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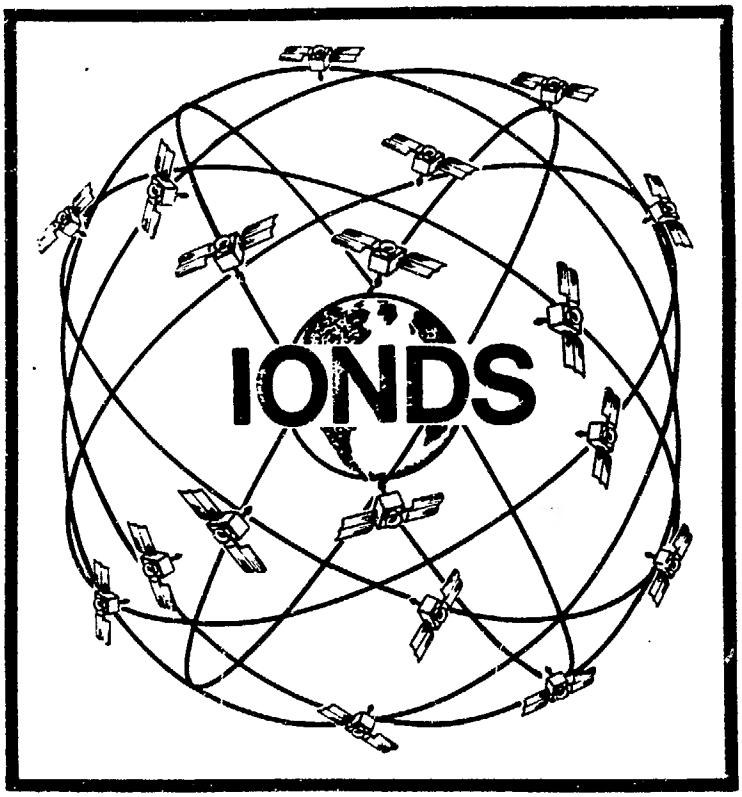
LIFE CYCLE COST ESTIMATION REQUIREMENTS FOR THE INTEGRATED OPERATIONAL NUDET DETECTION SYSTEM (IONDS) GLOBAL SEGMENT (IGS) USER SUBSEGMENT (U)



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RFP No. F04701-82-R-0110

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FOR THE

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LIFE CYCLE COST ESTIMATION REQUIREMENTS

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INTEGRATED OPERATIONAL NUDET DETECTION SYSTEM (IONDS)

GLOBAL SEGMENT (IGS) USER SUBSEGMENT (U)

COMPLIANCE DOCUMENT

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LIFE CYCLE COST ESTIMATION REQUIREMENTS

FOR THE

INTEGRATED OPERATIONAL NUDET DETECTION SYSTEM (IONDS)

GLOBAL SEGMENT (IGS) USER SUBSEGMENT (U)

COMPLIANCE DOCUMENT

1.0 INTRODUCTION.

The objective of the Ground/Airborne IGS Terminal (G/AIT) program is to provide the means by which operational forces are furnished NUDET (Nuclear Detonation) data for use in force management decisions. Since this can be achieved only by the deployment of terminals at varied command post locations, management decisions during the development phase must place major emphasis on the evaluation of alternatives in the context of life cycle cost (LCC). The intent of this cost estimating approach is to provide a consistent means of assessing the impact of alternatives and to establish a basis for determining LCC. This may be done based on the following philosophy:

a. The objective of a good weapon system development must be to achieve the required performance for the least life cycle cost. Specifically, design implementation decisions must seriously assess the effects on long term support cost such as maintenance resources and sparing. Reliability, producibility and maintainability are considered integral parts of the system design and are worthy of equal consideration with performance achievement.

b. The credibility of any LCC estimate is directly related to the validity of the assumptions made in generating input variables.

These variables fall into two categories -- programmatic and designer's choice. The programmatic variables (e.g., production, quantity, year of economics, MTBF, deployment factors, etc.) must be furnished by the Government to permit a credible comparative assessment of design alternatives. Other variables (e.g., design complexity, tooling requirements, etc.) are design driven and are the contractor's choice to the extent to where they can be justified.

This justification will involve both technical and cost considerations. The technical consideration should be consistent with the proposed design and the nonrecurring cost estimates should be consistent with the proposed cost.

c. LCC modeling is a credible design tool. The assessment of a design, in the context of LCC variables, can provide a sensitivity to unnecessary complexity which optimizes system design when convolved with reliability (including parts selection) and performance considerations.

The purpose of this manual is to provide instructions and requirements for estimating the G/AIT's life cycle cost through the use of PRICE (H and S) and ONSCOSTS cost-modeling methods.

These three models provide the means for determining life cycle cost from the acquisition phase (nonrecurring and recurring) through the operation and support phase of the Ground/Airborne IGS Terminal procurement.

2.0 OVERVIEW.

a. PRICE Hardware Model (PRICE H) was developed by RCA in early 1960 and used rigorously in the late 1960's and early 1970's to estimate avionics and space systems' costs. Interest grew outside of RCA to the extent that arrangements were made to lease this model from RCA. Commercial operations began in 1975 with nearly 200 new trainees each year.

PRICE H is a traditional method used to derive cost estimates. Although PRICE H is based upon representative traditional process of cost estimating (material lists, man-hour of labor, etc.) they are neither inputs nor outputs. Representative cost factors are reduced by experienced users and then inserted into the operational model for final evaluation.

PRICE H is applicable to all aspects of hardware acquisitions whether it be development, production, purchase, government furnished, or modification of existing equipment. It estimates the cost associated with design, drafting, project management, documentation, support engineering, special tool and test equipment, plus overhead. Cost for integrating subassemblies and testing system requirements are estimated by PRICE H. Costs for field test, site construction and software are also estimated by the PRICE H hardware model.

(1) Methodology - The method used to model the estimating procedure is parametric. When the model calculates a manufacturing cost, it does not use parts list and labor resource charts but a parametric representation of parts and labor costs.

PRICE H contains thousands of mathematical equations relating input variables to cost. Each specific set of input parameters defines the hardware cost model. The resultant cost is determined from mathematical equations. PRICE H does not perform the function of a look-up table but relies upon its internal mathematical equations to determine cost.

PRICE H was designed to estimate costs with a minimal amount of hardware information. In the conceptual stage of development this feature makes it a legitimate tool for cost estimating.

(2) Mechanics - From a mechanics standpoint, PRICE H is a conversation between a computer and a user. The parametric data used to determine hardware cost is formulated and stored in computer data files. After the user stores the data, he controls the output format, makes sensitivity analyses, contributes to integration and test efforts and uses estimates to arrive at a hardware cost.

Since PRICE H must be adaptive to hardware configuration, the user must validate the data for hardware calibration. Although the input is a tedious and arduous task, its performance saves time when considering the overall process.

b. PRICE Software Model (PRICE S) is an outgrowth of RCA's empirical modeling methods for solving computer software costs and schedules. This model is designed to cover all types of software development, including business systems, communication, command and control, avionics and space systems. Its universality is achieved by parametric techniques similar to the hardware cost estimating method. PRICE S provides sensitivity and schedule analyses, monthly cost and progress summaries, risk analysis and project tracking.

(1) Mechanics. The parametric procedures employed by this model provide several major advantages. They permit rapid top-down evaluations, independent of traditional bottoms-up estimates. They enable rapid updates in light of increased knowledge and changing requirements. They permit extrapolation beyond the range of personel experience. They provide a framework for organizing and categorizing relevant experience for future projects. They provide a language for negotiation which identifies assumptions for proposed development costs and schedules.

(2) Modes of Operation. PRICE S provides four modes of operation which are available to the user -- normal operation, resource calibration, application calibration and design-to-cost. Since PRICE S is an interactive model, the user has to access time-sharing computer via telephone lines from standard office terminals.

Normal Mode - The normal mode is the one used to develop cost estimates for new software projects. This mode combines the project descriptors and customized parametric values with economic and technological growth factors.

Resource and Application Calibration - These calibration modes instruct PRICE S to run in reverse to calculate empirical factors from historical costs. They enable an estimator to organize and describe real-world experience.

Design-to-cost - The design-to-cost mode uses specified target costs to compute typical program sizes and schedules which are consistent with given cost constraints. It permits PRICE S to investigate feasibilities and to set scope of work goals when faced with total resource limits and allowable expenditures.

c. Operation and Support Cost Model (ONSCOSTS). The ONSCOSTS model expands and supplements the Air Force Logistics Command (AFLC) Logistics Support Cost (LSC) model to yield estimated costs as initial fixed costs, annual recurring costs and service life total costs for seventeen cost categories. There are twelve statistical outputs. This depth of output provides the program manager with the capability to request more diversified estimates and trade-off studies than heretofore available.

(1) Levels of Output. ONSCOSTS calculates costs and statistics to five levels corresponding to the following:

- System (SYS).
- Support Equipment (SEQ).
- Subsystem (SUB).
- Line Replaceable Unit (LRU).
- Software, including programs with firmware (SFT).

(2) Column of Outputs. Outputs are formatted for ready presentation as final reports. Costs are printed in three columns which correspond to:

- INITIAL. This is a one-time cost called "Support Investment." These costs must be expended prior to initial operational use of the equipment being acquired.
- ANNUAL. The annually recurring costs must be expended over the operational life of the equipment.
- SUM. The sum is the total of the INITIAL cost plus the ANNUAL cost multiplied by the estimated service life in years.

(3) Lines of Cost Output. Following the name of each equipment there are output lines by cost categories listing abbreviated titles and the costs for INITIAL, ANNUAL and SUM.

3.0 LIFE CYCLE COST OBJECTIVES.

The objectives of the G/AITs LCC are to evaluate design alternatives and to determine the overall system configuration subject to the following constraints:

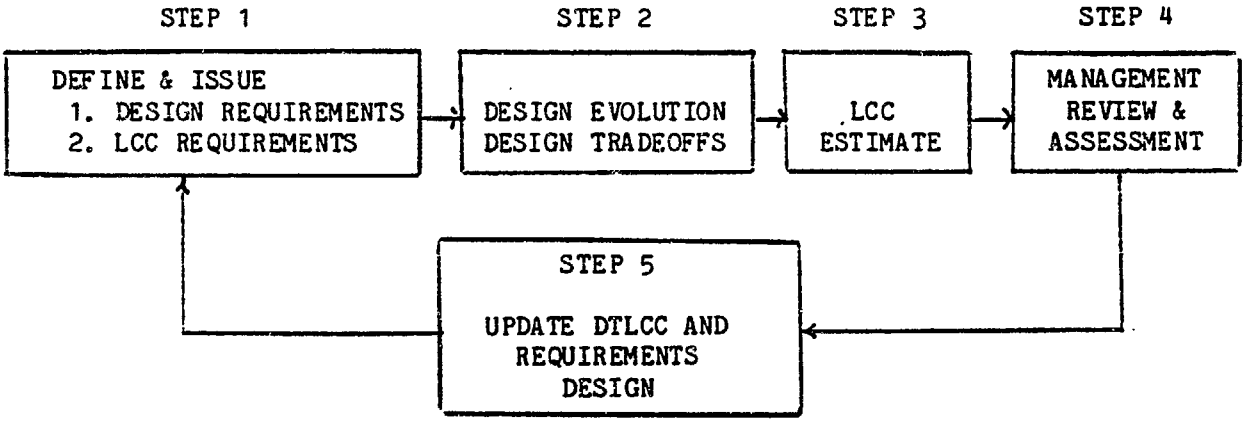
a. Meets or exceeds technical performance requirements.

b. Meets or exceeds specified reliability and maintainability requirements.

c. Provides the lowest feasible life cycle cost characteristics.

d. Determines the total cost of the G/AIT over its full life cycle.

To identify the lowest effective LCC, cost estimates shall be developed using the parametric cost model (PRICE H/PRICE S) and the grass roots estimate (ONSCOSTS). Outputs from these models may be used to review, assess and update the iterative LCC management process shown below.



4.0 USE OF MODELS.

While running PRICE H, PRICE S and ONSCOSTS during the acquisition, operation and support phase, it is important that cost drivers are identified, understood and evaluated. Those items that are considered important cost drivers are underlined in this section. To determine an equitable cost estimate for evaluating the G/AIT procurement, each contractor shall furnish with their proposal a list of input variables for Price H, Price S and ONSCOSTS plus their cost listings (printouts) for each option listed on page 54.

The following input variables are provided by the Government to establish an LCC baseline:

PRICE H

(1) Production Quantity - QTY = (See page 59)

(2) Year of Economics - YRECON = 1982.

(3) Prototypes - PROTOS = (Two runs shall be made - the first one shall use PROTOS = 1 using anticipated new design factors (NEWEL/NEWST); the second one shall use PROTOS = 2 and design factors (NEWEL/NEWST = 0). Sum the results of these two runs).

(4) Development Start - DSTART = Apr 1983.

(5) Development Complete - DLPRO = May 1987 and contractor's best estimate.

(6) Production Start - PSTART = Jul 1984.

(7) Production Complete - PEND = (See page 59).

PRICE S

(1) Schedule - DSTART = Apr 1983.

(2) Supplemental Information.

- Economic year - YEAR = 1982.

ONSCOSTS

(1) Level of output - System, Support Equipment, Subsystem, Line Replaceable Unit, Software including programs of Firmware.

(2) Base-year-dollars = 1982.

(3) ONSCOSTS INPUT CONSTANTS. The input constants used for costing ONSCOSTS procurement options are contained in Table I and shall be used in place of the data referenced in AFSCR 173-10.* For a complete description of ONSCOSTS input data, its diversified estimates, trade-off capabilities and outputs, see Appendix I.

*(NOTE: The intermediate repair facilities (IRFA) are excluded from the IONDS ONSCOSTS computation).

a. PRICE H Input Variables. This section defines the variables used to describe the hardware program for the operation and support phase of the life cycle cost. (For a complete description, usage and tables relating to these input variables, use the current RCA PRICE H Reference Manual.) There are ten different modes for entering data into PRICE H, each serving a different purpose. The term "mode" is a coded value which provides engineers with the following alternative operations:

MODE	ITEM	OPERATION
1	Electronic & Mechanical Item	Most common mode. Provides for analysis of typical item containing both electronic and mechanical/structural elements, or electronic elements only.

TABLE I. INPUT DATA BASE OPERATION AND SUPPORT COST (ONSCOSTS)

ONCOSTS INPUT CONSTANTS	PROCUREMENT CATEGORIES			
	USE FOR WORLDWIDE, THEATER AND SELECTED AREA, UNLESS INDICATED	WORLDWIDE	THEATER	SELECTED AREA
AOHR (OP. HRS. PER MO) AIRBORNE GROUND	AIRBORNE EC 135-90 HRS E4B-220 HRS GROUND 220 HRS	→	AIRBORNE EC135/E4B- 20 HRS GROUND 100 HRS	AIRBORNE EC135/E4B- 30 HRS GROUND 100 HRS
ASEB, ASED, & ASEI (HOURS PER YEAR SE IS AVAILABLE AT BASE, DEPOT, AND IFRA, RESPECTIVELY)	ASEB/ASED-8,769.6 HRS ASEI - 0 HRS	→	→	→
BASE (NO. OF OP LOCATIONS)		16	12	40
BLRA (AV. INTERMEDIATE FAC. LABOR RATE WHEN USED)	$27.45/HR.	→	→	→
DEPO (NO. OF TRC'S)		1	3	8
DLRA (AV. DEPOT LEVEL LABOR RATE)	$35.83/HR.	→	→	→
EXBO (EXPECTED BACK ORDERS)	0.001	→	→	→
FACB, FACD, & FACI (FACILITIES COST AT BASE, DEPOT, AND IFRA)	CONTRACTOR TO RECOMMED FACI - 0 HRS	→	→	→

TABLE I. INPUT DATA BASE OPERATION AND SUPPORT COSTS (ONSCOSTS) (CONT'D)

ONCOSTS INPUT CONSTANTS	PROCUREMENT CATEGORIES			
	USE FOR WORLDWIDE, THEATER, AND SELECTED AREA, UNLESS INDICATED	WORLDWIDE	THEATER	SELECTED AREA
FACD (COST OF ADDL. DEPOT LEV. MAINT. FAC.)	CONTRACTOR TO RECOMMEND	→	→	→
FACI (COST OF ADDL/NEW MAINT. FAC. PER INTER. REP. LOC.)	CONTRACTOR TO RECOMMEND	→	→	→
FACU (FACILITIES UPKEEP)	CONTRACTOR TO RECOMMEND	→	→	→
FCOS, FCRA, FMHR & FPTK (FUEL RELATED COSTS -- ARE THEY EVEN APPLICABLE?)	SEE AFLCR 173-10 OR CONTRACTOR TO ESTIMATE	→	→	→
IMCO (INIT. INV. MGT. COST)	$1200.00/Item	→	→	→
IMLR (AV. BASE LEVEL LABOR RATE WHEN USED)	$27.45/HR.	→	→	→
IRCT (INTERMEDIATE REPAIR CYCLE TIME WHEN USED)	0.5 MO.(15 days)	→	→	→
IRFA (INT. REP. FAC.)°/SAME AS BASES WHEN USED)	0-SAME AS BASES	→	→	→
JPAG (NO. OF PAGES OF MAINT. AND SUPPLY AT BASE AND DEPO)	CONTRACTOR TO RECOMMEND	→	→	→

TABLE I. INPUT DATA BASE OPERATION AND SUPPORT COST (ONSCOSTS) (CONT'D)

ONCOSTS INPUT CONSTANTS	PROCUREMENT CATEGORIES			
	USE FOR WORLDWIDE, THEATER AND SELECTED AREA, UNLESS INDICATED	WORLDWIDE	THEATER	SELECTED AREA
NCIV (NUMBER OF CIVILIANS IN THE OPERATING CREW)	ZERO	→	→	→
NENL (NUMBER OF ENLISTED PERSONNEL IN THE OPERATING CREW)	ZERO	→	→	→
NOFF (NUMBER OFOFFICER PERSONNEL IN THE OPERATING CREW)	ZERO	→	→	→
OHBF (OVERHEAD/BASE LEVEL MAINT. FACTOR)	0.18	→	→	→
OHDF (OVERHEAD/DEPOT LEVEL MAINT. FACTOR)	0.18	→	→	→
OHIF (OVERHEAD/INTER. LEVEL MAINT. FACTOR)	0.18	→	→	→
OSEA (OVERSEAS LOCATIONS, FRAC. OF TOT. DEPLOYMENT)	0.33	→	→	→
OSTC (AV. ORDER & SHIP. TIME/CONUS)	0.31	→	→	→
OSTO (AV. ORDER & SHIP. TIME/OVERSEAS)	0.9	→	→	→

TABLE I. INPUT DATA BASE OPERATION AND SUPPORT COST (ONSCOSTS) (CONT'D)

ONCOSTS INPUT CONSTANTS	PROCUREMENT CATEGORIES			
	USE FOR WQRLDWIDE, THEATER AND SELECTED AREA, UNLESS INDICATED	WORLDWIDE	THEATER	SELECTED AREA
PAYC (AV. MO. PAY FOR 1 CIV. OF AV. GR. IN OP. CREW)	$2443.85(GS-11)	→	→	→
PAYE (AV. MO. PAY FOR 1 E/M OF AV. GR. IN OP. CREW)	$1061.00(Sgt)	→	→	→
PAYO (AV. MO. PAY OF 1 OFF. OF AV. GR. IN OP. CREW)	$2521.00(Capt)	→	→	→
PCSC (AV. COST RELO. 1 CIV. CREW MEMBER)	$3500.00	→	→	→
PCSE (AV. COST RELO. 1 E/M CREW MEMBER)	$1827.00	→	→	→
PCSM (PERMANENT CHANGE OF STATION COST)	$1827.00	→	→	→
PCSO (AV. COST RELO. 1 OFF. CREW MEMBER)	$4826.00	→	→	→
PDYC (AV. PER DIEM COST PER. CIV.)	$ 60.00	→	→	→
PDYE (AV. PER DIEM COST PER. E/M)	$ 60.00	→	→	→
PDYO (AV. PER DIEM COST PER. OFF.)	$ 60.00	→	→	→

TABLE I. INPUT DATA BASE OPERATION AND SUPPORT COST (ONSCOSTS) (CONT'D)

ONCOSTS INPUT CONSTANTS	PROCUREMENT CATEGORIES			
	USE FOR WORLDWIDE THEATER AND SELECTED AREA, UNLESS INDICATED	WORLDWIDE	THEATER	SELECTED AREA
PIUP (OP. SER. LIFE OF TOT. SYSTEM. IN YRS.)	15 YRS.	→	→	→
PMHB (DIR. PRODUCTIVE MAINT. M/H PER BASE)	1,728 M/H Per Year	→	→	→
PMHD (DIR. PRODUCTIVE MAINT. M/H PER DEPOT)	1,728 M/H Per Year	→	→	→
PMHI (DIR. PROD. MAINT. M/H PER INTERMEDIATE FAC.)	1,728 M/H Per Year	→	→	→
POHD (PERSONNEL O/H FACTOR FOR OPS. SUPPORT)	0.18	→	→	→
POHR (EXPECTED PEAK OP. HRS. PER. MO.)		360	360	240
PSCU (AV. SHIP. & PKG. COST/CONUS)	$0.94/lb	→	→	→
PSOS (AV. SHIP. & PKG. COST/OVERSEAS)	$1.42/lb	→	→	→
RMCO (RECURRING MANAGEMENT COST)	$150.00	→	→	→
RUTS (RATIO OF UNIT WEIGHT TO SHIPPING WEIGHT)	$1.35	→	→	→

TABLE I. INPUT DATA BASE OPERATION AND SUPPORT COSTS (ONSCOSTS) (CONT'D)

ONCOSTS INPUT CONSTANTS	PROCUREMENT CATEGORIES			
	USE FOR WORLDWIDE THEATER AND SELECTED AREA, UNLESS INDICATED	WORLDWIDE	THEATER	SELECTED AREA
SPAD (ANNUAL BASE SUPPLY IN INV. MGT. COST PER ITEM)	$36.59	→	→	→
TDAT (COST OF ORIG. TECH DOCUMENTATION)	ZERO	→	→	→
TDUP (TECH DATA COST PER PAGE FOR UPKEEP)	ZERO	→	→	→
TDYC (AV. NO. OF DAYS TDY FOR CN. CREW MEM.)	ZERO	100 Per Year		
TDYE (AV. NO. OF DAYS TDY FOR E/M CREW MEM.)	ZERO	→	→	→
TDYO (AV. NO. OF DAYS TDY FOR OFF. CREW MEM.)	ZERO	50 Per Year		
TMMB, TMMD, & TMMI (TRAINED MAINTENANCE MEN AT BASE, DEPOT, AND IRFA)	TMMD - 10 TMMI - 0	TMMB - 5 →	TMMB - 2	TMMB - 2 →
TRBA (ANNUAL TURNOVER RATE, BASE LEV. MAINT. PERS.)	0.33	→	→	→
TRDE (ANNUAL TURNOVER RATE, DEPOT LEV. MAINT. PERS.)	0.15	→	→	→

TABLE I. INPUT DATA BASE OPERATION AND SUPPORT COST (ONSCOSTS)(CONT'D)

ONCOSTS INPUT CONSTANTS	PROCUREMENT CATEGORIES			
	USE FOR WORLDWIDE, THEATER AND SELECTED AREA, UNLESS INDICATED	WORLDWIDE	THEATER	SELECTED AREA
TRGC (AV. INIT. TRNG. COST PER CIV. CREW MEM.)	$5500.00	→	→	→
TRGE (AV. INIT. TRNG. COST PER E/M CREW MEM.)	$9532.00	→	→	→
TRGO (AV. INIT. TRNG. COST PER OFF. CREW MEM.)	$9532.00	→	→	→
TRIF (ANNUAL TURNOVER RATE/INTER MAINT. PERS. WHEN USED)	0.33	→	→	→
TRNC (TURNOVER RATE OF OPERATING CREW CIVILIANS)	ZERO	→	→	→
TRNE (ANNUAL TURNOVER RATE/E/M CREW MEM.)	0.33	→	→	→
TRNO (ANNUAL TURNOVER RATE/OFF CREW MEM.)	0.33	→	→	→
UMMB, UMMD, & UMMI (UTILIZATION OF MAINTENANCE BASE, DEPOT & IRFA)	UMMB - 0.4 UMMD - 1.0 UMMI - ZERO	→	→	→
UNEQ (UNIT EQUIP., NO. OF INDIVIDUAL SYS.)		106	110	554
XMTB, XMTD, & XMTI (EXTRA MAINTENANCE TIME AT BASE, DEPOT & IRFA	XMTB - 0.49 XMTD - 0.65 XMTI - 0.65	→	→	→

TABLE I. INPUT DATA BASE OPERATION AND SUPPORT COSTS (ONSCOSTS) (CONT'D)

ONCOSTS INPUT CONSTANTS	PROCUREMENT CATEGORIES			
	USE FOR WORLDWIDE, THEATER AND SELECTED AREA, UNLESS INDICATED	WORLDWIDE	THEATER	SELECTED AREA
NOTE: The following are 4th level variables. Use weighted average for appropriate application, e. g., 63 days x 95% in conus = 59.85, 73 days x 5% overseas = 3.65. The combined value for depot = 63.50 days.				
DRCT (DEPOT REPAIR CYCLE TIME/CONUS)	2.1 MOS - 63 Days	→	→	→
DRCT (DEPOT REPAIR CYCLE TIME/OVERSEAS)	2.41 MOS - 73 Days	→	→	→
DRCT (CONTR. REPAIR CYCLE TIME/OVERSEAS)	2.51 MOS - 76 Days	→	→	→
DRCT (CONT. REPAIR CYCLE TIME/CONUS)	2.2 MOS - 66 Days	→	→	→

2	Mechanical Item	For analysis of mechanical/structural items which contain no electronic elements, e.g., housing modules or optical packages.
3	Purchased Item	Processes purchased item to support computation of integration and test costs.
4	GFE Item	Processes Government Furnished Equipment (GFE) item to support computation of integration and test costs.
5	Integration and Test	Provides for extracting appropriate data from all items being integrated into a system, and developing these data into an integration and test (I&T) empirical data set. Total system costs can therefore reflect the cost of integration and test as well as the cost of all individual items.
6	Modified Item	Processes the modification effort on purchased or GFE items using approach and inputs similar to Modes 1 and 2.
7	ECIRP	Used to derive complexity values from historical project, technical and cost data.
8	THRU-PUT	Used to Thru-put costs not estimated by PRICE.
9	PROADJ	Processes follow-on production lots. Must be preceded by a MODE 1, 2, or 10.
10	DESIGN-TO-COST	Calculates hardware parameters based on target cost goals and type of technology.

Figure 1 shows the input form for PRICE H -- basic Modes 1, 2, 6, 7 and 10. Figure 2 shows the input form for PRICE H for Modes 3, 4, 5, 8 and 9. Data for each form will be inputted by consecutive lines such as General A, General B, Mechanical/Structural, etc. Thus, the first line of data in Figure 1 is the General A line and will be the sequenced in order as listed on the input sheets. The following definitions will aid in understanding and filling out each entry on the input sheet.

**PRICE 84 (This must be used only as the first line of the file.)

Title: Date:

General A	Production Quantity QTY	Prototypes PROTOS	Weight (lbs) WT	Volume (ft^3) VOL	MODE	1 E/M ITEM 2 MECHANICAL ITEM 6 MODIFIED ITEM 7 ECIRP 10 DESIGN TO COST
General B	Quantity/Next Higher Assembly QTYNHA	NHA Integration Factors Electronic INTEGE	Structural INTEGS	Specification Level PLTFM	Year of Economics YRECON	Year of Technology YRTECH
Mechanical/ Structural	Structure Weight WS	Manufacturing Complexity MCPLXS	New Structure NEWST	Design Repeat DESRPS	Equipment Classification MECID	Mechanical Reliability MREL
Electronics	Electronics Weight/ft^3 WECF	Manufacturing Complexity MCPLXE	New Electronics NEWEL	Design Repeat DESRPE	Equipment Classification CMPID	Electronic Reliability EREL
Development	Development Start DSTART	1st Prototype Complete DFPRO	Development Complete DLPRO	Engineering Complexity ECMPLX	Tooling & Test Equip. DTLGTS	Prototype Activity PROSUP
Production	Production Start PSTART	First Article Delivery PFAD	Production Complete PEND	Cost-Process Factor CPF	Tooling & Test Equip. PTLGTS	Rate/Month Tooling RATOOL
Actual Cost Data (Mode 7 only)	Average Unit AUCOST	Production Total PTCOST	Prototypes PRCOST	Development Total DTCOST		
Additional Data (Mode 10 only)	Electronic Volume Fraction USEVOL	Structural Weight/ft^3 WSCF	Target Cost TARCST			

Notes:

FIGURE 1. INPUT WORKSHEET FOR PRICE H

Purchased/GFE Item (Modes 3 & 4)

General A	Production Quantity QTY	Prototypes PROTOS	Weight (lbs) WT	Volume (ft^3) VOL	MODE	
General B	Quantity/Next Higher Assembly QTYNHA	NHA Integration Factors: Electronic INTEGE	NHA Integration Factors: Structural INTEGS	Specification Level PLTFM	Year of Economics YRECON	Year of Technology YRTECH
General C	Manufacturing Complexities: Electronic MCPLXE	Manufacturing Complexities: Structural MCPLXS	Equipment Classification: Electronic CMPID	Equipment Classification: Structural MECID	Structure Weight WS	
COST (Mode 3 only)	Purchased Unit Cost COST	Cost Multipliers: Development DMULT	Cost Multipliers: Production PMULT	Cost Multipliers: Escalation ESC		
SCHEDULE (Mode 3 only)	Development Start DSTART	1st Proto Complete DFPRO	Development Complete DLPRO	Production Start PSTART	Production Complete PEND	(Use this line only if ESC ≠ 0.)

Integration & Test (Mode 5 -- must be the last box in the file.)

General A (I & T)	Production Quantity QTY	Prototypes PROTOS	New Electronics NEWEL	New Structure NEWST	MODE 5	
General B	Quantity/Next Higher Assembly QTYNHA	NHA Integration Factors: Electronic INTEGE	NHA Integration Factors: Structural INTEGS	Specification Level PLTFM	Year of Economics YRECON	Year of Technology YRTECH
Schedule	Development Start DSTART	1st Proto Complete DFPRO	Development Complete DLPRO	Production Start PSTART	Production Complete PEND	

Thru-put (Mode 8) CATEGORY CODES: FIELD SUPPORT--1 FIELD TEST--2 SOFTWARE--3 OTHER--4

General A (Thru-put)	Category Code CATGRY	Development Cost DCOST	Production Cost PCOST	Total Cost TCOST	MODE 8	

Multiple Lot Production Adjustment (Mode 9 -- must be preceded by a Mode 1 or Mode 2 input.)

General A (PROADJ)	Production Quantity QTY	Production Start PSTART	First Article Delivery PFAD	Production Complete PEND	MODE 9	Print Control PRNT

FIGURE 2. INPUT WORKSHEET FOR PRICE H, OTHER MODES

General A

QTY (Production Quantity) is the total number of production units that will be produced in the production period defined by PSTART and PEND which are described below. Production units are those units which undergo normal acceptance tests. Whenever production is involved, QTY is a required input. When development estimates are required, QTY must be entered as zero. QTY has a direct and almost linear effect on production cost and no effect on development cost.

PROTOS (Prototypes) indicate the number of prototypes to be built. The number input for PROTOS should include engineering models, brassboards, partial prototypes, as well as, working and testing models. PROTOS should not include breadboard models. If brassboard activity is planned, it should be equated to fabrication of a partial prototype. PROTOS may be entered as any real positive number. For production estimates, PROTOS must be zero.

WT (Weight) sets forth the total weight of the assembly in pounds. Total weight = weight of electronics plus the weight of the structure. WT has a direct effect on all costs in development and production and is a required input in Modes 1, 2, 4, 6 and 7. It is optional in Mode 3.

VOL (Volume) defines the size of the product in cubic feet. Its primary use in the PRICE methodology is in the derivation of the assembly's packaging densities, electronic (WECF) and/or mechanical (WSCF) inputs. If Volume is used to manually calculate structural weight, packaging densities, and

subsequently MCPLXS or MCPLXE, it can have a significant effect on costs. If these values are known and no calculation is required, Volume has no effect on costs. VOL must be greater than or equal to 0.0001 cubic feet.

General B

QTYNHA (Quantity/Next Higher Assembly) is the number of units required to be integrated and tested at the next higher assembly level. It must be a whole number and is a required input in all modes except 7, 8 and 9. It has no effect on cost of the unit where the variable entry is made and only affects cost accumulated for integration of the next higher assembly level.

INTEGE (Electronic Integration Factor) defines the level of electronic integration and test. It describes the level of effect required for the integration of electronic equipment in the next higher assembly level, and has no effect on the cost of the box for which it is entered. INTEGE is used by the program to generate an empirical data set indicative of the level of integration and test effort. This data set (basically weight and complexities) is of abstract value and should not be considered to have any physical significance.

INTEGS (Mechanical Integration Factor) is the level of mechanical integration and test. It describes the level of effort required for the integration of mechanical/structural equipment in the next higher assembly level. The INTEGS value is used to generate an empirical data set of abstract values which do not represent any actual physical device. PRICE requires mass (weight, size, etc.) in order to calculate costs.

PLTFM (Platform Specification Level) is a code that describes the intended operating environment and the normal reliability requirements of the environment. Development costs are a function of reliability requirements and greatly affect the value of PLTFM. PLTFM, by itself, does not have a big impact on cost. However, MCPLXE and MCPLXS values are chosen as a function of PLTFM and have a major effect on program cost.

YRECON (Year of Economics - 1982 dollars) defines the year of economics from 1946 to 2025. When YRECON is not used, an input DSTART or PSTART defines the year of economics. YRECON uses 1 January as its reference date and does not add inflation to the final estimate.

YRTECH (Year of Technology) establishes the year of technology for PRICE H. The model assumes that technology is current when development and production efforts commence. Adjustments are automatically made for improvements throughout the duration of the program. When YRTECH is entered, the model establishes the 1st of January of that year as the date of technology.

Mechanical/Structure

WS (Structure Weight) is the weight of mechanical/structural items expressed in pounds. For electronic equipment, WS usually involves the enclosure, rack, or cabinet and such other mechanical items as slides, blowers, heat sinks, etc. WS is an important variable which should be determined as accurately as possible. The entire production and development cost of a mechanical item is predicted on the value of WS.

MCPLXS (Manufacturing Complexity of the Structure) is the manufacturing complexity factor for mechanical/structural items. It is usually an empirically derived value that represents the product's producibility. It is a function of the material type, finished density and fabrication methods.

MCPLXS should be a PRICE input whenever it is reliably determined from empirical information. In the event MCPLXS is not known, its input value must be entered as "C" and the proper MECID parameter used. The program will compute and output a general MCPLXS for the equipment class. MCPLXS is used to calculate the only piece cost (OPC) of structure or mechanical elements. MCPLXS's effect on cost is not linear; an increase from 5.0 to 6.0 may more than double the production cost.

NEWST (New Structure) defines the degree of new design requirements for a structure. It refers only to that portion of a structural assembly that is unique and not to repetitiveness or redundancy. The NEWST parameter refers only to relative new designs.

DESRPS (Design Repeat of Structure) sets forth the amount of structural repetition in a particular concept. It is necessary to consider the level of repetitiveness for an assembly. If a device consists of ten identical subassemblies, only one subassembly requires a design effort. Without proper indication the PRICE program would generate costs reflecting each subassembly as a unique design. In developing values for DESRPS parameters, the level of activity ranges from 5% to 50% of the total design effort.

MECID (Equipment Classification, Mechanical) can be used to identify a specific kind of structure as follows:

Equipment Class Code

100	Mechanical	500	(Not yet defined)
200	(Not yet defined)	600	Propulsion
300	Electo-Mechanical	700	Antenna
400	Battery	800	Electro-Optics

The principal use of this variable is in Mode 3 where it generates a general MCPLXS for purchased items. It provides a means to calculate MCPLXS in the absence of other reasonable source of reference.

MREL (Mechanical Reliability) is a linear multiplier used to rate the value of MTBF in the Mechanical/Structural area. MREL has no effect on the cost estimate provided by PRICE, but can have a significant effect on Life Cycle Costs if the calculated value of MTBF is used in a subsequent Life Cycle Cost analysis. MREL can be used to increase the output value of MTBF.

WECF (Electronics Weight/ft^3) defines the electronic packaging density of an assembly in pounds per cubic feet. It is not a cost driver used by itself but plays several important roles. It is defined by:

$$WECF = \frac{WT - WS}{USEVOL \times VOL}$$

where WT - WS is the weight of electronic equipment and USEVOL x VOL is the volume occupied by this equipment. It is an important check of input values relating to WT, WS and VOL. The second role of WECF is to determine the proper value to use for MCPLXE. MCPLXE is a significant cost driver.

MCPLXE (Manufacturing Complexity of the Electronics) is a manufacturing complexity factor for electronics and can be derived using other values, principally CMPID. MCPLXE represents the product's producibility and is a function of its component elements, p ckaging density, manufacturability, testing and power dissipation. This entry should be an input whenever it can be reliably determined. MCPLXE is a very significant cost driver.

NEWEL (New Electronics) defines the degree of new electronic design. It refers only to that portion of the electronic assembly that is unique. Do not confuse it with the repetitiveness factor DESRPE. NEWEL pertains only to the relative new design effort appropriate to unique designs. When there are three new designs and eight unique designs, the formula for expressing NEWEL follows:

$$\text{NEWEL} = \frac{\text{NEW DESIGN}}{\text{UNIQUE DESIGN}} = \frac{3}{8} = 0.375$$

DESRPE (Design Repeat of Electronics) sets forth the amount of design repetition for a specific concept. DESRPE describes the electronic portion of the design.

It must be kept in mind that a portion of the total design concept involves internal integration and test procedures. This level ranges from 5% to 35% of the total design effort. When generating costs for drafting and design, it is necessary to consider the level of repetitiveness. For example, a digital processor contains 12 equivalent cards of which only 8 cards are involved. This means that 4 of the cards must be identical to one or more of the 8 unique cards. This identity may be performed by using the following formula:

$$\text{DESRPE} = \frac{\text{Redundant Hardware}}{\text{Total Hardware}} = \frac{4}{12} = 0.333$$

33% of the total electronics effort does not require additional design effort because it is identical to portions of the remaining 67%.

CMPID (Equipment Classification, Electronic) is an optional input variable which describes the class of electronic equipment and its component technology.

	Equipment Class Code
100	Power Supplies
200	Analog, signal processors, receivers
300	Digital
400	Control (without cathode ray tube)
500	Displays (with cathode ray tube)
600	Transmitters

The principal use of this variable is to determine a reasonableness and coherency check of other electronic parameters, primarily MCPLXE.

EREL (Electronic Reliability) is a linear multiplier used to change the value of MTBF. EREL has no effect on cost estimates provided by PRICE, but can have a significant effect on Life Cycle Costs if new calculated values of MTBF are used in subsequent Life Cycle Cost analyses.

Development

DSTART (Development Start Date) is a variable indicating the start of the "scope of work" or the performance of the development effort. It is entered as a three or four digit code, e.g., 1 Feburary 1980 = 280. This variable is used to: (1) Establish the starting time for the application of escalation, (2) Establish the year of technology for the development effort.

DFPRO (Development First Prototype) is a variable indicating the date of completion of all qualification tests for the first prototype. It is entered as a three or four digit code as described in DSTART.

The accuracy of this variable is important since engineering costs are significantly influenced by schedules. In all cases PRICE input variables must include either ECMPLX or DFPRO. It is desirable to include both variables and have the model internally assess the schedule suggested by ECMPLX and compare it to the schedule directed by DFPRO. In cases where DFPRO is not known, an input "C" will cause the program to calculate the calendar months required.

DLPRO (Development Last Prototype) indicates the date of completion of the engineering scope of work and/or the final prototype. It is entered as a three or four digit code as described in DSTART. When the time interval between DFPRO and DLPRO is longer than necessary, the model assumes the time interval is used to value-engineer the product, i.e., to make it cheaper to produce. When DLPRO is not known, the model calculates the new date. In all cases DLPRO must be equal to or less than DFPRO.

ECMPLX (Engineering Complexity) is the engineering complexity ranking factor. It is used to scope the development effort and to develop the calendar time (in months) for completing the first prototype. Since development costs are very sensitive to ECMPLX it is important that input variables for ECMPLX be assessed critically. The PRICE model requires either ECMPLX or DFPRO as an input. If the program calculates ECMPLX, a typical scope of work would be assumed to be accomplished by DFPRO, with no provisions for acceleration or stretch-out.

DTLGTS (Development Tooling and Test Equipment) defines the level of tools and test equipment necessary for prototype assembly. A value of 1.0 means that a full complement is necessary and is chargeable to the job. Converseley, a value of 0.0 implies that no such cost is necessary. DTLGTS is an optional input.

PROSUP (Prototype Support) is an empirical value to adjust prototype and associated design costs. This entry is an optional input. A preset value of 1.0 is used by the model for any box which has no value entered.

Production

PSTART (Production Start Date) is the date indicating the start of the production cycle. This date identifies significant manufacturing activities but does not include long-lead procurement activities which may start before the completion of development. It is entered as a three or four numeral code, e.g., November 1, 1978 = 1178.

PFAD (Production First Article Delivery Date) is the completion date of the first production unit. PFAD defines the length of time required to complete the first production unit after significant manufacturing activities begin. That length of time should not include the procurement of very long-lead items.

PEND (Production End Date) is the completion date of the production program. It is entered a as three or four numeral code as described in PSTART. This entry is used to determine the production period over which costs are to be escalated, tools refurbished and ECN levels established.

CPF (Cost Process Factor) describes the manufacturing process from which the PRICE improvement factor (PIF) is derived. It is used to adjust manufacturing costs and to reflect the rate of improvement. PRICE computes cost improvement values based on manufacturing, technology and quantity.

PTLGTS (Production Tooling and Test Equipment) defines the level of special tools and test equipment for production. A value of 1.0 means that a full complement is necessary, chargeable and represents a consensus of experience. A value of 0.0 implies that no such cost is necessary. PTLGTS is an optional input.

RATOOL (Rate Tooling) describes a monthly production rate which is higher than what is described in the input values of QTY, PFAD and PEND. A non-zero entry of RATOOL will cause PRICE to estimate the cost of additional tooling required to achieve the monthly production rate.

RATOOL is an optional input and should only be used when an estimate for rate tooling (second and subsequent lots) is required as part of the first production lot.

Actual Cost Data (Mode 7 only).

AUCOST (Average Unit Production Cost) is the average unit manufacturing cost for the specified production quantity. It includes production, labor, material and overhead. AUCOST is an optional ECIRP input.

PTCOST (Total Production Cost) is the total manufacturing cost for the specified production quantity. It includes production labor, material and overhead, plus nonrecurring costs such as sustaining engineering, tooling and test equipment. PTCOST is an optional ECIRP input.

PRCOST (Prototype Cost) is the total manufacturing cost for all prototypes including tooling and test equipment. It includes production, labor, material, overhead, tooling and test equipment. PRCOST is an optional ECIRP input.

DTCOST (Total Production Cost) is the total cost of development. It includes production, labor, material and overhead for prototype models, nonrecurring costs such as design engineering, drafting, tooling and test equipment, data and project management. DTCOST is an optional ECRIP input.

Additional Data (Mode 10 only).

USEVOL (Electronic Volume Fraction) defines the fraction of the total assembly volume that is occupied by electronics. It is a mandatory input in Mode 10 and is defined by:

$$USEVOL = \frac{WT - WS}{WECF \times VOL}$$

WSCF (Structural Weight/ft^3) is the structural density of the assembly, expressed in pounds per cubic foot. It is defined as: WSCF = WS/VOL. WSCF is an input only for Mode 10.

TARCST (Target Cost) is the target cost for the assembly under study in the Design-to-Cost Mode. TARCST must be expressed in COSTU dollars.

OTHER MODES

General A (Mode 3 and 4).

QTY (Production Quantity) defines the number of purchased GFE units which will be included in the total production program. In mode 3, QTY is multiplied by the average unit (COST). In mode 4, the value of QTY has no significance. The cost contribution of GFE items relates only as it affects integration and test costs. The number of units and systems to be integrated affects system cost.

PROTOS (Prototypes) defines the number of purchased or GFE units included in the total development program. PROTOS affects development costs for Modes 3 and 4 in exactly the same way QTY affects production costs.

WT (Weight). In mode 3, WT may be input as "C" but the weight should be supplied when available. In mode 4, WT is a mandatory input and its only contribution is to integration and test costs.

VOL (Volume) may be input as "C" for mode 3. It follows the same rules for alternate inputs as WT in mode 3. VOL is a mandatory mode 4 input.

Mode (see previous description).

General B

QTYNHA (Quantity/Next Higher Assembly) - See previous definition.

INTEGE/S (Electronic and Mechanical Integration Factors) - See previous definition.

PLTFM (Platform Specification Level) - See previous definition.

YRECON (Year of Economics) is an optional input in mode 3 which may be used when it is desirable to escalate a quoted cost. YRECON is not used in mode 4.

YRTECH (Year of Technology) is an optional input in modes 3 and 4.

General C

MCPLXE/S (Manufacturing Complexities). These are optional input values for mode 3. In mode 4, these inputs must be supplied.

CMPID/MECID (Equipment Classification). These are optional input values for mode 3. In mode 4, these inputs must be supplied, or the associated inputs for MCPLXE/S must be supplied.

WS (Structure Weight) is an optional input and is expressed in pounds. It is used whenever the structured weight of an electromechanical purchased or GFE item is known. If this entry is zero, the model computes a "typical" WS.

COST (Mode 3 only).

COST (Average Unit Cost) is the average unit cost of purchased items, and is the selling price quoted by the supplier. COST must be set at 1000 in the program constants and is a mandatory entry.

DMULT/PMULT (Development and Production Cost Multipliers). Cost multipliers are optional inputs for mode 3. The purpose is to add material handling or subcontract management surcharges that apply to their particular companies.

ESC (Escalation). In mode 3, entry for ESC is optional depending upon the nature of the quotation from the supplier.

Schedule (Mode 3 only)

The schedule line for mode 3 is a composite of all schedule variables included on the development and production lines. The schedule line should only be used when a value for ESC was entered on the cost line.

General A (I & T - mode 5).

QTY - See previous definition.

PROTOS - See previous definition.

NEWEL - See previous definition.

NEWST - See previous definition.

General B (mode 5).

QTYNHA (Quantity/Next Higher Assembly). An entry of zero for the first three variables indicates that this is the highest level of integration for the system.

INTEGE/S - See previous definition.

PLTFM - See previous definition.

YRECON - See previous definition.

YRTECH - See previous definition.

Schedule (Mode 5). See previous definition.

General A (Thru-put, mode 8).

This mode allows costs, which were developed independently from PRICE, to be entered for final print-out with PRICE calculated costs.

CATGRY (Cost Category) defines the category of through-put cost on each mode 8 sheet.

DCOST/PCOST/TCOST (Development, Production and Total Costs for mode 8).

These items are through-put cost as they appear on the input sheet.

General (PROADJ - mode 9 only)

This mode is designed to provide for automatic adjustment to certain PRICE parameters applicable to follow-on production lots.

b. Program Constants - Global. Another class of variables in the PRICE model is called Program Constants. They remain constant from box to box, from system to system and have preset values that are always used unless deliberately altered. These constants are in two categories -- escalation rates and global variables. Since the IONDS program does not use PRICE to calculate annual escalation rates, global variables model are used.

These variables are classified into two categories -- program global variables and system global variables. The PRICE Global Worksheet, shown in Figure 3, includes the names of the program and system global variables.

Program Global Variables

DDATA (Development Data) is a PRICE output representing costs for all documentation, including reports. The input value controls the DATA costs during the development phase. The amount of DDATA costs are in direct relationship with the amount of new design for both electronics and structure.

DTLGTS (Development Tooling and Test Equipment) defines the level of special tools and test equipment necessary for the development of the assembly.

DPROJ (Development Project Management) defines the degree of project management required for the engineering phase.

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Title: Global Variables **Date:**

Program Global Variables		Data	Tooling & Test Equip.	Program Management	(Reserved for Future Use)	System Engineering	Prototype Schedule Factor
	Development:	DDATA	DTLGTS	DPROJ	0	SYSTEM	PSF
			Tooling & Test Equip.	Program Management	(Reserved for Future Use)	Electronic Changes	Structural Changes
	Production:	PDATA	PTLGTS	PPROJ	0	ECNE	ECNS

System Global Variables	Resource Level	Drafting	Design Engineering	Number of Shifts	Number of Facilities	
	RSRCE	DRAFT	DESIGN	NSHIFT	NFACS	
	Escalation	Development Multiplier	Production Multiplier	Cost Units	Technology Delay	
	ESC	DMULT	PMULT	COSTU	TECDEL	

Notes:

FIGURE 3. PRICE GLOBAL WORKSHEET

SYSTEM (System Engineering) is that support which converts system specification and requirements into a comprehensive design specification for the "black box."

PSF (Prototype Schedule Factor) defines the sequence in which the prototype is completed. This variable is used to calculate the engineering performance period.

PDATA (Production Data) is a PRICE output representing the costs for all documentation, including reports. Data costs are not limited to the development phase but include modification changes during the production phase. During this phase there will be modification changes to O&M manuals, spares lists, etc.

PTLGTS (Production Tooling and Test Equipment) defines the level of special tools and test equipment for production. This variable is an optional input.

PPROJ (Production Project Management) defines the degree of project management required in the production phase.

ECNE/ECNS (Engineering Change Notices, Electronic/Structural) establishes the level of Engineering Change Notices (ECNs) and electronic/structural assemblies that may be expected during the production period.

RSRCE (Resources) is used to represent the level of resources available for production.

DRAFT (Drafting) represents costs for conversion of designs to drawings, including layout and checking.

DESIGN (Design Engineering) represents engineering cost to convert system specifications to detailed design. It provide inputs and guidance for drafting effort plus prototype construction and test.

NSHIFT (Number of Shifts) defines the total number of work shifts operating during the production phase.

NFACS (Number of Facilities) defines the number of factories, locations or facilities involved in the production phase. This variable has a direct effect on schedule and tooling and a lesser effect on project engineering.

ESC (Escalation) is a coded value indicating the period over which costs are to be escalated. It is used to define a single constant escalation rate.

DMULT (Development Cost Multiplier) is a multiplying factor used to include mark-ups for G&A, IR&D and fee, or profit in the output development costs.

PMULT (Production Cost Multiplier) is a multiplying factor used to include mark-ups for G&A, IR&D and fee, or profit in the production cost outputs.

COSTU (Cost Units) defines the cost units in the PRICE output. The present value for COSTU is 1000 which yields costs in thousands of dollars.

TECDEL (Technology Delay) allows PRICE to adjust for technology lag in terms of years. Technology lag may be recorded by entering the number of years in TECDEL.

HIDDEN GLOBALS are accessed through the data change option. One input controls the print formats (PRNT) and the other controls the technology consideration (ZTECH).

PRINT (Print Control) defines the format for PRICE outputs.

ZTECH (Technological Adjustment) introduces cost reductions for advanced technologies.

c. PRICE S Input Variables. This section describes the input requirements for the normal mode of the PRICE Software Model. It follows the PRICE S worksheet on a line-by-line basis. A typical input worksheet for PRICE S is shown in Figure 4. (For a complete description, usage and tables relating to these input variables, use the current RCA PRICE S Reference Manual.)

DESCRIPTORS

INST (Instructions) is the total number of deliverable, executable, machine-level instructions which describe the size of the software development efforts. Comments, format statements, data declaration statements, etc., should not be included in the instruction count. INST is not a mandatory input to PRICE S, provided a proper combination of alternative input is given. Four alternatives are possible:

Project Title									
Project Category									
Descriptors	INST	APPL	RESO	UTIL	PLTFM	CPLX	NEWD	NEWC	
Schedule	DSTART	DEND	ISTART	IEND	TSTART	TEND			
Resource Constraints	DCOST	DMAX	ICOST	IMAX	TCOST	TMAX			
Mix	MDAT	MONL	MREA	MINT	MMAT	MSTR	MOPR	MAPPS	APPLS
New Design	DDAT	DONL	DREA	DINT	DMAT	DSTR	DOPR	DAPPS	
New Code	CDAT	CONL	CREA	CINT	CMAT	CSTR	COPR	CAPPS	
Interface Types	TDAT	TONL	TREA	TINT					
Interface Quantities	QDAT	QONL	QREA	QINT					
Sizing Data	FUNCT	STRU	LEVEL	CAP	SOURCE	EXPAN			
Supplemental Information	YEAR	MULT	ESC	TARCST	INTEG				
Program Constants	GTABLE=								

Notes:

FIGURE 4. INPUT WORKSHEET FOR PRICE S

1. SOURCE and EXPANSION
2. FUNCTIONS
3. STRUCTURE and LEVEL
4. TARGET COST and RESOURCE

INST is an important cost driver.

APPL (Application) is a single parameter that summarizes the application mix from real-time command and control to math and string manipulation.

RESO (Resource) is an empirically derived parameter which includes such items as skill level, experience, productivity, efficiency, computer operating charges, labor and overhead rates.

UTIL (Utilization) is the fraction of available hardware cycle time and total memory capacity time that is used. It describes the extra effort needed to adapt software to operate within limited processor capabilities.

PLTFM (Platform) describes the customer's planned operating environment. It is a measure of the portability, reliability, structuring, testing and documentation required for acceptable contract peformance. PLTFM is a cost driver.

CPLX (Complexity) provides a quantitative description of the factors concerning the design task. Factors include product familiarity, personnel skills, hardware/software design interactions and other unusual development factors.

NEWD (New Design)

NEWC (New Code) NEWD and NEWC are composite values (weighted averages) for the total amount of new design and new code.

Schedule

DSTART (Date of start) is a recommended input date of design efforts. DSTART is used to calculate cost penalties for stretch-out, phase acceleration and deviations from typical phase overlaps.

DEND is the date when the design efforts end.

ISTART is the date implementation efforts start.

IEND is the date implementation efforts end.

TSTART is the date when the test and integration efforts start.

TEND is the date when the test and integration efforts end.

RESOURCE CONSTRAINTS

DCOST - the average cost per man-month or man-hour (Design phase - unscaled units).

DMAX - the maximum man-months or man-hours per months (Design phase).

ICOST - the average cost per man-month or man-hour (Implementation phase - unscaled units).

IMAX - the maximum man-months or man-hours per month (Implementation phase).

TCOST - the average cost per man-month or man-hour (Test/Integration phase).

TMAX - the maximum man-months or man-hours per month (Test/Integration phase).

MIX - describes the software profile in terms of its functional application.

MDAT - data storage and retrieval.

MONL - the on-line communication.

MREA - the real-time command and control.

MINT - interactive operations.

MMAT - mathematical applications.

MSTR - string manipulation.

MOPR - operating systems.

OPTIONAL INPUTS

MAPP8 - user-defined MIX element.

APPL8 - user-defined APPL category.

New Design - provides information on the amount of design required for each non-zero MIX element.

DDAT - data storage and retrieval.

DONL - on-line communications.

DREA - real-time command and control.

DINT - interactive operations.

DMAT - mathematical application.

DSTR - string manipulation.

DOPR - operating systems.

OPTIONAL INPUT

DAPP8 - Applies only when MAPP8 and APPL8 are specified.

New Code - provides information on the amount of new code required for each non-zero MIX element. New code corresponds to MIX and NEW DESIGN.

CDAT - data storage and retrieval.

CONL - on-line communications.

CREA - real-time command and control.

CINT - interactive operations.

CMAT - mathematical applications.

CSTR - string manipulation.

COPR - operating systems.

OPTIONAL INPUT

CAPP8 - Applies only when MAPP8 and APPL8 are specified.

Interface Types - specifies the number of unique hardware devices which must be supported by the software.

TDAT - data storage and retrieval devices.

TONL - on-line communications devices.

TREA - real-time command and control devices.

TINT - interactive devices.

Interface Quantities - have a one-to-one correspondence with the interface types and describe the system hardware configuration.

QDAT - number of data storage and retrieval devices.

QONL - number of on-line communication devices.

QREA - number of real-time command and control devices.

QINT - number of interactive devices.

Sizing Data - represents the sizing constraints of the total software package.

FUNCT (Functions) represents the total number of functional modules for the software development. FUNCT is a cost driver if INST is not entered.

STRU (Structure) is an empirical variable which relates the average functional level (LEVEL) to the total number of functional modules (FUNCT).

LEVEL - is the average level of the Work Breakdown Structure displayed in an equivalent functional tree diagram.

CAP (Capacity) - CAP, UTIL and INST are related through the equation:

$$UTIL = \frac{INST}{CAP}$$

where CAP is the memory size expressed in terms of the number of available instructions.

SOURCE AND EXPAN - is the alternate method to describe program size. INST = SOURCE x EXPAN. SOURCE and EXPAN are cost drivers when INST is not entered.

Supplemental Information - is additional information to complete the software input.

YEAR - establishes the economic and technological reference points.

MULT (Multiplier) is a linear multiplier for all project costs. Its primary purpose is to adjust all costs to include mark-ups, such as G&A, IR&D and project or fee. Additional mark-ups from the normal is a cost driver.

ESC (Escalation) is the variable which defines the cost escalation factors from 1 January of YEAR through the end of the project.

TARCST (Target Cost) is the target cost used in the calibration and design-to-cost modes.

INTEG (Integration factor for System Integration and Test) - is the normal range of INTEG from 0 to 1 with 0.5 representing a typical level of integration effort.

Program Constraints

GTABLE (Global Constant Table Filename) is an optional line and is used to specify a customized global table which was created and stored under a valid filename.

5.0 COSTING GROUND RULES AND ASSUMPTIONS.

The current ground rules and assumptions for the G/AIT LCC analysis follow:

a. Constant 1982 dollars.

b. 15-year system life.

c. Operating and support cost items relating to the Government were based on the following:

   1. Current AFLCP 173-10.

   2. Current AFR 173-13.

ONSCOSTS factors assumed as follows:

SYSTEM LEVEL

AOHR - Average operating hours per month - 730.5.

NENL & NDFF - Number of enlisted personnel and officers in operational crew -- contractor estimate as appropriate.

PDYE & PDYO - Per diem for enlisted personnel and officers.

SUBSYSTEM LEVEL

DLRA - DEPO labor rate.

HPAG & JPAC - Number of pages of operating manuals and maintenance and supply manuals for IRFA and DEPO -- ROM contractor estimate.

TCDE & TCIR - Training cost at DEPO and IRFA -- ROM contractor estimate.

LRU LEVEL

MTBM - Mean time between maintenance. The average elapsed time between maintenance actions other than schedule preventive maintenance to the subsystem. Includes maintenance actions due to causes external to the equipment (such as false alarms, directed tune-ups, operation and maintenance damage, meteorological damage, etc.) additive to the maintenance caused by true failures. (Reference AFR 80-5, Attachment 1, paragraph 16.C).

QPAS - Quantity per assembly -- number of LRUs per assembly/subsystem.

UNCO - LRU unit cost.

Contractual Precedence. The statements: "Contractor to estimate" in the ONSCOSTS test are not intended to imply precedence over the contractual rights of the Government to review and approve or require change of the data values.

6.0 COST DATA DESCRIPTION.

During the proposal phase, the contractor shall summarize the preliminary and updated design-to-cost goal and life cycle cost estimate of the system. The contractor shall describe his approach in arriving at the cost data using the following outline as a guide:

COST DATA

Program Schedules - Summary

Costing Ground Rules and Assumptions

Life Cycle Costs

Rank Ordered List of Systems Components Which Amount for Not Less Than 80% of the Total Estimated System LSC RDT & E Costs.

Production Costs - DTC Goal

Operations and Support Costs

Time-Phased Program Costs

Funding Spreads

Rate Sensitivities

Supplemental Data

7.0 DESIGN-TO-COST.

a. Design-to-cost for PRICE H. With today's decreasing defense budgets and increased system costs, there is a growing interest in design-to-cost procurement which optimizes performance for predetermined cost.

In any design procedure, a preliminary plan must be determined before cost estimates can proceed. Once these plans are made, PRICE Mode 10 can be used to calculate hardware technology, target, production cost, schedules, manufacturing process and design inventory. The outputs of total weight, total volume and structural weight can be evaluated to determine the feasibility of hardware parameters as shown in Figure 5. Input requirements for Mode 10 are as follows:

General A; General B; Mechanical/Structural - WT, VOL and WS must be entered as a "C." MCPLXE and MCPLXS must be entered to define the technology.

Electronics - Since WS must be "C," setting MCPLXE or MCPLXS to zero will establish the device as structural or electronic. Both the electronic and mechanical lines will be read. For all electronic items the mechanical line must be zero and for all mechanical items the electronic line must be zero.

All other standard inputs are the same as a normal mode 1 or 2 worksheet.

Additional Data

USEVOL - must be entered on this line and cannot be substituted for WECF on the Electronic Line.

WSCF - must be entered.

TARCST - is the target production cost and must be expressed in COSTU dollars.

**PRICE 84 (This must be used only as the first line of the file.)

Title: MODE 10 EXAMPLE

Date: 10/20/80

General A	Production Quantity QTY 20	Prototypes PROTOS 2	Weight (lbs) WT C	Volume (ft^3) VOL C	MODE 10	1 E/M ITEM 2 MECHANICAL ITEM 6 MODIFIED ITEM 7 ECIRP 10 DESIGN TO COST
General B	Quantity/Next Higher Assembly QTYNHA 0	NHA Integration Factors Electronic INTEGE 0	Structural INTEGS 0	Specification Level PLTFM 1.4	Year of Economics YRECON	Year of Technology YRTECH
Mechanical/ Structural	Structure Weight WS C	Manufacturing Complexity MCPLXS 4.87	New Structure NEWST .75	Design Repeat DESRPS C	Equipment Classification MECID	Mechanical Reliability MREL
Electronics	Electronics Weight/ft^3 WECF 46	Manufacturing Complexity MCPLXE 6.72	New Electronics NEWEL .25	Design Repeat DESRPE C	Equipment Classification CMPID	Electronic Reliability EREL
Development	Development Start DSTART 281	1st Prototype Complete DFPRO C	Development Complete DLPRO C	Engineering Complexity ECMPLX .8	Tooling & Test Equip. DTLGTS	Prototype Activity PROSUP
Production	Production Start PSTART 282	First Article Delivery PFAD C	Production Complete PEND C	Cost-Process Factor CPF 10453	Tooling & Test Equip. PTLGTS	Rate/Month Tooling RATOOL
Actual Cost Data (Mode 7 only)	Average Unit AUCOST	Production Total PTCOST	Prototypes PRCOST	Development Total DTCOST		
Additional Data (Mode 10 only)	Electronic Volume Fraction USEVOL .72	Structural Weight/ft^3 WSCF 11	Target Cost TARCST 48			

Notes: ESC = 100

FIGURE 5. PRICE H DESIGN-TO-COST INPUT

OUTPUTS - mode 10 calculates values of WT, VOL and WS that are within the constraints of the target cost, packaging densities, type of technology and schedules.

b. Design-to-cost for PRICE S. The design-to-cost mode for PRICE S is used to estimate project sizes and schedules that are compatible with given target costs. In this mode, TARCST is specified and the model computes a program size consistent with project descriptors and schedule constraints.

Running Design-to-Cost.

All input parameters required for normal operation are also required for the design-to-cost mode with the following exceptions:

INSTRUCTION must be 0.

SOURCE must be 0.

FUNCTIONS must be 0.

Either STRUCTURE or LEVEL must be 0.

TARCST must be input greater than 0.

CPLX must be input greater than 0.

PRICE S recognizes from this combination of inputs that a DESIGN-TO-COST run is desired. TARGET COST must be in the appropriate units and must be consistent with the values entered for YEAR, MULT and ESC. If CAPACITY is entered and UTILIZATION is entered as zero, UTILIZATION will be calculated by INST/CAP.

c. Design-to-cost for ONSCOSTS. ONSCOSTS does not have a design-to-cost mode but may be used as an evaluation tool in connection with a design to life-cycle cost (DTLCC) application.

8.0 TERMINAL OPERATION.

a. PRICE H/S. This portion is designed to introduce the user to the On-Line System, DEC System and the IO Time Sharing System. The System is easy to use and requires only a limited acquaintance with the use of a time sharing system.

The first thing to do is to start the terminal session by turning on the terminal and setting the switches according to the following:

FUNCTION	TERMINAL SWITCH SETTINGS
POWER	ON
DUPLEX	FULL
CHARACTERS/SECOND	30
MODE	LINE
PARITY	EVEN
QSL	UPPER

After the terminal switches have been properly set, the on-line-system (OLS) computer system can be accessed by the telephone as follows:

(1) Dial the appropriate OLS telephone number for your area.

(2) Wait for the high-pitched tone which indicates that you are in contact with the computer. If you get a busy signal or no answer, call the OLS representative.

(3) Upon hearing the tone, press the telephone handset firmly into the terminal cradle. When the light appears, the system will respond with the proper message. Proceed to answer the questions.

b. ONSCOSTS. This portion of the section describes the procedures for running the ONSCOSTS model. Since the ONSCOSTS model may be run by a remote or direct terminal, check Appendix I for complete detail.

9.0 PRODUCTION PLAN.

Base the cost of the production on PRICE H / S models using a multi-year procurement plan with the following buy categories: (NOTE: The following buy categories are subject to change. The Program Office will submit the appropriate changes as required.)

YEAR	WORLDWIDE	THEATER	SELECTED AREA
1984	10	0	0
1985	16	0	0
1986	41	14	197
1987	31	26	222
1988	8	32	122
1989	0	29	13
1990	0	9	0
TOTAL	106	110	554

The average unit production cost goal shall be priced in constant 1982 dollars. Use a learning curve of 95% for the total production of the G/AIT. Prepare and submit within 90 days when the cost variance is greater than 10%.

10.0 COST OUTPUT.

This section describes the information presented on typical PRICE H, PRICE S and ONSCOSTS output reports. These output reports provide the user with a complete, coherent summary of principal factors and implications which should be critically examined and justified before project costs are validated. For PRICE H and PRICE S, all input parameters are printed just as they are entered from the input worksheet. All values calculated by the PRICE models, except for costs, are identified by an asterisk.

The typical PRICE H output report is the minimum report required; however, additional reports are available and may be submitted as required. PRICE S is capable of submitting the following outputs reports -- basic report, resource/complexity sensitivity report, instruction/application sensitivity report, schedule effect summary, monthly progress summary and resource allocation profiles.

The depth of output for the ONSCOSTS mode consist of cost totals, cost details, statistic details, costs as a percent, cost differences from the basic, a single line showing the initial, annual and/or total cost, or a single statistic. Depending upon the command issued, up to 17 cost details and up to 12 statistics may be printed as outputs. Outputs may be directed to a preallocated file or to an input time-sharing terminal.

11.0 CONSOLIDATED COSTS.

The consolidated costs include the compilation of acquisition costs (PRICE H and PRICE S), plus the operations and support costs provided by ONSCOSTS. Since these outputs are separate, the total cost for each shall be incorporated as follows:

ACQUISITION COST

PRICE H----------$_____

PRICE S----------$_____

ONSCOSTS----------$_____

Total Consolidated Cost $_____

APPENDIX I

OPERATION AND SUPPORT COST MODEL (ONSCOSTS)

This appendix provides a complete description of the input variables for ONSCOSTS which is an Operation and Support Cost model derived from the equations originating from the Air Force Logistics Command cost model. This depth of input and output plus the built-in options provide the capability to request numerous diversified estimates and trade-off studies.