed by a line of overprinted characters. Type in your password (see the division programmer for the latest one) and give RETURN.
- i. In response to the question SYSTEM, type FIV (for FORTRAN IV). BAS (for BASIC) may also be used. Give RETURN.
- j. In response to the question NEW or OLD, type any system command, for example, type NEW filename, OLD filename, RUN program, or BYE (see Table 3 for a brief description of some of the commands available).

SAMPLE SIGN-ON PROCEDURE

(Analyst's responses are in lower case and are underlined)

U# xx99 (see programmer for User No.)

PASSWORD (see programmer for Password)

xx99

SYSTEM - fiv

NEW OR OLD-

run model (Name of program changes periodically, see prompt card on terminal)

MODEL

NAME OF DATA INPUT FILE---? input

14 THRUPUTS HAVE BEEN ADDED, AND THE TOT AMT IS:

RAW: 2400.00000

SHIFTED: 2640.00000

NAME OF FILE TO STORE RESULTS---? costfile

RESULTS STORED IN COST FILE

run reptgen (Name of program changes periodically, see prompt card on terminal)

REPTGEN

HOW MANY REPORTS, WHICH ONES---? 1,1

COST DATA FILE---? costfile

GIVE WORDS 1, 2 AND 3---? abcdefg 12345678 xxxxxxxxxxxx

ADJUST PAPER, GIVE RETURN, OUTPUT FOLLOWS

Sign-On

One Run of Model

One Run of Report Generator

FIGURE 30

TABLE 3

SYSTEM COMMANDS

<u>COMMAND</u>	<u>INTERPRETATION</u>
BYE	End the session and disconnect the telephone line. Analyst must hang up the phone.
CAS	List the names of all the files saved under my user number. Note: Analyst <u>must</u> purge files no longer required.
EDIT DELETE 0-110	Remove all lines from line 0 up to and including line 110 from the file in the working area.
EDIT DELETE 110	Remove line 110 from the file in the working area.
EDIT LIST 110	List line 110 from the file in the working area.
EDIT LIST 99999	List the last line from the file in the working area, regardless of its actual line number.
HELLO	Ask the user for a new user number. This command allows another team to use the terminal without the need to hang up or redial the phone number.
LIST	List the file in the working area.
LIST filename	List the file named "filename" (which may or may not be in the working area.)
NEW filename	Clear the work area of all data, and give the work area the name "filename". The user normally will proceed to type in data.

TABLE 3

SYSTEM COMMANDS
(Continued)

<u>COMMAND</u>	<u>INTERPRETATION</u>
OLD filename	Search among the previously stored files and programs and find one named "filename". Make a copy of it and put the copy in the working area.
PURGE	Destroy the file in the working area and also the saved copy of it. Analysts <u>must</u> purge files no longer required (see CAS).
RENAME filename	Give the working area the name "filename".
REPLACE filename	Give the working area the name "filename" and also store a copy of the working area under the name "filename". <u>Caution:</u> The file formerly stored under that name has been replaced by the file now in the working area. The file formerly stored there is therefore lost.
RUN program	Find and run the program named "program".
SAVE	Make a copy of the file in the working area and store it for later retrieval. Note: this file will remain saved until purged. Analysts <u>must</u> purge files no longer required (see PURGE).
110 DATA	Add a line of data to the file in the working area. No matter when typed, the line will be inserted in the correct numerical sequence. If there is already a line with that line number, the new line replaces it.

4.9 Changing the Equations in the Model. This section gives step by step procedures to change the equations in the Army Life Cycle Cost Model. Changes are accomplished in three steps. First, the analyst makes his own copy of the Army Life Cycle Cost Model. Second, he makes all his changes on the copy and stores listable and machine language forms of his own program. Third, he documents all the changes. Documentation is accomplished by marking up the blank data input forms and by preparing Cost Data Sheets (described in 4.2 and 2.3.2, respectively). The importance of documentation to the user cannot be overemphasized. The rest of this section shows an example in which the standard equation in cell A(2,1) is replaced by another equation. The standard equation calculates the cost of Development Engineering, Frame, as the number of manyears times the cost per manyear. The new equation calculates the cost as two times the cube root of the empty weight in pounds, times the rate of climb in feet per second (this CER is illustrative only). The analyst proceeds as follows:

a. First make a copy of the listable version of the Army Life Cycle Cost Model (the listable version is different from the machine language version the analyst normally runs). To accomplish this type "OLD MODEL*" where MODEL* is the name of the listable version (see the prompt card on the terminal for the latest program names).

b. Using the EDIT LIST command (see Table 3), find the line or lines to be changed. For example, suppose the standard equation appears on line 1000 as follows:

1000 A(2,1) = XN(1)*AC(1)*SF(1)

c. Type in the changes. The analyst must provide for the data input and for the algebraic calculations. In this example the program needs the empty weight (the analyst might choose the symbol EWT) and the rate of climb (denoted ROC). The analyst types as follows:

```
1000      PRINT, "GIVE EMPTY WT AND RATE OF CLIMB"  
1010      INPUT, EWT, ROC  
1020      A(2,1) = 2.0*(EWT)**.333*ROC*SF(1)
```

Line 1000 above replaces the old line 1000 and prints the request for data at run time. Line 1010 stops the program for the analyst to enter the two pieces of data at run time. Line 1020 does the algebra.

d. The analyst makes up a name (for example, MODEL2) to store the listable copy of his modified model. Type:

```
      RENAME MODEL2  
(Analyst must now wait for computer response of "READY")
```

e. Save this listable version for future reference by typing:

```
      SAVE  
(Analyst must now wait for computer response of "READY")
```

f. Make a machine language form of the modified program by typing:

```
      RENAME      RUNMOD2  
      SAVE  
      LOAD        RUNMOD2  
      REPLACE     RUNMOD2  
(After each command above, wait for "READY")
```

g. The analyst now has a stored machine language model. He might type "BYE" at this point, for example, and then come in the next day and type "RUN RUNMOD2". The program would run like the

standard one except it would also stop and say:

GIVE EMPTY WT AND RATE OF CLIMB?

at which point the analyst might type 14273,150 and give a carriage return. When naming variables, choose names that begin with the letters A through H (inclusive) and O through Z (inclusive). Names must begin with a letter and can have up to eight characters.

h. All changes must be documented.

APPENDIX A

SAMPLE INPUTS AND OUTPUTS

A-1 General. This Appendix contains all the sample input files discussed above together with the resulting output reports. It will help the analyst to study the figures in this Appendix. This Appendix can also be used when putting the system on another computer.

INPUTS TO MODEL; RUN OF MODEL

INPUTS

```
100 BASE YEAR 77
110 MODEL MICO
120 SF
130 1.1 1.1 1.1 1.1 1.1
140 1.1 1.1 1.1 1.1 1.1
150 1.1 1.1 1.1 1.1 1.1
160 THRUPUTS
170 ROW COL AMT
180 2 1 1000.0
190 2 1 200
200 2 2 300
210 3 1 400
220 3 2 500
```

MODLA

NAME OF DATA INPUT FILE---?INPUTS

5 THRUPUTS HAVE BEEN ADDED, AND THE TOT AMT IS:

RAW: 2400.00000

SHIFTED: 2640.00000

NAME OF FILE TO STORE RESULTS---?COSTFILE

RESULTS STORED IN COSTFILE

FIGURE A-1

OUTPUT OF MODEL, RUN OF REPORT GENERATOR

COSTFILE

101	1760.00	880.00	0.	0.
102	1320.00	330.00	0.	0.
103	440.00	550.00	0.	0.
104	0.	0.	0.	0.
105	0.	0.	0.	0.
106	0.	0.	0.	0.
107	0.	0.	0.	0.
108	0.	0.	0.	0.
109	0.	0.	0.	0.
110	0.	0.	0.	0.

RGENG

HOW MANY REPORTS, WHICH ONES---?8,1,2,3,4,5,6,7,8

COST DATA FILE---?COSTFILE

DEFINITIONS FILE---?KEYCOST

APPROPRIATIONS FILE---?FUNDING

TIME PHASING FILE---?SPREAD

INFLATION FILE---?INDICES

GIVE WORDS 1,2 AND 3---?SAMPLE WEAPON SYSTEM

ADJUST PAPER, GIVE RETURN

FIGURE A-2

KEYCOST AND SATELITES

KEYCOST

100 LABEL LOCATION
 110 HARDWARE FILEAA
 120 FLYAWAY FILEBB
 130 WEAP-SYS FILECC
 140 PROCMN'T FILEDD
 150 PROGRAM FILEEE

FILEAA

100	QTY	1000	
110	ROW	COL	FRACTION
120	3	1	1.0
130	3	2	.5

FILEBB

100	QTY	1000	
110	ROW	COL	FRACTION
120	3	1	1.0
130	3	2	.5
140	2	1	.5

FILECC

100	QTY	1000	
110	ROW	COL	FRACTION
120	3	1	1.0
130	3	2	.5
140	2	1	.5
150	2	2	.5

FILEDD

100	QTY	1000	
110	ROW	COL	FRACTION
120	3	1	1.0
130	3	2	1.0
140	2	1	1
150	2	2	1

FILEEE

100	QTY	1000	
110	ROW	COL	FRACTION
120	1	1	1.0

FIGURE A-3

FUNDING, SPREAD, INDICES AND SATELITES

				SPREAD		
				100	PHASE	1
				110	CODE	1
				120	YEAR	AMOUNT
				130	65	100
				140	66	0
				150	67	110.
				160	68	0.
				170	69	120.
				180	70	0
				190	71	120
				200	72	0
				210	73	120
				220	74	0
				230	YEAR	PERCENT
				240	75	.10
				250	76	.20
				260	77	.05
				270	77	.25
				280	78	.20
				290	79	.10
				300	80	.05
				310	81	.05
				320	CODE	3
				330	YEAR	AMOUNT
				340	65	0
				350	66	0
				360	67	0
				370	68	0
				380	69	0
				390	70	0
				400	71	0
				410	72	0
				420	73	0
				430	74	0
				440	YEAR	PERCENT
				450	75	0
				460	76	0
				470	77	0
				480	77	.1
				490	78	.1
				500	79	.1
				510	80	.1
				520	81	.1
				530	82	.2
				540	83	.1
				550	84	.1
				560	85	.05
				570	86	.05

FUNDING

100	ROW	CODE	FRACTION
110	1	1	.50
120	1	3	.50

INDICES

100	APPROP	LOCATION
110	1	RDFILE
120	3	PROCFILE

RDFILE

100	65	.70
110	66	.75
120	67	.80
130	68	.85
140	69	.90
150	70	.95
160	71	1.00
170	72	1.05

PROCFILE

100	65	.80
110	66	.83
120	67	.86

FIGURE A-4

HEADERS MAIN FILE AND SATELITES

APPST*.

AIRRID*

100 ROWST* APPST* COLST*

101	RD1&E.....
102	PROC, AC.....
103	PROC, MSL.....
104	PROC, WPN.....
105	PROC, AMMO.....
106	PROC, OTHER.....
107	QMA.....
108	MPA.....
109	MCA.....
110	FHMA.....
111	TOT, W/O ERDA.....
112	ERDA.....
113	TOTAL.....
114	PERCENT.....

COLST*

[illegible]

FIGURE A-5

ROW HEADERS FILE

ROWST*

101	RES & DEVELOPMENT
102	DEVELOPMENT ENGR
103	PEP
104	TOOLING
105	PROTOTYPE MANUF
106	DATA
107	SYS TEST & EVAL
108	SYS/PROJECT MGT
109	TRAINING
110	FACILITIES
111	OTHER
112	INVESTMENT
113	NON-RECURRING INV
114	PRODUCTION
115	ENGR CHANGES
116	SYS TEST & EVAL
117	DATA
118	SYS/PROJECT MGT
119	OPN'L/SITE ACT
120	TRAINING
121	INIT SP & REP PTS
122	TRANSPORTATION
123	OTHER
124	OPERATING AND SPT
125	MIL PERSONNEL
126	CREW P&A
127	MAINT P&A
128	INDIRECT P&A
129	PCS
130	CONSUMPTION
131	REPL SPARES
132	POL
133	UNT TNG AMMO/MSL
134	DEPOT MAINTENANCE
135	LABOR
136	MATERIEL
137	TRANSPORTATION
138	MODIFICATIONS
139	OTHER DIR SPT OPNS
140	MAINT, CIV LABOR
141	OTHER DIRECT
142	INDIRECT SPT OPNS
143	PERSONNEL REPL
144	TPP
145	QTRS, MAINT/UTIL
146	MEDICAL SUPPORT
147	OTHER INDIRECT
148	TOTAL, LESS ERDA
149	ERDA
150	TOTAL

FIGURE A-6

REPORT 1

DATE: 01/23/76

TOTAL SYSTEM COST: 2640.0

REPORT 1—COST ELEMENT BY SYSTEM STRUCTURE IN MILLIONS OF CONSTANT 77 DOLLARS

COST ELEMENT \	\SYSTEM \STRUC- \TURE	FRAME	PRO- PULSION	GUID CONTR/ COMMO	FIRE CONTROL	ARMA- MENT	PAYLOAD /AMMO	(TO BE SPECI- FIED)	PEC SPT EQUIP	COMMON SUPPORT EQUIP	OTHER	TOTAL	PER- CENT
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)		
1	RES & DEVELOPMENT	1760.0	880.0	0.	0.	0.	0.	0.	0.	0.	0.	2640.0	100.0
2	DEVELOPMENT ENGR	1320.0	330.0	0.	0.	0.	0.	0.	0.	0.	0.	1650.0	62.5
3	PEP	440.0	550.0	0.	0.	0.	0.	0.	0.	0.	0.	990.0	37.5
4	TOOLING	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
5	PROTOTYPE MANUF	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
6	DATA	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
7	SYS TEST & EVAL	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
8	SYS/PROJECT MGT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
9	TRAINING	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
10	FACILITIES	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
11	OTHER	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
12	INVESTMENT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
13	NON-RECURRING INV	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
14	PRODUCTION	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
15	ENGR CHANGES	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
16	SYS TEST & EVAL	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
17	DATA	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
18	SYS/PROJECT MGT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
19	OPN'L/SITE ACT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
20	TRAINING	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
21	INIT SP & REP PTS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
22	TRANSPORTATION	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
23	OTHER	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
24	OPERATING AND SPT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
25	MIL PERSONNEL	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
26	CREW P&A	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
27	MAINT P&A	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
28	INDIRECT P&A	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
29	PCS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
30	CONSUMPTION	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
31	REPL SPARES	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
32	POL	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
33	UNIT TNG AMMO/MSL	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
34	DEPOT MAINTENANCE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
35	LABOR	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
36	MATERIEL	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
37	TRANSPORTATION	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
38	MODIFICATIONS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
39	OTHER DIR SPT OPNS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
40	MAINT, CIV LABOR	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
41	OTHER DIRECT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
42	INDIRECT SPT OPNS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
43	PERSONNEL REPL	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
44	TPP	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
45	OTRS, MAINT/UTIL	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
46	MEDICAL SUPPORT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
47	OTHER INDIRECT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
48	TOTAL, LESS ERDA	1760.0	880.0	0.	0.	0.	0.	0.	0.	0.	0.	2640.0	100.0
49	ERDA	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
50	TOTAL	1760.0	880.0	0.	0.	0.	0.	0.	0.	0.	0.	2640.0	100.0

MICO INPUTS SAMPLE WEAPON SYSTEM
COSTFILE KEYCOST FUNDING SPREAD INDICES

FIGURE A-7

REPORT 2

DATE: 01/23/76

TOTAL SYSTEM COST: 2640.0

REPORT 2---KEY COST DEFINITIONS IN MILLIONS OF CONSTANT 77 DOLLARS

	TOTAL	QUANTITY	UNIT
HARDWARE	715.0	1000.0	0.7150
FLYAWAY	1375.0	1000.0	1.3750
WEAP-SYS	1540.0	1000.0	1.5400
PROCMN'T	2640.0	1000.0	2.6400
PROGRAM	1760.0	1000.0	1.7600
MICO	INPUTS	SAMPLE	WEAPON
COSTFILE	KEYCOST	FUNDING	SPREAD
			INDICES
			SYSTEM

FIGURE A-8

REPORT 3

DATE: 01/23/76

TOTAL SYSTEM COST: 2640.0

REPORT 3---APPROPRIATION BY LIFE CYCLE PHASE IN MILLIONS OF CONSTANT 77 DOLLARS

	R&D	INV	O&S	TOTAL	PERCENT
RDT&E.....	1320.0	0.	0.	1320.0	50.0
PROC, AC.....	0.	0.	0.	0.	0.
PROC, MSL.....	1320.0	0.	0.	1320.0	50.0
PROC, WPN.....	0.	0.	0.	0.	0.
PROC, AMMO.....	0.	0.	0.	0.	0.
PROC, OTHER.....	0.	0.	0.	0.	0.
OMA.....	0.	0.	0.	0.	0.
MPA.....	0.	0.	0.	0.	0.
MCA.....	0.	0.	0.	0.	0.
FHMA.....	0.	0.	0.	0.	0.
TOT, W/O ERDA.....	2640.0	0.	0.	2640.0	100.0
ERDA.....	0.	0.	0.	0.	0.
TOTAL.....	2640.0	0.	0.	2640.0	100.0
PERCENT.....	100.0	0.	0.	100.0	100.0

MICO	INPUTS	SAMPLE	WEAPON	SYSTEM
COSTFILE	KEYCOST	FUNDING	SPREAD	INDICES

FIGURE A-9

REPORT 4—APPROPRIATION BY YEAR (DETAIL)

IN MILLIONS OF CONSTANT 77 DOLLARS

[illegible]

DATE: 01/23/76

TOTAL SYSTEM COST: 2640.0

REPORT 4—APPROPRIATION BY YEAR (DETAIL)

IN MILLIONS OF CONSTANT 77 DOLLARS

[illegible]

DATE: 01/23/76

TOTAL SYSTEM COST: 2640.0

REPORT 5---APPROPRIATION BY YEAR (TOTAL)

IN MILLIONS OF CONSTANT 77 DOLLARS

	65	66	67	68	69	70	71	72	73	74	75	76	77	78	
RDT&E.....	100.0	0.	110.0	0.	120.0	0.	120.0	0.	120.0	0.	82.3	172.9	45.4	238.3	200.2
PROC,AC.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PROC,MSL.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	167.8	173.8
PROC,WPN.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PROC,AMMO.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PROC,OTHER..	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DMA.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MPA.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MCA.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
FHMA.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOT,W/O ERDA	100.0	0.	110.0	0.	120.0	0.	120.0	0.	120.0	0.	82.3	172.9	45.4	406.1	374.0
ERDA.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL.....	100.0	0.	110.0	0.	120.0	0.	120.0	0.	120.0	0.	82.3	172.9	45.4	406.1	374.0

	79	80	81	82	83	84	85	86	87	88	89	90	91	92	TOTAL
RDT&E.....	105.1	55.2	57.9	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	1527.4
PROC,AC.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PROC,MSL.....	180.1	186.6	193.4	400.7	207.6	215.1	111.4	115.5	0.	0.	0.	0.	0.	0.	152.0
PROC,WPN.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PROC,AMMO.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PROC,OTHER.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DMA.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MPA.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MCA.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
FHMA.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOT,W/O ERDA	285.2	241.8	251.3	400.7	207.6	215.1	111.4	115.5	0.	0.	0.	0.	0.	0.	3479.4
ERDA.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL.....	285.2	241.8	251.3	400.7	207.6	215.1	111.4	115.5	0.	0.	0.	0.	0.	0.	3479.4

MICO INPUTS SAMPLE WEAPON SYSTEM
COSTFILE FUNDING SPREAD INDICES

FIGURE A-11

REPORT 6

DATE: 01/23/76

TOTAL SYSTEM COST: 3479.4

REPORT 6—APPROPRIATION BY YEAR (DETAIL)

IN MILLIONS OF CURRENT DOLLARS

	65	66	67	68	69	70	71	72	73	74	75	76	77	78	
RESEARCH AND DEVELOPMENT															
RT&E.....	100.0	0.	110.0	0.	120.0	0.	120.0	0.	120.0	0.	82.3	172.9	45.4	238.3	209.2
PRDC, AC.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PRDC, USL.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	167.3	173.8
PRDC, RPN.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PRDC, AMND.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PRDC, OTHER.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
QMA.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
QPA.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
QCA.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
FIHA.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOT, W/O ERDA	100.0	0.	110.0	0.	120.0	0.	120.0	0.	120.0	0.	82.3	172.9	45.4	406.1	374.0
ERDA.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL.....	100.0	0.	110.0	0.	120.0	0.	120.0	0.	120.0	0.	82.3	172.9	45.4	406.1	374.0
INVESTMENT															
RT&E.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PRDC, AC.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PRDC, USL.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PRDC, RPN.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PRDC, AMND.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PRDC, OTHER.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
QMA.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
QPA.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
QCA.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
FIHA.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOT, W/O ERDA	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ERDA.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
OPERATING AND SUPPORT															
RT&E.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PRDC, AC.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PRDC, USL.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PRDC, RPN.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PRDC, AMND.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PRDC, OTHER.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
QMA.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
QPA.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
QCA.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
FIHA.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOT, W/O ERDA	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ERDA.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ATCO INPUTS SAMPLE WEAPON SYSTEM															
COSTFILE FUNDING SPREAD INDICES															

DATE: 01/23/76

TOTAL SYSTEM COST: 3479.4

REPORT 4--APPROPRIATION BY YEAR (DETAIL)

IN MILLIONS OF CURRENT DOLLARS

[illegible]

FIGURE A-12

DATE: 01/23/76

TOTAL SYSTEM COST: 3479.4

REPORT 7-- APPROPRIATION BY YEAR (TOTAL)

IN MILLIONS OF CURRENT DOLLARS

	65	66	67	68	69	70	71	72	73	74	75	76	77	78
RDT&E.....	100.0	0.	110.0	0.	120.0	0.	120.0	0.	120.0	0.	82.3	172.9	45.4	200.2
PROC, AC.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PROC, MSL.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	167.8	173.8
PROC, WPN.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PROC, AMMO.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PROC, OTHER..	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
OMA.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MPA.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MCA.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
FHMA.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOT, W/O ERDA	100.0	0.	110.0	0.	120.0	0.	120.0	0.	120.0	0.	82.3	172.9	45.4	374.0
ERDA.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL.....	100.0	0.	110.0	0.	120.0	0.	120.0	0.	120.0	0.	82.3	172.9	45.4	374.0

	79	80	81	82	83	84	85	86	87	88	89	90	91	92	TOTAL
RDT&E.....	105.1	55.2	57.9	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	1527.4
PROC, AC.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PROC, MSL.....	180.1	186.6	193.4	400.7	207.6	215.1	111.4	115.5	0.	0.	0.	0.	0.	0.	1952.0
PROC, WPN....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PROC, AMMO....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PROC, OTHER..	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
OMA.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MPA.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MCA.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
FHMA.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOT, W/O ERDA	285.2	241.8	251.3	400.7	207.6	215.1	111.4	115.5	0.	0.	0.	0.	0.	0.	3479.4
ERDA.....	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL.....	285.2	241.8	251.3	400.7	207.6	215.1	111.4	115.5	0.	0.	0.	0.	0.	0.	3479.4

MICO	INPUTS	SAMPLE	WEAPON	SYSTEM
COSTFILE		FUNDING	SPREAD	INDICES

FIGURE A-13

REPORT 8

DATE: 01/23/76

TOTAL SYSTEM COST: 3479.4

REPORT 8---APPROPRIATION BY LIFE CYCLE PHASE IN MILLIONS OF CURRENT DOLLARS

	R&D	INV	O&S	TOTAL	PERCENT
RDT&E.....	1527.4	0.	0.	1527.4	43.9
PROC, AC.....	0.	0.	0.	0.	0.
PROC, MSL.....	1952.0	0.	0.	1952.0	56.1
PROC, WPN.....	0.	0.	0.	0.	0.
PROC, AMMO.....	0.	0.	0.	0.	0.
PROC, OTHER.....	0.	0.	0.	0.	0.
OMA.....	0.	0.	0.	0.	0.
MPA.....	0.	0.	0.	0.	0.
MCA.....	0.	0.	0.	0.	0.
FHMA.....	0.	0.	0.	0.	0.
TOT, W/O ERDA.....	3479.4	0.	0.	3479.4	100.0
ERDA.....	0.	0.	0.	0.	0.
TOTAL.....	3479.4	0.	0.	3479.4	100.0
PERCENT.....	100.0	0.	0.	100.0	100.0
=====					
MICO	INPUTS	SAMPLE	WEAPON	SYSTEM	
COSTFILE		FUNDING	SPREAD	INDICES	

FIGURE A-14

APPENDIX B

COMPOSITE INDICES

B-1 General. This Appendix explains what composite indices are, how they are calculated, and how to use the composite index program. Composite indices are used widely, but the concept is rarely explained except in general terms. Therefore, this appendix contains more detail than some of the others. The user who already understands composite indices may skip to section B-7 which describes the computer program.

B-2 Definition and Use of Composite Indices. A composite index is the ratio of a current (or "then year") obligated dollar to a constant (or base year) obligated dollar. The word "composite" refers to the fact that the ratio combines the effects of price changes and of delays in expenditures.^{1/} There are three points to remember about composite indices. First, each set of indices is constructed for use with time phased cost streams expressed in constant dollars of a specific base year. Second, they are used with obligations, not expenditures. Last, since they are ratios, one can convert time-phased constant dollars to time-phased current dollars, or vice versa, by multiplying or dividing, respectively. Table B-1 and Figure B-1 show the relationship between constant dollars and current dollars for RDT&E. In future years, more money will be required for the same level of effort. In past years,

^{1/} If one time-phased using expenditures, as opposed to obligations, there would be no delay. In this case one would use price indices, not composite indices.

less money bought the same effort. In order to describe how composite indices are calculated it is first necessary to describe price indices and outlay rates.

CONSTANT AND CURRENT DOLLARS

<u>YEAR</u>	<u>AMOUNT OBLIGATED EXPRESSED IN FY74 DOLLARS (\$M)</u>	<u>AMOUNT OBLIGATED EXPRESSED IN CURRENT DOLLARS (\$M)</u>
70	1.0	.85976
71	1.0	.90759
72	1.0	.95356
73	1.0	.99632
74	1.0	1.04896
75	1.0	1.11324
76	1.0	1.17363
7T	1.0	1.23132
77	1.0	1.28797
78	1.0	1.34717

TABLE B-1

GRAPH OF CONSTANT AND CURRENT DOLLARS

(For a ten year project with a constant level of effort of 20 manyears per year)

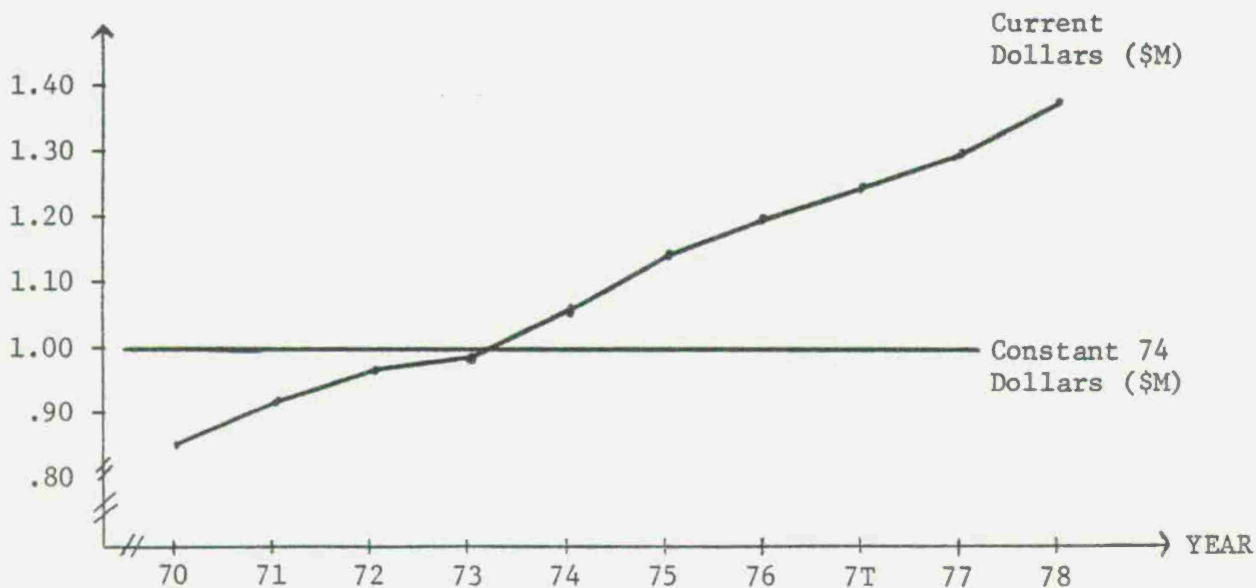


FIGURE B-1

B-3 Price Indices. A price index for a given year is the ratio of the level of prices in that year to the level of prices in a selected base year. By definition the base year must always have a price index of 1.000. Table B-2 shows a hypothetical set of price indices for RDT&E. Notice that price indices go forward in time and also backward. Often the inflation guidance for future years has one base year and the data for historical years has a different base year. The analyst then must normalize his data until all indices refer to the same base year.

B-4 Outlay Rates. Even though funds are obligated in a certain year, there is usually a delay before the funds are paid out. During this delay prices may change, so the decision maker, anticipating this, must ask for more. If there is only a short delay (such as for RDT&E) he needs only a little more. If there is a long delay (such as for MCA) he needs much more. Outlay rates are a set of numbers which express the way the funds are to be paid out. They can be thought of as the fraction of effort paid for in each year. Table B-3 shows a hypothetical set of outlay rates for RDT&E. As defined here, a set of outlay rates must add to 1.000.

PRICE INDICES FOR RDT&E

BASE YEAR: FY74

<u>YEAR</u>	<u>INDEX</u>
70	.8251
71	.8720
72	.9216
73	.9640
74	1.000
75	1.068
76	1.130
7T	1.190
77	1.245
78	1.302
79	1.362

TABLE B-2

OUTLAY RATES FOR RDT&E (1974)

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Rate:	.45	.42	.09	.02	.02	.0	.0

TABLE B-3

B-5 Calculation of Composite Indices. The method for calculating composite indices, based on price indices and outlay rates is shown in Tables B-4 and B-5. For simplicity, these tables assume that one set of seven outlay rates will hold for all years. Actually, due to the introduction of "7T," different years require different sets of outlay rates. One can think of price levels in Tables B-4 and B-5 as expressing the cost of one FY 74 dollar's worth of goods. The number of dollars needed in each year is then the price level for that year times the fraction of effort (outlay rate) in that year. The total number of dollars is obtained by adding up the number of

dollars needed in each year. Table B-4 shows that the combined effects of delays and price increases can be expressed by the number 1.0490. Table B-5 shows the same calculations for the composite index for a different year (FY 75). Indices for other years are calculated in the same way. Again, composite indices represent the ratio of obligated dollars (recognizing price changes and delays in expenditure) to obligated dollars (expressed in dollars of a selected base year). They are used to convert time phased constant base year obligations to time phased current (or "then year") obligations.

CALCULATION OF THE
COMPOSITE INDEX FOR FY74

(Using FY74 as the Base Year)

<u>YEAR</u>	<u>PRICE LEVEL</u>		<u>OUTLAY RATES</u>			<u>COMPOSITE INDEX</u>
70	.8251					
71	.8720					
72	.9216					
73	.9640					
74	1.000	*	.45	=	.4500	1.0490
75	1.068	*	.42	=	.4486	
76	1.130	*	.09	=	.1017	
7T	1.190	*	.02	=	.0238	
77	1.245	*	.02	=	.0249	
78	1.302	*			1.0490	
79	1.362					

TABLE B-4

CALCULATION OF THE
COMPOSITE INDEX FOR FY75

(Using FY74 as the Base Year)

<u>YEAR</u>	<u>PRICE LEVEL</u>		<u>OUTLAY RATES</u>			<u>COMPOSITE INDEX</u>
70	.8251					
71	.8720					
72	.9216					
73	.9640					
74	1.000					
75	1.068	*	.45	=	.4806	1.1132
76	1.130	*	.42	=	.4746	
77	1.190	*	.09	=	.1071	
78	1.245	*	.02	=	.0249	
79	1.302	*	.02	=	.0260	
	1.362				<u>1.1132</u>	

TABLE B-5

B-6 Changing the Base Year. By the way they are constructed, a set of composite indices can be used with time phased dollars of only one base year. But since price levels are ratios, it is easy to change the base year of the price indices, as shown in Table B-6. Select an alternate year, say FY 1975, and notice the price level for that year. If one divides every number in the column by this number, then all pairs of numbers will still be in the same ratios to each other. The result is a new set of price levels with the alternate year (FY75) as the new base year. Construction of composite indices for use with the new base year proceeds exactly as before, as shown in Table B-6.

CHANGING THE BASE YEAR

(From FY74 to FY75)

<u>YEAR</u>	<u>PRICE LEVELS (BASE 74)</u>		<u>PRICE LEVEL OF 75</u>		<u>PRICE LEVELS (BASE 75)</u>		<u>OUTLAY RATES</u>		<u>COMPOSITE INDEX</u>
70	.8251	÷	1.068	=	.7726				
71	.8720	÷	1.068	=	.8165				
72	.9216	÷	1.068	=	.8629				
73	.9640	÷	1.068	=	.9026				
74	1.000	÷	1.068	=	.9363	*	.45	=	.4213
75	1.068	÷	1.068	=	1.000	*	.42	=	.4200
76	1.130	÷	1.068	=	1.058	*	.09	=	.0952
77	1.190	÷	1.068	=	1.114	*	.02	=	.0223
78	1.245	÷	1.068	=	1.166	*	.02	=	.0233
79	1.302	÷	1.068	=	1.219				.9821
80	1.362	÷	1.068	=	1.275				

TABLE B-6

B-7 Composite Index Program. The Composite Index Program performs all the calculations described above. It reads an input file containing the price indices and outlay rates for one appropriation, changes the base year if required, does all the arithmetic, and writes the resulting composite indices to a file for later reference. To run the program, first create the input file in the format of Figure B-2, type RUN followed by the program name (the name of the latest program appears on a prompt card near the terminal) and answer the questions. The program will ask for the name of the input file described above, the name desired for the output file, and the year with which the composite indices are to be used. When the program is finished, the resulting composite indices have been written to a permanently stored file. Remember to purge the file when it is no longer needed. A preprinted form is at Figure B-3.

SAMPLE COMPOSITE INDEX INPUT FILE

```
100 OUTLAY RATES
110 YEAR RATES
120 75 .22 .58 .05 .09 .05 .01 0
130 76 .22 .07 .56 .09 .05 .01 0
140 7T .02 .27 .56 .09 .05 .01 0
150 77 .22 .58 .12 .06 .02 .0 0
160 78 .22 .58 .12 .06 .02 0 0
170 PRICE INDICES
180 YEAR INDEX
190 75 1.155
200 76 1.2358
210 7T 1.2729
220 77 1.3493
230 78 1.4276
```

Notes:

1. Line 160. The last set of outlay rates is repeated as often as necessary to calculate the out years.
2. Line 230. The price change implied by the last two years is repeated as often as necessary to calculate the out years.
3. The four lines in this sample containing alphabetic data (lines 100, 110, 170, 180) must appear exactly as shown, except that different line numbers can be used.

FIGURE B-2

COMPOSITE INDEX INPUT FORM

100	OUTLAY	RATES					
110	YEAR	RATES					
120	_____	_____	_____	_____	_____	_____	_____
130	_____	_____	_____	_____	_____	_____	_____
140	_____	_____	_____	_____	_____	_____	_____
150	_____	_____	_____	_____	_____	_____	_____
160	_____	_____	_____	_____	_____	_____	_____
170	_____	_____	_____	_____	_____	_____	_____
180	PRICE	INDICES					
190	YEAR	INDEX					
200	_____	_____					
210	_____	_____					
220	_____	_____					

Notes:

1. Lines 100, 110, 180, 190. Must appear exactly as shown, except that different line numbers can be used.
2. Line 170. The last set of outlay rates is repeated as often as necessary to calculate the out years.
3. Line 220. The price change implied by the last two years is repeated as often as necessary to calculate the out years.

FIGURE B-3

APPENDIX C

SENSITIVITY AND UNCERTAINTY

C-1 General. This Appendix has several purposes. First, it gives the analyst a brief description of sensitivity and uncertainty, and explains why sensitivity analysis is more often the preferred tool. Second, this Appendix provides a brief review of some of the main statistical principles behind uncertainty analysis. This review necessarily presumes a higher level of technical training than the rest of this guide, but it should provide most analysts the general understanding they need to answer questions about uncertainty analysis. Third, this Appendix tells how to do sensitivity and uncertainty analyses.

C-2 Sensitivity Analysis. Sensitivity analysis is a procedure in which the analyst changes the values of the key input variables (for example, the first unit costs or the number of units purchased) in order to determine how sensitive his point estimate is to changes in the values of these variables. Sensitivity analysis is also used to answer the many "what if" questions that managers ask (for example, "what if the Project Manager chooses an off-the-shelf engine, production of which involves no further learning?"). This technique is deterministic, in the sense that if certain input values are true, then a certain point estimate is completely determined. If other input values are true, then another, different, point estimate is determined. Each set of inputs produces one point estimate. Since

sensitivity analysis reveals the effects of changing various assumptions, it gives the analyst a good understanding of his estimate. Sensitivity analysis is the only tool capable of answering these "what if" type questions.

C-3 How to Do a Sensitivity Analysis. To do a sensitivity analysis, the analyst changes the values of the variables in the data input file and makes repeated runs of the model. For example, suppose the first unit cost for production of airframes, denoted UC(1), is estimated to be one million dollars, with a standard deviation of .1 million dollars. The question is: what if our estimate of the first unit cost is wrong by as much as one standard deviation? If the base case data input file is named BASECASE, the analyst proceeds as follows:

- a. Get a copy of the saved data input file by typing:

```
OLD  
BASECASE
```

- b. Check the existing data by listing the lines in question (unit costs start at line 700, see Figure 9):

```
EDIT LIST 700-705
```

- c. The computer will respond by printing:

```
700 UC  
705 1.0 0 0 0 0
```

- d. Prepare another similar data input file for the high estimate by typing, for example:

```
RENAME BASEHI  
SAVE
```

- e. Change the value of the variable being tested by typing:

```
705 1.1 0 0 0 0
REPLACE
```

- f. Prepare another similar data input file for the low estimate by typing, for example:

```
RENAME BASELO
SAVE
```

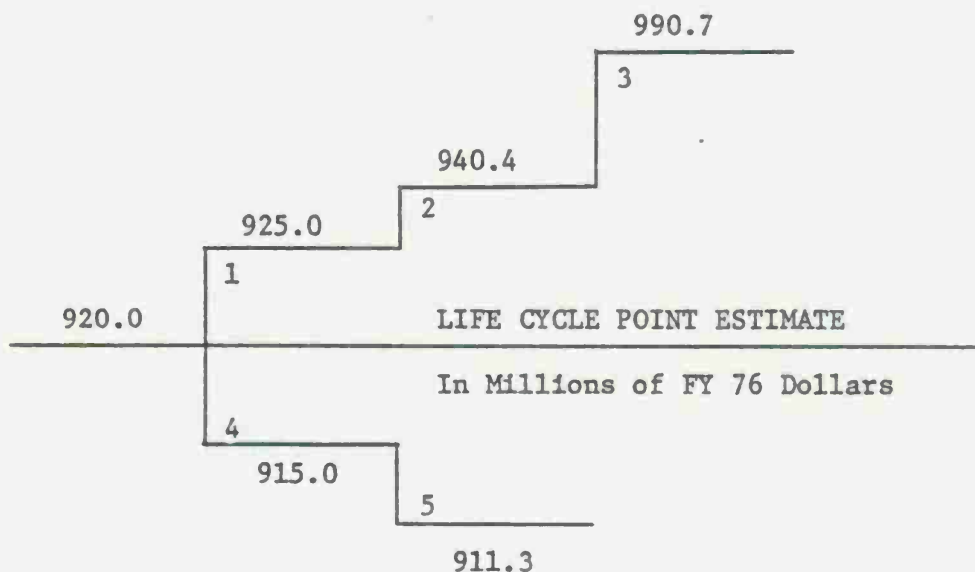
- g. Change the value of the variable being tested by typing:

```
705 .9 0 0 0 0
REPLACE
```

- h. The analyst can now do a sensitivity analysis by running the model three times, each time giving the name of a different input file. When the computer asks: Name of input file, he responds BASECASE the first time, and then BASEHI and BASELO the second and third times. There is no need to run the Report Generator to get the results. Instead, call up each of the files which store the results, using the OLD command, then type EDIT LIST 150. Recall that the last line stores the life cycle costs. Portray the results as in Figure C-1.

C-4 Uncertainty Analysis. Uncertainty analysis is a procedure in which the analyst specifies a statistical distribution for each cost cell making up the life cycle cost estimate (for some exercises he may choose a smaller subset, for example, he may address only certain cells in R&D). For each cost cell the analyst gives measures of central tendency (for example, the mean and the mode) and measures of dispersion (for example, the variance, the standard deviation and the coefficient of variation). If the distribution of the cost estimate

SENSITIVITY ANALYSIS



"HIGH" SENSITIVITY ASSUMPTIONS:

1. UC(1) increases by one standard deviation.
2. R&D schedule slips six months.
3. Increased reliability testing is required by single engine.

"LOW" SENSITIVITY ASSUMPTIONS:

4. UC(1) decreases by one standard deviation.
5. Increased reliability is realized in O&S phase.

FIGURE C-1

is not symmetric, the analyst also gives a measure of the skewness. Using one of several techniques, the statistical distribution of the total is then determined, as pictured in Figure C-2. While sensitivity analysis is a deterministic technique, and produces a point estimate, uncertainty analysis is a statistical technique and produces a distribution (usually in the form of a bell-shaped curve). Uncertainty analysis is used to give a general feeling for the spread of the final cost estimate.

C-5 Cautions When Doing Uncertainty Analysis. The analyst must be aware of the distinction between the mean, also called the "expected value", and the mode, also called the "most likely" (see Figure C-3). Referring to Report 1, if the numbers in the cost cells are means, then the totals are correct. But if the numbers in the cost cells are modes, then the totals are not correct (they are too low, generally). The only way to get the correct totals in this case is to use uncertainty analysis and rely on Monte Carlo or other techniques. Thus, there are two very different assumptions about what the cost cells estimate (mean or mode), and the totals generally are very different. Two points relate to the above discussion. First, if the mean and mode are different for a cost cell (for example, if it's distribution is skewed), then it is actually misleading to present the mode as a "best guess." Second, when it is evaluated, a CER gives an estimate of a mean, and this mean already includes the effects of the stretchouts, obstacles and other cost-increasing events found in the data base. If the analyst determines that his CER is predicting low, he should increase

his point estimate in Report 1. This approach is better than trying to compensate for a low CER by leaving all reports low and then prescribing a skewed distribution for the uncertainty analysis.

UNCERTAINTY ANALYSIS

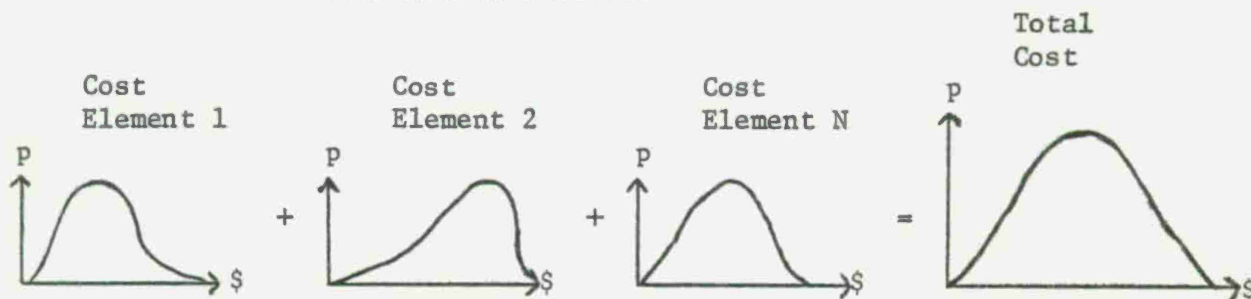


FIGURE C-2

MEAN AND MODE

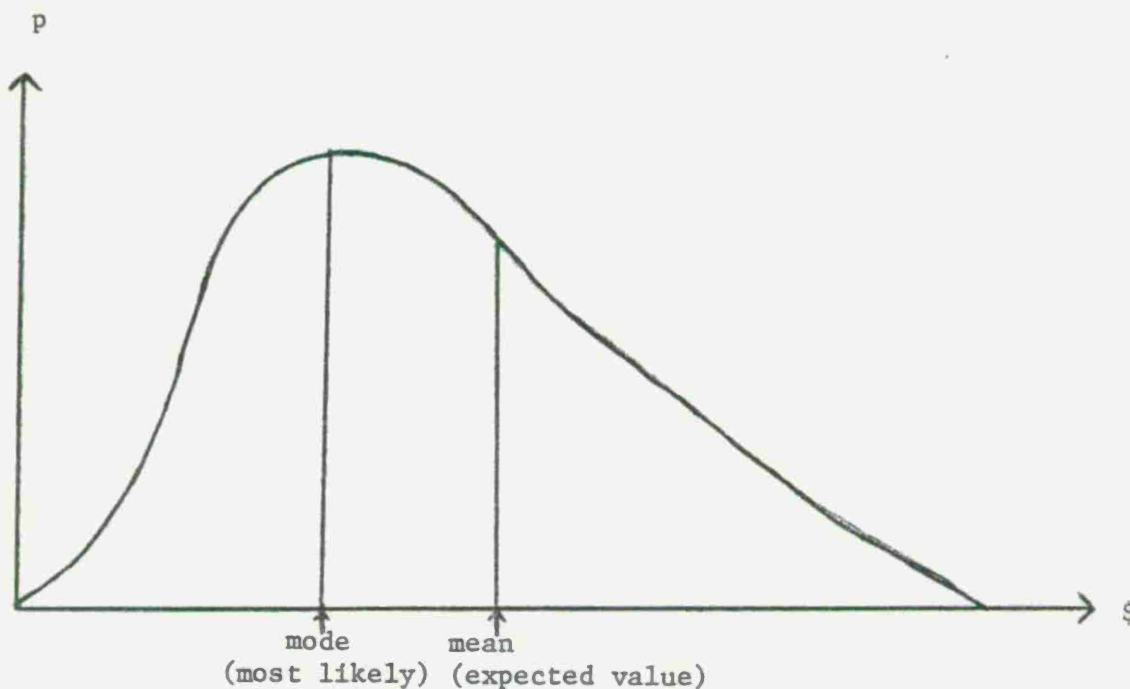


FIGURE C-3

C-6 How to Do an Uncertainty Analysis. The analyst can choose any aggregation, for example, he may choose R&D only, or R&D plus Investment. Also, it is possible to choose either the primary cost cells in which costs are calculated, or the secondary cost cells in which the subtotals are stored. It is important to avoid any double costing. After deciding what cells to include, the analyst must pick a low and a high amount for each cell. He then types RUN, followed by the program name (which changes periodically, see the prompt card near the terminal). The program leads the analyst through the analysis by asking questions. For each cell a low, most likely, and a high value is required. As the program is currently being revised, additional information is kept with the program, rather than in this guide.

