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LIFE CYCLE COST ANALYSIS OF SHUTTLE-DERIVED LAUNCH VEHICLES

CONTRACT NAS9-16410

FINAL REPORT

DRL NO. MA-857T

SEPTEMBER 1982

VOLUME I

TECHNICAL REPORT

Prepared For

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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INTRODUCTION

This document summarizes results from the study effort for Contract NAS9-16410 "Life Cycle Cost Analysis of Shuttle-Derived Launch Vehicles". This study was performed for the Lyndon B. Johnson Space Center (JSC) of the National Aeronautics and Space Administration (NASA) by ECON, Incorporated.

In accordance with Item MA-857T of Data Requirements List No. T-1681, this Final Report summarizes the results of all study efforts associated with ECON's independent assessment of life cycle costs for Shuttle-Derived Launch Vehicle (SDLV) concepts. The report is organized in two volumes. Volume I, the Technical Report, is organized as follows:

- Section 1 summarizes the study background, ground rules and assumptions. It also includes the SDLV Work Breakdown Structure.
- Section 2 discusses the approach used in deriving SDLV costs, including calibration factors and historical data used.
- Section 3 presents a summary of study findings. It includes SDLV cost estimates and SDLV/STS cost comparisons.
- Sections 4 through 7 comprise comprehensive reports of SDLV life cycle cost estimates. These costs are reported in NASA/JSC standard reporting formats.
- Appendix A presents supporting data. It includes detailed hardware cost estimates (below subsystem level) that were derived using the RCA PRICE 84 cost model.

Volume II, the Executive Summary, presents a digest of study approach and findings. The contents of Volume II were briefed orally at Johnson Space Center on July 22, 1982.

1. BACKGROUND

OBJECTIVE

This study, which ECON began in August 1981, had the following objectives:

- Perform an independent assessment of SDLV development, production and operations costs. This assessment was to be performed using only the design, performance and programmatic definition of the Shuttle-Derived Launch Vehicle concepts as established by Martin Marietta and Rockwell International, the two contractors performing SDLV conceptual studies under separate contract to NASA.
- Evaluate the relative life cycle costs of space transporation systems using the Shuttle alone in comparison to a mix of Shuttle and SDLV vehicles. These results were to be tested against a range of mission activity levels.
- Calculate and compare the costs for alternative SDLV concepts.

GROUND RULES AND ASSUMPTIONS

The following ground rules and assumptions were observed in this study.

Estimating Ground Rules. All costs were estimated in constant 1982 dollars. The values presented assume typical fee levels for a prime contractor. Government program-management and support costs were estimated for every phase of the SDLV life cycle (See Section 7); however for comparability with Shuttle costs, only those Government costs attributable to cost-per-flight values were included in the evaluation.

Economic Analysis Guidelines. For purposes of analysis, Shuttle acquisition costs were always considered sunk. Acquisition was

defined as including: 1) Design, Development, Test and Evaluation (DDT&E) phase activities through Shuttle initial operational capability, and 2) Production of a four-Orbiter fleet. The production costs of Orbiters five and beyond were included in comparative assessments.

For the SDLV, acquisition costs were kept separate but were not considered sunk in those evaluations of transportation costs that were performed at equal mission capability. It is only appropriate to sink SDLV acquisition costs in evaluations where some totally new mission capability would be introduced.

Development Program Assumptions. It was assumed that the DDT&E phase of the SDLV program would culminate with a demonstration flight. Production costs for this first flight article were included in the DDT&E costs, as were costs for launch, mission control and recovery associated with the first mission. It was also assumed that post-flight refurbishment of the reusable Propulsion/Avionics Module would take place as part of the DDT&E program.

For test-flight launch, the SDLV program was charged the average cost of one External Tank and a pair of Solid Rocket Booster's priced as of calendar year 1990. Kennedy Space Center (KSC) launch-operations costs were likewise assessed at values typical of the first launch date, as were Johnson Space Center flight operations costs.

Acquisition Cost Assumptions. It was assumed that the reusable fleet of Propulsion/Avionics Modules would comprise four vehicles. Two P/A Modules would be permanently assigned at Kennedy Space Center, one would be permanently assigned at Vandenburg Air Force Base, and one would serve as a backup unit for either site. Three P/A Modules would be manufactured during the Production phase and one would be the DDT&E unit refurbished.

Recurring Cost Assumptions. It was assumed that hardware common to both Shuttle and SDLV would be charged at its projected cumulative average price over the 1983-2000 time period. This hardware -- which includes the External Tank (ET) and the Solid Rocket Boosters (SRBs) -- is estimated on the basis of total number of flights in 1983-2000 portion of the mission model; SRB costs include refurbishment of recovered hardware. Launch and flight operations common to SDLV and Shuttle were also allocated on an average-cost-per-flight basis.

WORK BREAKDOWN STRUCTURE

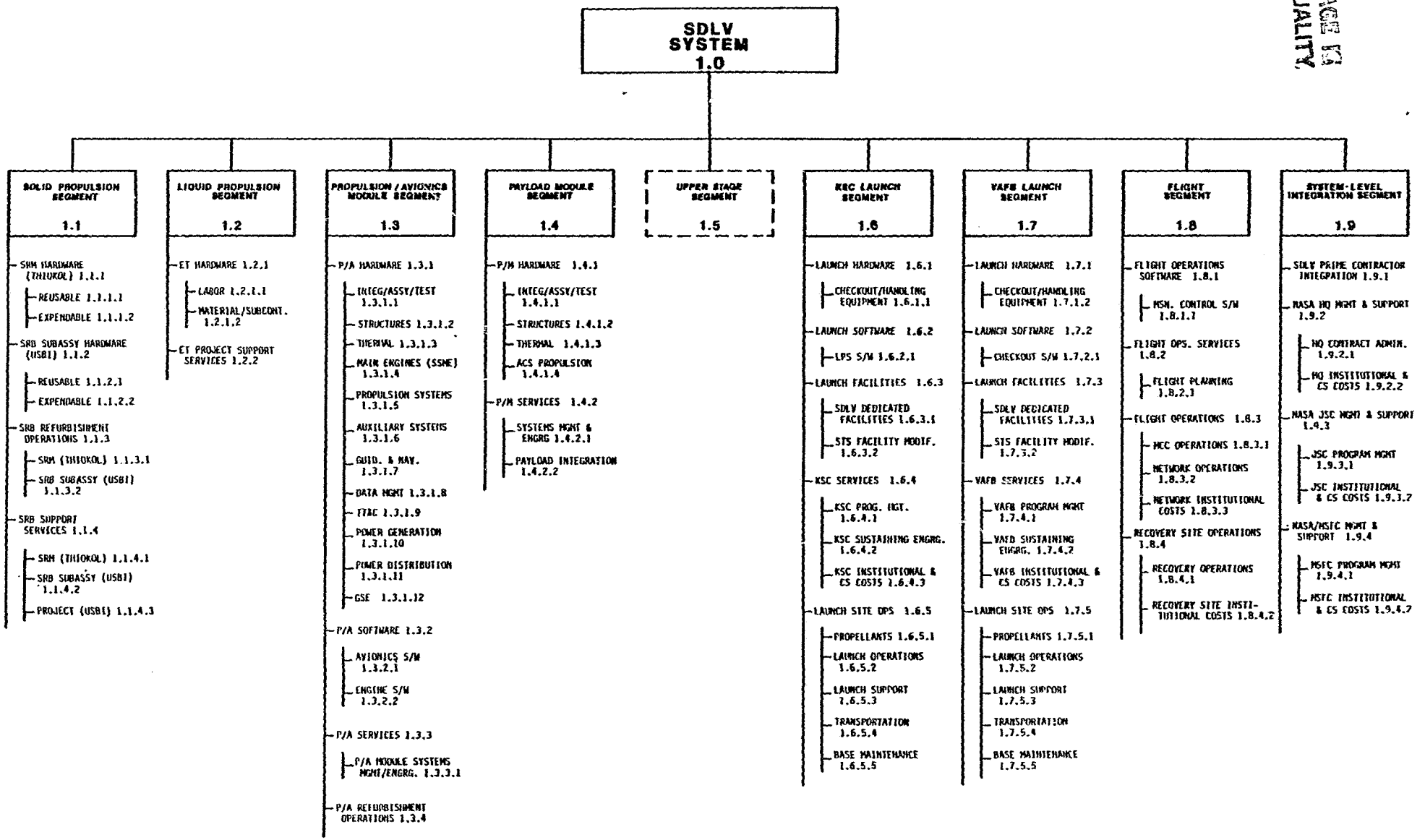
The Work Breakdown Structure (WBS) used in this study is based on the modular WBS concept that was developed by the Space Systems Cost Analysis Group to replace MIL-STD-881A. This WBS, shown in Figure 1, conforms to the architectural philosophy formulated by the Group. This philosophy mandates that space system WBS have the following attributes:

- Be end-term oriented;
- Be universal (i.e., equally applicable to all phases of the system's life cycle);
- Be modular (i.e., allow for growth and/or greater depth of reporting); and
- Keep separate the costs for hardware, software, services, facilities (these costs are generated by different estimating techniques).

The level 2 structure of the SDLV study WBS reflects the major end items and services that make up the reference vehicle concepts. These include the existing Shuttle External Tank and Solid Rocket Booster; the SDLV Propulsion/Avionics and Payload Modules; and all the services needed to launch, operate and manage the SDLV system. Note that a block was held in reserve at level 2 for upper stages. WBS 1.9 covers integration of the SDLV system by a prime contractor, and also accumulates management and institutional costs incurred at NASA centers and NASA Headquarters in support of SDLV.

Levels 3 and 4 of the WBS indicate the depth and nature of costs being estimated. In some cases, particularly in the SDLV-peculiar modules, costs were estimated at WBS level 5 and have been summed for reporting purposes at level 4.

FIGURE 1



2. TECHNICAL APPROACH

OVERVIEW

To preserve the independent assessment character of its analysis, ECON exclusively used parametric and other historically-based techniques to estimate SDLV life cycle costs. The overall flow of this analysis is summarized in Figure 2. Four types of activity are reflected in this figure:

- Data Base Preparation: This involved collection and normalization of a NASA-supplied technical and cost data base from historical space programs. Data were collected in the areas of hardware, software, operations and facilities.

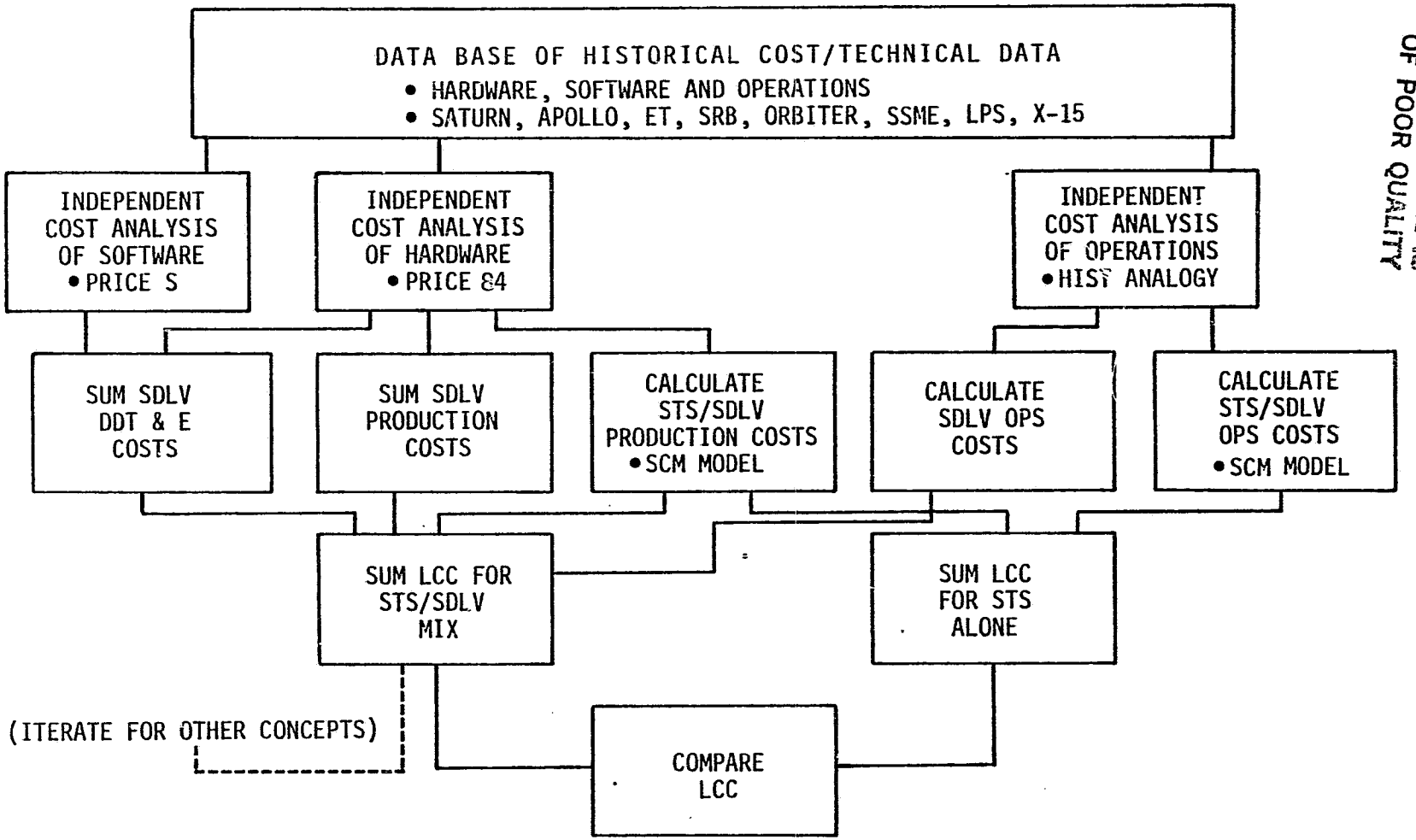
- Cost Estimating: This involved calibrating cost models from the historical data base and projecting estimates for the SDLV concepts. Costs were estimated using separate tools for each class of end item. SDLV hardware development and production costs were estimated using the RCA PRICE 84 model, as calibrated; SDLV software costs were estimated using the PRICE 'S' model, also as calibrated from the data base. SDLV facility costs were estimated by analogy to existing Shuttle facilities. SDLV operations costs were estimated by analogy to Shuttle and expendable launch vehicle (ELV) operations.

- Cost Accumulation: This involved calculating and summing costs in the quantities required to accomplish the various levels of mission activity. Nonrecurring costs (i.e., DDT&E and reusable fleet production) were summed manually. Recurring costs were calculated using ECON's Shuttle Cost and Price Model (SCP) with two separate sets of inputs, one set being an ECON independently-assessed data base.

- Cost Comparison and Evaluation: This involved calculating costs for equal-capability alternatives to the SDLV. Mission scenarios were evaluated in which increased numbers of Shuttle flights were substituted for SDLV flights of grater single-launch capability.

FIGURE 2

SIMPLIFIED STUDY LOGIC



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Recurring costs for these all-Shuttle scenarios were estimated using SCP.

The following sections explain in greater detail some of the models and techniques used in the study.

HARDWARE COST ANALYSIS

Using the PRICE 84 model, ECON estimated hardware costs for those elements unique to the SDLV (Payload and Propulsion/Avionics modules) as well as for the Shuttle/SDLV common External Tank and SRB. PRICE 84, a general-case simulation model, estimates development and production costs at any desired level of hardware indenture. Cost drivers in the PRICE 84 model include size, complexity, quantity, state of the art, and schedule. Of these, inherent complexity of the product (which RCA calls manufacturing complexity) is the key variable. There are three ways to obtain values for this variable:

- Calibrated values as derived from actual costs of similar hardware (preferred method),
- RCA supplied tables (of particular use in electronic hardware), and
- Calculated values derived from empirical relationships.

ECON used all three methods in this study. Following is a discussion of the calibration and calculation methods.

Calibration of PRICE 84 Complexity Variables. As part of this study, ECON performed a PRICE model calibration exercise using the data base supplied by NASA. The objective was to derive the manufacturing complexity values (for structures or electronics) of the defined hardware. The resulting variables were used, in combination with prior ECON calibrated values, to estimate SDLV hardware costs.

An example of the calibration process is shown in Figure 3. As recommended by RCA PRICE Systems, the calibration was made on the recurring production costs of the reference system (in this case the lightweight liquid oxygen tank of the Shuttle ET). Quantities, schedules and design descriptors were set up in a data file and then the file was iterated in PRICE with varying values of structural manufacturing complexity (MCPLXS) until the estimated recurring production costs closely matched the costs

FIGURE 3

TYPICAL PRICE CALIBRATION

LOX TANKAGE FOR ET

TANK,LOX

PRODUCTION QUANTITY	1	UNIT WEIGHT	12418.00	MODE	2
PROTOTYPE QUANTITY	0.0	UNIT VOLUME	125.00	QUANTITY/SHIP	1

UNIT PROD COST 2674.14 COST PROCESS FACTOR 56 MONTHLY PROD RATE 0.00

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	29.	64.	93.
DESIGN	64.	192.	256.
SYSTEMS	4.	-	4.
PROJECT MGMT	25.	1018.	1042.
DATA	10.	514.	524.
SUBTOTAL(ENG)	131.	1787.	1918.
MANUFACTURING			
PRODUCTION	-	2674.	2674.
PROTOTYPE	0.	-	0.
TOOL-TEST EQ	125.	5935.	6060.
SUBTOTAL(MFG)	125.	8609.	8734.
TOTAL COST	256.	10396.	10652.

DESIGN FACTORS	MECHANICAL	PRODUCT DESCRIPTORS	
WEIGHT	12418.000	ENGINEERING COMPLEXITY	0.400
DENSITY	99.344*	PROTOTYPE SUPPORT	1.0
MFG. COMPLEXITY	6.600	PROTO SCHEDULE FACTOR	.250*
NEW DESIGN	0.050	PLATFORM	2.000
DESIGN REPEAT	0.779*	YEAR OF TECHNOLOGY	1980*
EQUIPMENT CLASS	*****	RELIABILITY FACTOR	1.0
ENGINEERING CHANGES	.022*	MTBF(FIELD)	12590*
INTEGRATION LEVEL	2.5		

ITERATE PRICE WITH VARYING MCPLXS UNTIL ESTIMATED RECURRING PRODUCTION COSTS MATCH COST OF LIGHTWEIGHT TANK:

T-8 = $2686K

COMPARE WITH S-II LOX TANKAGE:

S-II = 6.3 (SIMPLE)
ET = 6.6 (COMPLEX)

actually experienced. In the example, the reference costs were for the best available data point, which is ET-8, the first light-weight tank. Separate "sanity checks" were also made of the sustaining management and engineering costs to see whether they were of the proper relative magnitude. Where several sources existed for calibrating a single generic item, the calibrated values were compared and any differences were explored by examining the end item for potential cost driving differences in design or process. In the example, differences between MCPLXS values of 6.6 for ET LOX tankage and 6.3 for Saturn S-II tankage appear to arise from the relative simplicity of the S-II tank shape and its slosh baffle design.

Results of the hardware calibration efforts conducted in this study are summarized in Tables 1, 2 and 3. Note that the levels at which the data base allowed calibration to take place ranged from component to subsystem level. In general, ECON used the component-level MCPLXS values in its analysis but tended to use the subsystem-level variables as check values.

Calculation of the Complexity Variables. For complex Propulsion/Avionics Module structures, ECON used a special equation derived by RCA to calculate MCPLXS. This equation relates the design, material, tolerances and intended application of a structure in a single expression of the form:

$$MCPLXS = \frac{A}{B}\left(1 + .06\ (C-D)\right)$$

WHERE:

$A = (4.3\ PLTFM^{.32})\ (NP^{.04})$

$B = (1.35\ PRECI^{.081})\ (MI^{.024})$

C = 4 For space systems, 3 for all others

D = Measure of assembly tolerance (range 1 to 5)

MI = Machinability Index

NP = Approximate number of parts in assembly

PLTFM = PRICE model variable called Platform

PRECI = Most demanding fab tolerance (thousandth of an inch)

ECON used this equation to derive MCPLXS values for P/A Module thrust structure, body structure and internal structure. The

TABLE 1

HARDWARE CALIBRATION RESULTS

1. LIQUID PROPULSION MODULES

ITEM	CALIB. SOURCES	MCPLXS	REMARKS
LIQUID HYDROGEN TANKAGE			
2014 ALUMINUM, INTEGRAL RIBS & STRINGERS	S-II	6.75	
2219 ALUMINUM, INTEGRAL STRINGERS	ET	6.60	
LIQUID OXYGEN TANKAGE			
SIMPLE ELLIPSOIDAL SHAPE	S-II	6.30	SIMPLE SLOSH BAFFLE
COMPLEX OGIVE SHAPE	ET	6.60	COMPLEX SLOSH BAFFLES
INTERTANK			
SIMPLE CYLINDER	S-II	5.90	
CYLINDER WITH SRB ATTACHMENTS	ET	6.60	
THERMAL PROTECTION			
FOAM ONLY	S-II	6.40	APPLIED ONLY TO LH_2 TANK
FOAM PLUS ABLATOR	ET	7.85	APPLIED TO ALL EXTERIOR SURFACES
SEPARATION	ET	5.90	
PROPELLANT SYSTEMS	ET	6.75	
ELECTRICAL POWER	ET	7.80	

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TABLE 2

HARDWARE CALIBRATION RESULTS

2. SOLID ROCKET BOOSTERS

ITEM	CALIB. SOURCES	MCPLXS	REMARKS
MOTOR CASE	STS/SRM	5.65	
NOZZLE	STS/SRM	6.00	
PROPELLANT	STS/SRM	3.70	
INSULATION/LINER	STS/SRM	4.70	
ELECTRICAL/INSTRUMENTATION	STS/SRB	8.15	
THRUST VECTOR CONTROL	STS/SRB	8.15	
BOOSTER STRUCTURES (NOSE, SKIRTS)	STS/SRB	6.75	
RECOVERY	STS/SRB	5.95	

TABLE 3

HARDWARE CALIBRATION RESULTS

3. PROPULSION/AVIONICS MODULE

ITEM	CALIB. SOURCES	MCPLXS	REMARKS
RE-ENTRY STRUCTURES	ORBITER (BODY)	8.75	
THERMAL PROTECTION	ORBITER (IEPS)	8.74	
LANDING AND HYDRAULICS	ORBITER (LANDING, HYDRAULICS, & SURFACE CONT.)	8.23	
PROPULSION LESS MAIN ENGINE	ORBITER (OMS, ACS, SSME FEED)	8.99	OMS, ACS COST BREAKOUT NEEDED
AVIONICS PLUS POWER DIST.	ORBITER (AVIONICS, POWER CONTROL/DISTRIB.)	9.15	POWER DIST. SYS. COST BREAKOUT NEEDED
CRYOGENIC ENGINE	SSME	8.98	

detailed PRICE reporting forms in Appendix A list the full set of input variables (and output costs and schedules) for the Propulsion/Avionics Module.

SOFTWARE COST ANALYSIS

ECON used the PRICE 'S' model to predict the cost of SDLV computer program development and modification. PRICE 'S', like PRICE 84, is a general case model with calibration capability. The technical parameters are changed; size, for example is measured in terms of machine-executable instructions rather than weight. However, the programmatic variables such as schedule are the same, and the model methodology is similar.

The Shuttle-Derived Launch Vehicle by definition draws heavily on the existing base of Space Shuttle software. Factors driving the SDLV software costs are as follows:

DRIVER	PRICE 'S' QUANTIFIER	EVALUATION FACTORS
How Big?	No. of Machine Instruc.	Shuttle Actual Sizes
How New?	Percent New Design Percent New Code	Modify Shuttle Or Build New?
How Difficult?	(Table Lookup)	Existing Contractor? Existing Machine?
What Kind of Software?	(Table Lookup)	Flight S/W Heavily Real Time; Ground S/W More Data Base, String Manipulation
What Utilization?	Percent of Computer Memory/Speed Used	Flight S/W Typically .90 to .95 Ground S/W In Non-Sensitive Range

A key effort in the software cost analysis was to establish a data base for Shuttle software, and to calibrate PRICE 'S' so as to reproduce these costs. Data on the size of STS computer programs was obtained for the following elements:

- Orbiter avionics, primary flight software
- Orbiter avionics, backup flight software

- Space Shuttle Main Engine (SSME) control flight software
- Mission control ground software
- Mission design software
- Launch Processing System (LPS) ground software

Corresponding software development cost data (in real-year dollars) were obtained for most of these items and iterative PRICE 'S' runs were made to match these real year costs by using reasonable combinations of model variables.

With these calibration data files in place, ECON proceeded to estimate SDLV software costs. For SDLV software based on Shuttle programs, the PRICE 'S' files were updated with revised values for the following parameters:

- Percent new design and code (to account for salvaging of existing code)
- Complexity of development (to account for rework of familiar software)
- Start date and year of economics (1982).

RECURRING COST CALCULATION

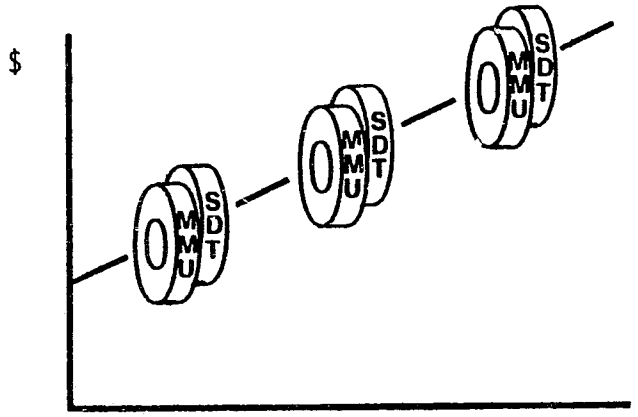
Most recurring-production and recurring-operations costs for SDLV were calculated using a subroutine of ECON's Shuttle Cost and Price (SCP) model. This subroutine, called Shuttle Cost Model (SCM), simplifies the full SCP model simulation of STS payloads and operations in order to quickly analyze cost streams and measure cost/rate sensitivities. The SCM subroutine of SCP currently operates with 70 cost algorithms of four general types, each with unique constants that -- taken together -- represent a default data base. This default data base comprises a set of equations that will simulate, in SCM, recent NASA Program Operating Plan cost estimates and cost data streams for the Space Shuttle system. The default data base may be overriden in any of the 70 individual cost elements.

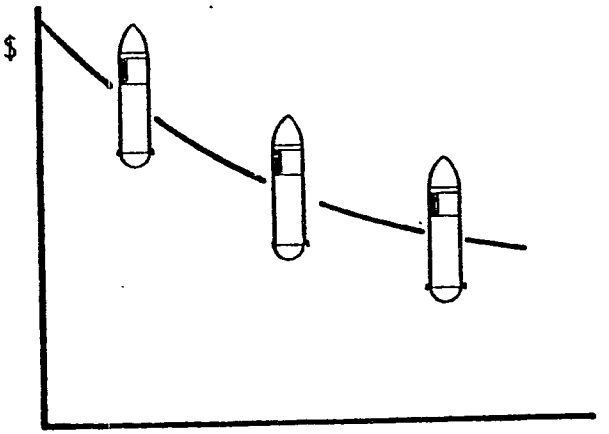
The four types of costing algorithms in SCP, shown graphically in Figure 4, are as follows:

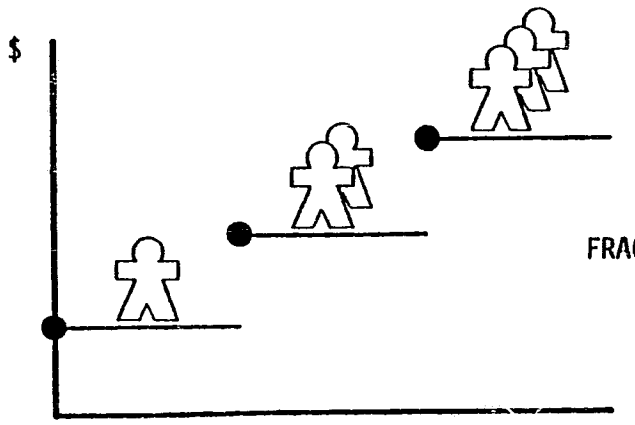
1) Flat annual cost plus cost per flight: The annual cost

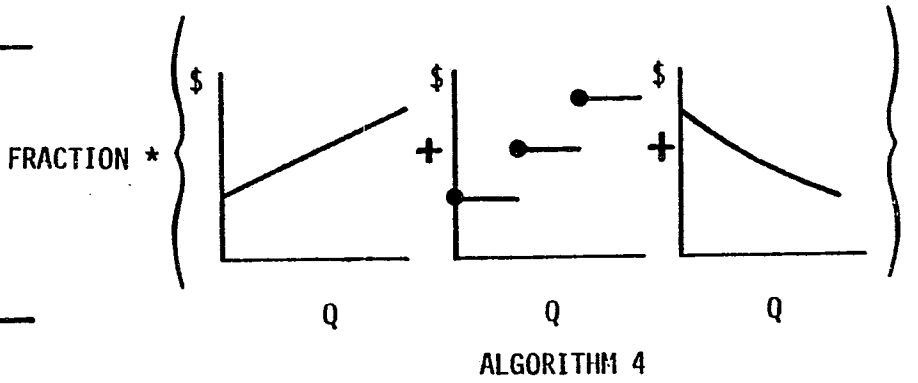
FIGURE 4

TYPES OF SCP COMPUTATIONAL ALGORITHMS









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may be specified by year.

2) Annual cost based on activity level.

3) Cost improvement (learning) curve projected from some first-unit cost: Either the Crawford (unit) or Wright (cumulative average) curve may be specified.

4) Fixed fraction of other specified costs.

The SDLV recurring costs were calculated in SCM using both the default (POP 81-2) data base and a modified data base that resulted from ECON's independent assessment of the POP 81-2 values. This independent assessment, which drew revised equations from the hardware and software cost analyses just described, incrased the External Tank, SRB, SSME, Flight Operations, and Launch Operations costs. The effect of these changes is illustrated in Section 3.

In order to estimate costs for SDLV recurring production and recurring opertions, ECON had to correlate the 70 cost elements in SCM to the SDLV Work Breakdown Structure to determine the applicability of each element. Certain of these elements proved to be Shuttle unique (e.g., crew equipment and training) and so were excluded from the SDLV cost estimates. The results of this correlation are shown in Table 4.

The SCM model applies the cost data base, as modified, to a flight activity model specified by the user. The model simulates procurement of hardware, flight and ground operations, and program management and support activities over the specified span of activity. ECON exercised the SCM model at a number of mission activity levels to encompass the range of STS and SDLV life cycle costs.

TABLE 4

DISPOSITION OF SCP-GENERATED COSTS IN SDLV ESTIMATES

COST NUMBER	COST CATEGORY	APPLICABILITY TO SDLV: USED DIRECTLY	USED FOR REFERENCE	NOT APPLICABLE	COSTS SHARED BETWEEN STS AND SDLV TRANSPORTATION SYSTEMS	SDLV WBS NO.
E1	ORBITER SPARES		X			1.3.4
E2	ORBITER RECURRING SUPPORT		X			1.3.3.1
E3	FIELD SUPPORT, JSC			X		
E4	REPLACEMENT GFE			X		
E5	FLIGHT DESIGN, PHASE 1		X			1.8.2.1
E6	FLIGHT DESIGN, PHASE 2	X			AVERAGE COST/FLIGHT	1.8.2.1
E7	MCC OPERATIONS	X			PRORATA ANNUAL COST	1.8.3.1
E8	ORBITER FLIGHT SOFTWARE	X			PRORATA ANNUAL COST	1.3.2.1
E9	SIMULATOR OPERATIONS			X		
E10	CREW OPERATIONS			X		
E11	ENGINEERING SUPPORT		X			1.3.3.1
E12	ORBITER ANALYTICAL INTEGRATION, RECURRING	X			AVERAGE COST/FLIGHT	1.4.2.2
E13	ORBITER ANALYTICAL INTEGRATION, SUPPORT	X			PRORATA ANNUAL COST	1.4.2.2
E14	NOT ASSIGNED					
E15	PROGRAM MANAGEMENT, JSC	X			PRORATA ANNUAL COST	1.9.3.1
E16	PROGRAM SUPPORT, JSC	X			PRORATA ANNUAL COST	1.9.3.2
E17	DIRECT CIVIL SERVICE & RELATED COSTS, JSC	X			PRORATA ANNUAL COST	1.9.3.2
E18	INDIRECT CIVIL SERVICE & RELATED COSTS, JSC	X			PRORATA ANNUAL COST	1.9.3.2
E19	PROPELLANTS, KSC	X			AVERAGE COST/FLIGHT PLUS PRORATA ANNUAL COST	1.6.4.1
E20	GSE SPARES, KSC	X			PRORATA ANNUAL COST	1.6.5..

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TABLE 4 (Cont'd)

DISPOSITION OF SCP-GENERATED COSTS IN SDLV ESTIMATES

COST NUMBER	COST CATEGORY	APPLICABILITY TO SDLV: USED DIRECTLY	USED FOR REFERENCE	NOT APPLICABLE	COSTS SHARED BETWEEN STS AND SDLV TRANSPORTATION SYSTEMS	SDLV WBS NO.
E21	VEH. GROUND OPS., BASE, ETR	X			PRORATA ANNUAL COST	1.6.5.2
E22	VEH. GROUND OPS., VARIABLE, ETR	X			AVERAGE COST/FLIGHT	1.6.5.2
E23	GROUND SYS. OPS., BASE, ETR	X			PRORATA ANNUAL COST	1.6.5.3
E24	GROUND SYS. OPS., VARIABLE, ETR	X			AVERAGE COST/FLIGHT	1.6.5.3
E25	SUSTAINING ENGR'G., ETR	X			PRORATA ANNUAL COST	1.6.4.2
E26	LOGISTICS SUPPORT, ETR	X			PRORATA ANNUAL COST	1.6.5.4
E27	PROGRAM MANAGEMENT, KSC	X			PRORATA ANNUAL COST	1.6.4.1
E28	PROGRAM MANAGEMENT, KSC	X			PRORATA ANNUAL COST	1.6.4.3
E29	LIQUID HYDROGEN PLANT	X			PRORATA ANNUAL COST	1.6.5.1
E30	DIR. CIVIL SERVICE & RELATED COSTS, KSC	X			PRORATA ANNUAL COST	1.6.4.3
E31	IND. CIVIL SERVICE & RELATED COSTS, KSC	X			PRORATA ANNUAL COST	1.6.4.3
E32	IND. OPERATIONS OF INSTALLATION, KSC	X			PRORATA ANNUAL COST	1.6.5.5
E33	PROPELLANTS, VAFB	X			AVERAGE COST/FLIGHT	1.7.5.1
E34	GSE SPARES, VAFB	X			PRORATA ANNUAL COST	1.7.5.3
E35	VEHICLE GROUND OPS., WTR	X			AVERAGE COST/FLIGHT PLUS PRORATA ANNUAL COST	1.7.5.2
E36	SUSTAINING ENGR'G., WTR	X			PRORATA ANNUAL COST	1.7.4.2
E37	LOGISTICS SUPPORT, WTR	X			PRORATA ANNUAL COST	1.7.5.4
E38	NOT ASSIGNED					
E39	IND. OPERATIONS OF INSTALLATION, VAFB	X			PRORATA ANNUAL COST	1.7.5.5
E40	PROGRAM MANAGEMENT, VAFB	X			PRORATA ANNUAL COST	1.7.4.1
E41	PROGRAM SUPPORT, VAFB	X			AVERAGE COST/FLIGHT PLUS PRORATA ANNUAL COST	1.7.4.3

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TABLE 4 (Cont'd)

DISPOSITION OF SCP-GENERATED COSTS IN SDLV ESTIMATES

COST NUMBER	COST CATEGORY	APPLICABILITY TO SDLV: USED DIRECTLY	USED FOR REFERENCE	NOT APPLICABLE	COSTS SHARED BETWEEN STS AND SDLV TRANSPORTATION SYSTEMS	SDLV WBS NO.
E42	DIR. CIVIL SERVICE & RELATED COSTS, VAFB	X			PRORATA ANNUAL COST	1.7.4.3
E43	IND. CIVIL SERVICE & RELATED COSTS, VAFB	X			PRORATA ANNUAL COST	1.7.4.3
E44	EXTERNAL TANK ASSY., INCR IIA		X			1.2.1.1
E45	EXTERNAL TANK ASSY., INCR IIB		X			1.2.1.1
E46	EXTERNAL TANK MAT'L, INCR II		X			1.2.1.2
E47	EXTERNAL TANK ASSY., INCR III	X			AVERAGE COST/UNIT	1.2.1.1
E48	EXTERNAL TANK MAT'L, INCR III	X			AVERAGE COST/UNIT	1.2.1.2
E49	EXTERNAL TANK PROJECT SUPPORT	X			PRORATA ANNUAL COST	1.2.2
E50	NEW/REUSABLE HARDWARE, THIOKOL	X			AVERAGE COST/UNIT	1.1.1.1
E51	EXPENDABLE HARDWARE, THIOKOL	X			AVERAGE COST/UNIT	1.1.1.2
E52	PROJECT SUPPORT THIOKOL	X			PRORATA ANNUAL COST	1.1.4.1
E53	NEW/REUSABLE HARDWARE, LABOR, THIOKOL	X			AVERAGE COST/UNIT	1.1.1.1
E54	REFURB. LABOR, THIOKOL	X			AVERAGE COST/REFURBISHMENT	1.1.3.1
E55	NEW/REUSABLE HARDWARE, USBI	X			AVERAGE COST/UNIT	1.1.2.1
E56	EXPENDABLE HARDWARE, USBI	X			AVERAGE COST/UNIT	1.1.2.2
E57	PROJECT SUPPORT, USBI	X			PRORATA ANNUAL COST	1.1.4.2
E58	SRB SUBASSY. LABOR	X			AVERAGE COST/UNIT	1.1.2.1
E59	REFURB. LABOR, USBI	X			AVERAGE COST/REFURBISHMENT	1.1.3.2
E60	SRB KSC LABOR	X			AVERAGE COST/UNIT	1.1.3.2
E61	SRB PROJECT SUPPORT	X			AVERAGE COST/FLIGHT PLUS PRORATA ANNUAL COST	1.1.4.3
E62	MAIN ENGINES	X			PRORATA ANNUAL COST	1.3.4

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TABLE 4 (Cont'd)

DISPOSITION OF SCP-GENERATED COSTS IN SDLV ESTIMATES

COST NUMBER	COST CATEGORY	APPLICABILITY TO SDLV: USED DIRECTLY	USED FOR REFERENCE	NOT APPLICABLE	COSTS SHARED BETWEEN STS AND SDLV TRANSPORTATION SYSTEMS	SDLV WBS NO.
E63	NOT ASSIGNED					
E64	PROGRAM MANAGEMENT, MSFC	X			PRORATA ANNUAL COST	1.9.4.1
E65	PROGRAM SUPPORT, MSFC	X			PRORATA ANNUAL COST	1.9.4.2
E66	DIR. CIVIL SERVICE & RELATED COSTS, MSFC	X			PRORATA ANNUAL COST	1.9.4.2
E67	IND. CIVIL SERVICE & RELATED COSTS, MSFC	X			PRORATA ANNUAL COST	1.9.4.2
E68	NASA HQ CONTRACT ADMIN.	X			FLAT PERCENTAGE OF ALL OTHER DIRECT COSTS	1.9.2.1
E69	HQ DIR. & IND. CIVIL SERVICE & RELATED COSTS	X			PRORATA ANNUAL COST	1.9.2.2
E70	OSTDS NETWORK SUPPORT	X			AVERAGE COST/FLIGHT PLUS PRORATA ANNUAL COST	1.8.3.2
E71	OSTDS DIR. & IND. CIVIL SERVICE & RELATED COSTS	X			PRORATA ANNUAL COST	1.8.3.3
E72	DFRC R&D		X			1.8.4.1
E73	DFRC DIR. & IND. CIVIL SERVICE & RELATED COSTS		X			1.8.4.2

3. SUMMARY OF RESULTS

SUMMARY OF THE ANALYSIS

ECON accomplished this analysis of Shuttle Derived Launch Vehicle life cycle costs using the methodology described in Section 2. The life cycle costs covered all phases of SDLV life -- including the DDT&E, Production and Operations phases -- and all types of end items, including hardware, software, services and facilities.

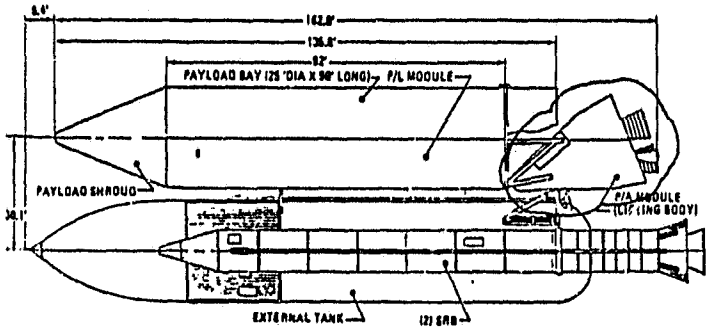
The analysis covered two SDLV concepts and selected alternatives. The reference concept analyzed in this report is shown in Figure 5. This SDLV configuration, developed in a parallel study by Martin Marietta, is described more fully in the Phase II Final Report for Contract NAS8-34183*. Figure 5 shows the major elements of this concept, namely:

- An External Tank identical to the lightweight version used on operational Space Shuttle missions.
- A pair of Solid Rocket Booster assemblies, also identical to those flown on operational Shuttle missions. Each SRB consists of a Solid Rocket Motor (SRM) manufactured by Thiokol, and recovery and auxiliary hardware manufactured by United Space Boosters Inc. (USBI).
- A Payload Module, analogous to the shroud on an expendable launch vehicle, to protect and carry the SDLV system payloads to orbit. The Payload Module is a completely new design.
- A reusable Propulsion/Avionics Module to house costly engines, avionics, and propulsion systems throughout ascent and deployment, and also to recover those items after the mission. The P/A Module uses Orbiter hardware and software to the maximum extent, but omits all manned mission equipment. In this most recent Martin study configuration, the P/A Module is designed to fly a lifting reentry trajectory rather than the ballistic reentry studied earlier. A weight summary for the reference P/A Module configuration is presented in Table 5. These weights were used in the cost analysis.

*Shuttle Derived Vehicles Technology Requirements Study, MMC-SDV-DR-6-2

FIGURE 5

REFERENCE CONFIGURATION



MAJOR ELEMENT WEIGHTS		
	INERT	LOW
CARGO CARRIER		289,397
• PAYLOAD	147,587	
• P/L MODULE	47,555	
• P/A MODULE	45,992	
• SSME	20,976	
ET	70,990	1,842,296
SRB	300,420	2,514,420
GLOW		4,446,112

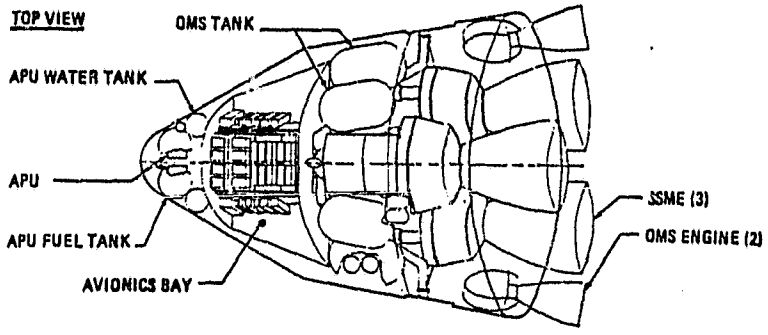


TABLE 5

P/A MODULE WEIGHT SUMMARY

ITEM	WEIGHT (LB)	ITEM	WEIGHT (LB)
STRUCTURE	(16,586)	RCS SUBSYSTEM	(9,957)
THRUST STRUCTURE	3,496	PRIMARY THRUSTERS	551
BODY (SHELL)	3,519	VERNIER THRUSTERS	38
WING	---	MISC.	241
TPS	5,295	MAIN FEED SUBSYSTEM	4,193
INTERNAL STRUCTURE	4,276	AUXILIARY SUBSYSTEM	4,934
LANDING AND RECOVERY	(6,706)	POWER	(3,272)
PARACHUTES	3,485	APU (HYDRAULIC)	1,225
LANDING GEAR/LEGS (4)	3,221	FUEL CELLS (2)	400
		FUEL CELLS TANKS (2)	294
PROPULSION	(4,845)	CABLING	428
RETRO ROCKET MOTOR	1,320	BLACK BOXES	443
HELIUM TANKS (MPS)	1,275	MISC.	482
OMS SUBSYSTEM			
ENGINES (2)	598	AVIONICS	(3,500)
HELIUM TANKS (2)	558	BLACK BOXES	1,425
PROPELLANT TANKS (4)	1,040	ANTENNAS (4)	4
MISC.	54	CABLING	2,071
SSME (3)	(20,976)		
ACTIVE THERMAL CONTROL SYSTEM	(1,126)	P/A MODULE DRY WEIGHT	66,968

The following paragraphs summarize some key results of the hardware and software cost analyses that were incorporated into the life cycle cost estimates.

Hardware Costs. The development and production costs for P/A Module hardware are summarized in Table 6. These costs, which were estimated using the PRICE 84 model, assumed that the structures and thermal subsystems of the P/A Module would be all-new designs. All other subsystems were considered to be repackaged from existing hardware; however, the overall module-level design integration was considered to represent an all-new configuration. Note that the costs given in Table 6 are not the total P/A module cost, just the hardware portion. For a full breakdown of these PRICE hardware model estimates see Appendix A.

Hardware costs for the Payload Module, also estimated using PRICE 84, were projected for three production quantities representing three mission activity levels. Following is a summary of Payload Module hardware costs:

COST ($ Millions, 1982)

DDT&E	Average Unit Production		
Phase	Qty = 92	Qty = 134	Qty = 167
240.759	20.039	18.352	17.463

The DDT&E costs assume that the Payload Module is an all-new design. See Apppendix A, section A.2, for detailed Payload Module PRICE 84 runs (for a quantity of 134 units).

Software Costs. The development costs for SDLV system computer programs are summarized in Table 7. These costs, which were estimated using the PRICE 'S' model, assumed the program sizes and percent-new values shown on this table. In the life cycle cost analysis, ECON used the Martin assumption that P/A Module flight software would be a new computer program rather than modified Orbiter software. However, in a separate trade study ECON concluded that a savings of $21 million could be effected by modifying Orbiter software, provided that the Orbiter software contractor would do the modification; these savings would not apply if a new contractor were to do the modification.

TABLE 6

PROPULSION/AVIONICS MODULE HARDWARE COSTS

WBS #	WBS IDENTIFICATION	ESTIMATED COSTS ($M 1982) DDT & E COST	PRODUCTION COST (3 UNITS)	TOTAL ACQUISITION COST
1.3.1.1	INTEG/ASSY/TEST	129.5	49.0	178.6
1.3.1.2	STRUCTURES	251.6	164.6	416.1
1.3.1.3	THERMAL	210.4	113.9	324.3
1.3.1.4	SSME	236.0	429.0	665.0
1.3.1.5	PROPULSION SYSTEMS	149.2	171.4	320.6
1.3.1.6	AUXILIARY SYSTEMS	76.1	19.3	95.4
1.3.1.7	GUIDANCE & NAVIGATION	27.2	36.3	63.5
1.3.1.8	DATA MANAGEMENT	34.5	45.2	79.7
1.3.1.9	TT & C	10.5	14.2	24.7
1.3.1.10	POWER GENERATION	17.6	18.9	36.5
1.3.1.11	POWER DISTRIBUTION	63.3	30.0	93.3
		1205.9	1091.8	2297.70

TABLE 7

SOFTWARE ACQUISITION COSTS

WBS #	WBS IDENTIFICATION	EST. # OF MACHINE INST.	FRACTION NEW — DESIGN	CODE	DDT & E COST ($M 1982)
1.3.2.1	P/A MODULE AVIONICS S/W	60,400	0.9	1.0	45.789
1.3.2.2	P/A ENGINE CONTROL S/W	12,500	0.1	0.1	2.369
1.6.2.1	KSC LAUNCH PROCESSING SYSTEM S/W	1,710,000	0.25	0.5	19.911
1.7.2.1	VAFB LAUNCH S/W	1,710,000	0.05	0.1	5.552
1.8.1.1	MISSION CONTROL S/W	2,695,000	0.1	0.2	25.399
1.8.2.1	FLIGHT PLANNING	910,000	0.5	1.0	14.088
					113.108

For the main-engine-control software, the mission-control and mission-planning software, and the KSC checkout software (Launch Processing System) it was assumed that existing Shuttle system computer programs would be modified for SDLV use. Table 7 shows the degree to which modification of the design (algorithms) and coding for each of these items was judged necessary.

For Vandenburg Air Force Base checkout software, which does not yet exist, it was assumed that the overall size of this software would be similar to the size of the KSC Launch Processing System. However, it was also assumed that SDLV system checkout requirements could more easily influence VAFB software and hence require less modification to transition from Shuttle to SDLV application.

SUMMARY OF SDLV LIFE CYCLE COSTS

The life cycle costs for the reference Martin Class I SDLV concept (with lifting reentry) were summed from the nonrecurring and recurring hardware and software costs just discussed, in combination with recurring costs as calculated using ECON's Shuttle Cost Model. The results of this analysis show that for the nominal mission model of 134 SDLV flights (1991-2000) the total life cycle cost would be $19.173 billion (1982 $). Of this amount, $2.258 billion is for the DDT&E phase, $9.173 billion for the Production phase and $7.742 billion for the Operations phase.

A summary breakdown of costs for each of these phases is presented in the following paragraphs.

DDT&E Costs. The DDT&E costs for Martin's Class I SDLV concept are displayed in Figure 6. These costs, expressed in 1982 dollars, cover the design and flight demonstration of hardware and software. Specific costs covered include:

- Analysis and design of space and ground segments
- Test hardware fabrication (one complete flight article plus selected subsystem and lower level hardware)
- Ground test operations
- Launch, flight and recovery operations of test article
- Initial tooling
- Software coding and validation
- Program management

FIGURE 6

DDT&E ESTIMATE

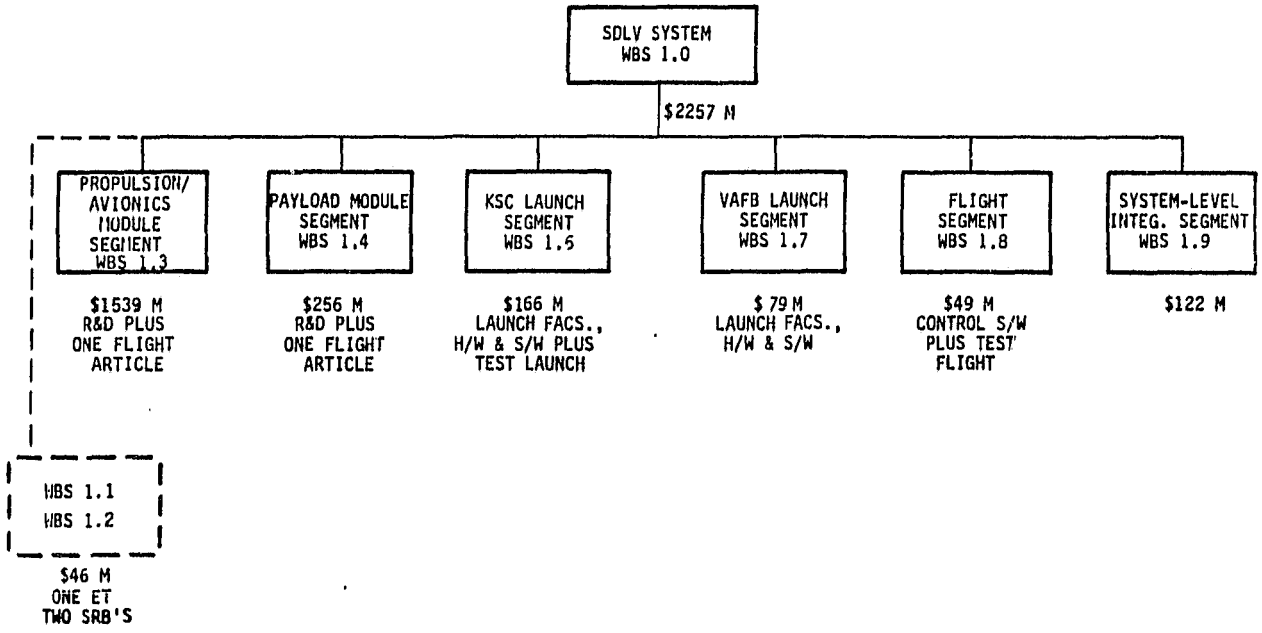
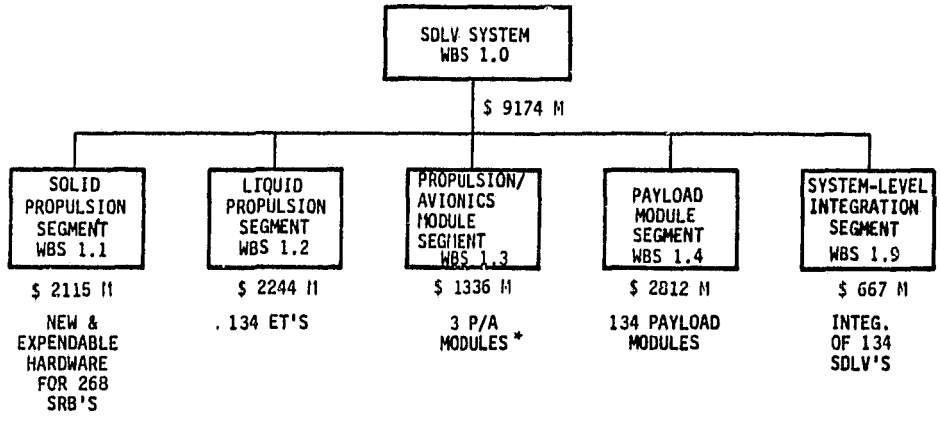


FIGURE 7

RECURRING PRODUCTION ESTIMATE



*ABOVE AN BEYOND REFURBISHED P/A MODULE FROM DDT&E PROGRAM

- Systems engineering and integration

Details of these costs are presented in Sections 4 and 5 of this report.

Production Costs. Production phase costs for the Martin Class I SDLV (Figure 7) include fabrication, assembly, checkout, acceptance, and sustaining engineering/management for all flight vehicles produced after the flight-test unit. These costs also include rate tooling for production of post-DDT&E units.

The production phase costs may be thought of as two elements, i.e. 1) one-time production of reusable SDLV hardware such as the Propulsion/Avionics Module, and 2) recurring production of expendable SDLV hardware such as Payload Modules, External Tanks and SRBs. The ET and SRB costs are shared between the SDLV and Shuttle projects since this hardware is common to both transportation systems. SRB Production phase costs include only the manufacturing of new hardware; SRB refurbishment costs are reported in the Operations phase. ET and SRB costs were calculated using ECON's SCM model. Two data bases were used in this analysis; the default data base (POP 81-2 values) was used to project lower-bound values, and values from an ECON independent assessment were used to estimate the expected costs.

Operations Costs. Operations phase costs for the Martin Class I SDLV (Figure 8) include launch, orbital deployment, recovery, refurbishment, and sustaining engineering/management in support of these activities.

The launch operations, flight operations and SRB refurbishment costs, all of which are shared between the SDLV and Shuttle programs, were estimated using the ECON SCM model. The default data base (POP 81-2 values) was used in most of these calculations.

Ballistic Reentry Concept LCC. At the request of NASA/JSC, ECON completed a separate life cycle cost evaluation of an SDLV concept using a ballistic reentry design for the P/A Module. This analysis was based on Martin's Phase I SDLV concept. The evaluation was limited to acquisition costs as differences in mission activity and operations profiles did not allow discrimination in Operations phase costs. As a result of this analysis, it was concluded the smaller P/A Module achievable with with ballistic reentry would reduce DDT&E phase costs by $44.85 million and the Production phase costs by $25.73 million.

FIGURE 8

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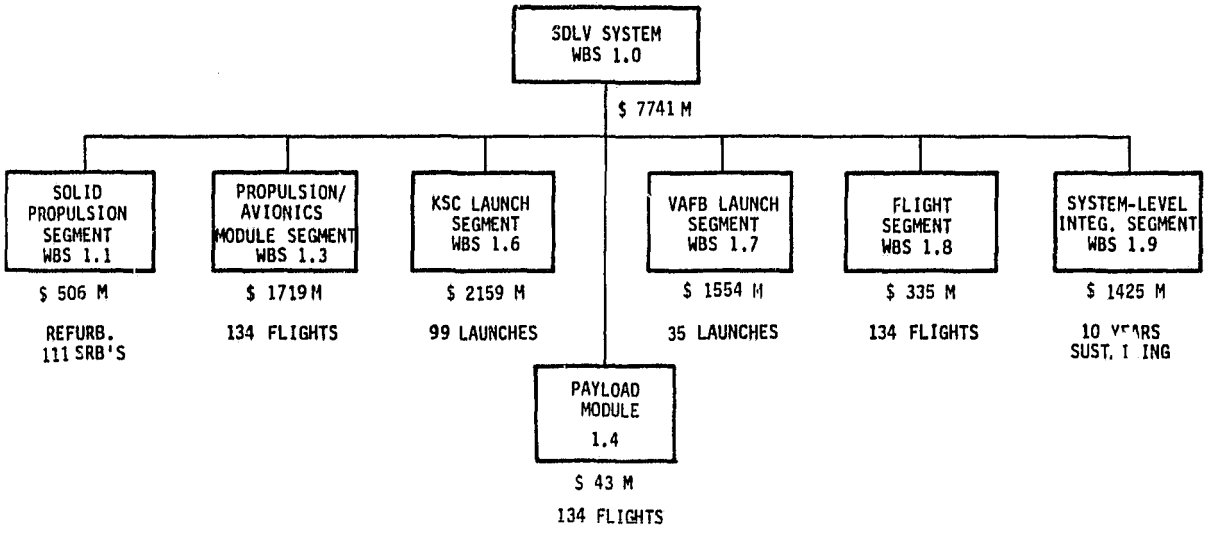
RECURRING OPERATIONS ESTIMATE



SUMMARY OF COMPARATIVE EVALUATION

To complete this study ECON performed a comparative evaluation of the life cycle cost of SDLV and Shuttle systems. This analysis was performed on the basis of equal transportation capability to low earth orbit. To test the sensitivity of results, three levels of mission activity were explored. At each activity level of total payload delivery, two space transportation scenarios were evaluated: 1) An all-Shuttle option in which only STS missions are flown, and 2) A mixed case in which the SDLV and Shuttle share missions.

The scenarios used in this analysis were derived by the SDLV study contractors and represent the results of mission capture analyses in which individual payloads were assigned to Shuttle or SDLV on the basis of mission capabilities and traffic levels. For example, all Spacelab payloads were automatically assigned to the Shuttle. The resulting scenarios were as follows:

	NUMBER OF FLIGHTS THROUGH YEAR 2000			
ACTIVITY	ALL FLIGHTS ON SHUTTLE	SHUTTLE/SDLV MIX		
	SHUTTLE	SHUTTLE	SDLV	TOTAL
LOW	378	213	92	305
MODERATE	675	367	134	501
HIGH	801	462	167	629

Shuttle-Only Case Recurring Costs. In order to evaluate the life cycle cost of scenarios in which the Shuttle alone would be used for space transportation, ECON performed a cost-per-flight sensitivity analysis. This analysis used the SCM model to estimate average cost per flight over a range of flight activity levels. The results, shown in Figures 9 and 10, were based on SCM runs in which peak launch rates varied from 20 to 61 Shuttle flights per year. In Figure 9 the cost per flight of all elements except launch is plotted as a function of the total number of flights through the year 2000. Two SCM data bases were used: the default, or POP 81-2, base, and ECON's independent cost assessment. The costs labeled 'Hardware' on Figure 9 cover External Tank; SRB; SSME; and Orbiter and crew systems refurbishment. The remainder of the costs on Figure 9 are for Flight Operations and for NASA sustaining support to the Shuttle program. Figure 10 plots the cost per flight of launch services at Kennedy Space Center and at Vandenburg Air Force Base. The VAFB costs are considered far more uncertain because the facility is still under development.

FIGURE 9

COST/FLIGHT SENSITIVITY TO SHUTTLE FLIGHT RATE

HARDWARE PLUS OTHER (NON-LAUNCH) SERVICES

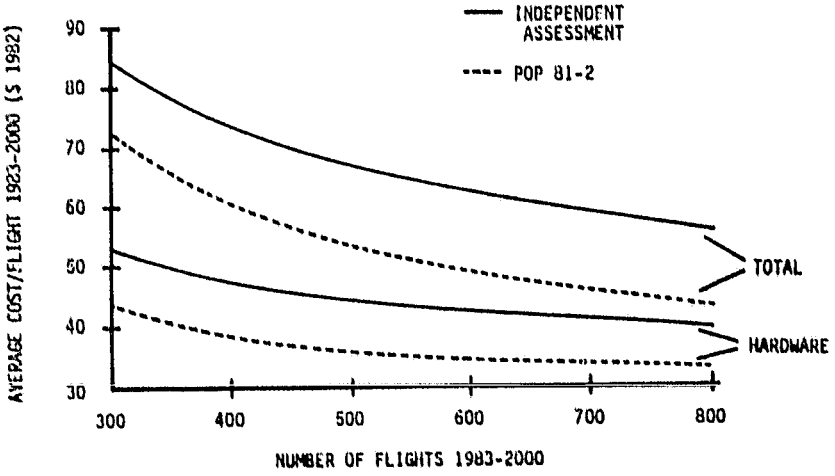
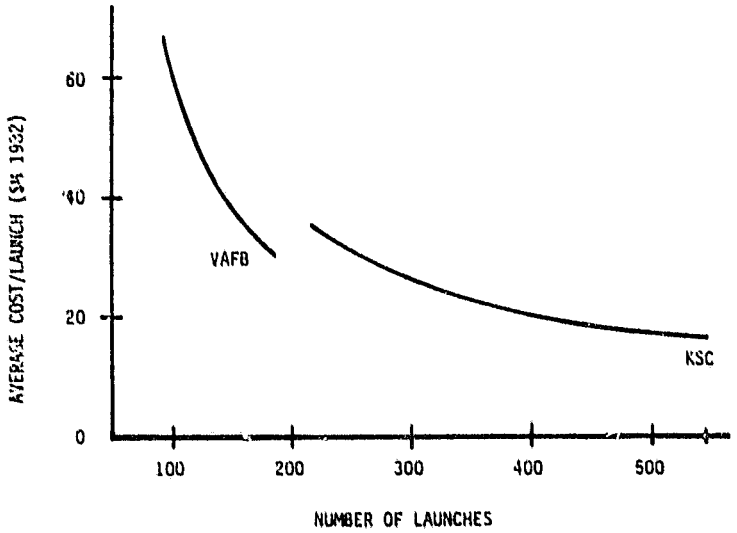


FIGURE 10

LAUNCH COST/FLIGHT SENSITIVITY



Using the curves from Figures 9 and 10, ECON calculated the recurring costs to perform the three mission scenarios using Shuttle flights only. The results are shown in Table 8.

SDLV/Shuttle Case Recurring Costs. The recurring costs to perform the three mission scenarios using a mix of SDLV and Shuttle flights are summarized in Table 9. The SDLV costs were derived from the Production and Operations phase estimates presented earlier. Shared costs common to SDLV and Shuttle (e.g. ET, SRB) were derived from the parametric SCM model runs, as were the costs for Shuttle-unique hardware.

Life Cycle Cost Comparison. In Table 10 the total life cycle costs for the alternative transportation systems are compared. These estimates include the recurring costs from Tables 8 and 9 and also the nonrecurring acquisition costs for SDLV (similar acquisition costs for the Shuttle are considered sunk).

Evaluation of Table 10 shows the following trends:

- On a recurring transportation cost basis the SDLV/Shuttle mix is less costly than the Shuttle alone for all three scenarios.
- When SDLV acquisition costs are added, the recurring cost savings are offset and the Shuttle becomes more cost effective.

Interpretation of Results. In interpreting these comparative life cycle costs, the following questions should be considered:

1) Is equal transportation capability a valid measure of comparison? Does the SDLV have unique mission performance capability such that the Government could consider writing off its DDT&E and fleet acquisition as sunk costs against this unique capability?

2) Can the introduction of the SDLV reduce future investment in the STS (e.g. quantity of Orbiters required for the Shuttle fleet) and thereby accrue additional savings to offset the higher LCC of the SDLV?

With respect to question 2), there are two ways in which the introduction of SDLV can effect economies in transportation to earth orbit. First, SDLV reduces the annual flight rate required to sustain a fixed level of activity; this in turn reduces potentially rate-sensitive costs such as Orbiter fleet size, launch facility capacity and production rate tooling. Secondly,

TABLE 8

RECURRING TRANSPORTATION COSTS

FOR STS ONLY CASE

($ M 1982)

	LOW ACTIVITY			MODERATE ACTIVITY			HIGH ACTIVITY		
	FLTS	AVG CPF	COST	FLTS	AVG CPF	COST	FLTS	AVG CPF	COST
HARDWARE	378	48.5	18,333	675	41.6	28,080	801	39.9	31,960
OTHER SERVICES	378	24.6	9,299	675	15.2	10,260	801	13.3	10,653
KSC LAUNCH	292	27.5	8,030	543	16.3	6,851	617	15.5	9,564
VAFB LAUNCH	86	57.8	4,970	132	40.5	5,346	184	32.5	5,980
			40,632			50,537			58,157

TABLE 9

FOR SDLV/STS MIX

($ M 1982)

	LOW ACTIVITY			MODERATE ACTIVITY			HIGH ACTIVITY		
ELEMENT	FLTS	AVG CPF	COST	FLTS	AVG CPF	COST	FLTS	AVG CPF	COST
SDLV & COMMON COSTS									
1.1 SRB	305	22.2	6,771	501	19.4	9,719	629	19.0	11,951
1.2 ET	305	19.1	5,825	501	16.7	8,368	629	16.1	10,127
1.3 P/A MODULE	92	12.8	1,178	134	12.8	1,715	167	12.8	2,138
1.4 P/L MODULE	92	23.6	2,171	134	21.3	2,854	167	20.2	3,373
1.6 KSC LAUNCH	235	33.6	7,896	386	21.8	8,414	484	18.0	8,712
1.7 VAFB LAUNCH	70	70.2	4,914	115	44.4	5,106	145	37.6	5,452
1.8 SDLV FLIGHT OPS.	92	3.1	285	134	2.5	335	167	2.3	384
1.9 SYS. INTEG.	305	17.7	5,398	501	10.6	5,311	629	9.8	6,164
STS UNIQUE COSTS									
ORBITER HARDWARE	213	7.9	1,683	367	6.6	2,422	462	6.0	2,772
ORBITER FLIGHT OPS.	213	11.8	2,513	367	9.9	3,633	462	9.2	4,250
			38,634			47,877			55,323

TABLE 10

COST COMPARISON AT EQUAL TRANSPORTATION CAPABILITY

(M 1982 $)

	LOW ACTIVITY		MODERATE ACTIVITY		HIGH ACTIVITY	
	STS	SDLV/STS	STS	SDLV/STS	STS	SDLV/STS
ACQUISITION COSTS						
DDT & E	N/A	2,257	N/A	2,257	N/A	2,257
PRODUCTION (P/A FLEET PLUS SDLV INTEGRATION)	N/A	2,002	N/A	2,002	N/A	2,002
SUBTOTAL		4,259		4,259		4,259
DIFFERENCE		-4,259		-4,259		-4,259
RECURRING COSTS	40,632	38,634	50,537	47,877	58,157	55,323
DIFFERENCE		+1,998		+2,660		+2,834
TOTAL COST	40,632	42,893	50,537	52,136	58,157	59,582
DIFFERENCE		-2,261		-1,599		-1,425

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SDLV can slow the retirement of Orbiters at the end of their useful lifetime.

ECON has studied the effects of rate on STS launch capability. This analysis, now more than two years old, identified STS system saturation points using then-current turnaround times. The calculations were performed using the operations-simulation portion of ECON's SCP model. Results of this analysis showed that with the 4-Orbiter fleet now authorized, the Space Transportation System could support a launch rate of 35 flights per year; the Orbiter fleet was estimated to be sufficient for 49 flights per year but Vehicle Assembly Building processing constraints reduced the rate to 35 per year. However, no conclusions can be drawn from this analysis until the simulation is repeated using current turnaround times. Such an analysis is beyond the scope of this study.

The effect of Orbiter retirement on STS costs is easier to model. The design lifetime of the Orbiter was originally specified as 100 flights. The extent to which that 100 flight useful life may be exceeded is not known; however it is possible to simulate that variation parametrically. Figure 11 shows the effect of total flight activity on Orbiter fleet size. In this analysis, the 4-Orbiter fleet is a given and Orbiter lifetime is varied from 100 to 200 flights. It is assumed for ease of analysis that the total number of flights is equally distributed across Orbiters. A cost of $1.25 billion (1982 $) is assigned to each Orbiter required beyond the basic four vehicle fleet; this is a representative cost for purposes of analysis.

By plotting the reduction in flights between all-Shuttle and SDLV/Shuttle mix, the Orbiter cost savings attainable with SDLV can be bounded parametrically. For each mission scenario and each value of Orbiter lifetime the fleet size is calculated with and without SDLV. The differences represent savings with SDLV. Results may be summarized as follows:

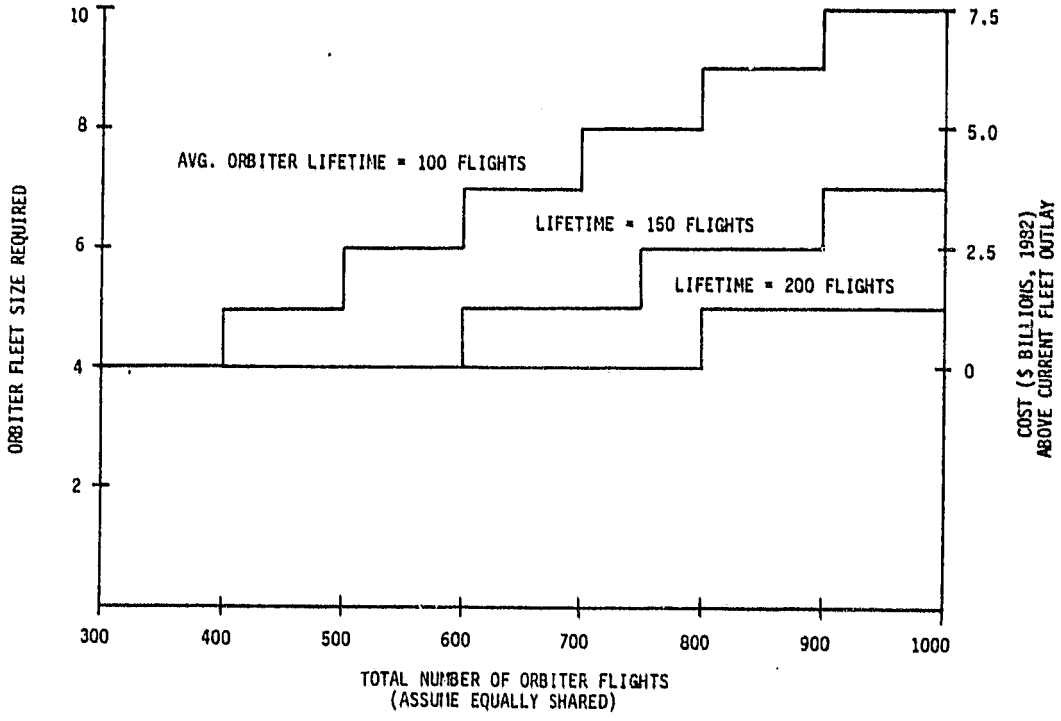
	NUMBER OF FLIGHTS		ORBITERS ADDED		
MISSION SCENARIO	WITHOUT SDLV	WITH SDLV	LIFE = 100	LIFE = 150	LIFE = 200
LOW	378	305	0	0	0
MODERATE	675	501	1	1	0
HIGH	801	629	2	1	1

Examination of these results shows a payoff to SDLV only for the moderate and high mission scenarios; however the magnitude of the cost savings achievable with the higher activity levels ($1.25

billion for one Orbiter and $2.5 billion for two Orbiters) is favorable to justification of the SDLV.

FIGURE 11

ORBITER FLEET SIZE & ADDED COST VERSUS ORBITER LIFETIME



4. SDLV LIFE CYCLE COST BREAKDOWN (FORM 'A' REPORTS)

This section arrays the life cycle costs of a representative SDLV concept by Work Breakdown Structure end item. These costs are presented in the format of NASA Form A as defined in NASA/JSC Data Requirements Description No. MF003M "Document, Program Cost and Schedule Estimates Plan". The sequence in which Form A reports are organized in this section is as follows:

- DDT&E phase
- Production phase
- Operations phase

Within each grouping the costs are displayed in accordance with WBS hierarchy.

The SDLV configuration for which these estimates were prepared is the most recent Martin Marietta Class I vehicle, with lifting reentry module, as described in the previous section. The life cycle costs are for 134 operational flights, fulfilling the SDLV portion of the moderate-activity mission model (the Shuttle mission costs for this model are reported elsewhere).

Most of the columns in Form A are self-explanatory; however, the following entries should be interpreted as follows:

- Number of Units: The quantity of hardware produced, the number of flights, number of refurbishments, etc.
- Reference Unit: This is the basis from which the recurring cost projections were made. It can be the theoretical-first-unit cost, an average cost per flight, or an average cost per year.
- Selected Cost: This is the expected (most probable) cost for an item given the technical and programmatic factors described elsewhere for that item.
- Highest Cost: This is an estimate of the maximum value that an item might cost, if uncertainties in key technical and/or programmatic factors are resolved at their pessimistic values (for example, if projected learning rates are not met, or engineering complexity

is higher than estimated). This value is not the same as the uncertainty in the estimating process.

- Lowest Cost: A projection of the most favorable cost outcome for an item. For costs estimated using the PRICE model, this would be the low value in the estimating range.

- Spread Function: These are the Lead and Lag values used in the PRICE A cost model to define expenditure profiles.

- Learning Index: The cost-improvement curve actually used in the SCM model to project recurring costs. The notation (C) indicates the Crawford or unit progress type curve, and (W) indicates the Wright or cumulative progress curve.

DATA FORM A

CONFIGURATION Martin Class 1 (Lifting Reentry)
COST UNITS $ Millions, 1982

NONRECURRING (DDT&E) X
RECURRING (PRODUCTION)
RECURRING (OPERATIONS)

WBS IDENTIFICATION			NO. UNITS	REFERENCE UNIT	SELECTED COST	HIGHEST COST	LOWEST COST	LEAD TIME	COST DURATION	SPREAD FUNCTION	LEARNING INDEX
NUMBER	NOMENCLATURE	LEVEL									
1.0	SDLV System	1			(2257.670)						
1.1	Solid Propulsion Segment	2	1 set	Cum. avg. SRB cost/flt as of 1990	24.808	25.676	19.388	36	36	.5, .2	
1.2	Liquid Propulsion Segment	2	1	Cum. avg. ET cost as of 1990	21.599	22.895	17.170	36	36	.2, .2	
1.3	Propulsion/Avionics Module Segment	2			(1538.611)			69	72	.2, .5	
1.3.1	P/A Hardware	3			(1205.736)	(1370.379)	(1062.624)				
1.3.1.1	Integration/Assembly/Test	4	1		129.631						
1.3.1.2	Structures	4	1		251.473						
1.3.1.3	Thermal	4	1		210.422						
1.3.1.4	Main Engines (SSME)	4	1		235.997						
1.3.1.5	Propulsion Systems	4	1		149.174						
1.3.1.6	Auxiliary Systems	4	1		76.081						
1.3.1.7	Guidance and Navigation	4	1		27.165						
1.3.1.8	Data Management	4	1		34.446						
1.3.1.9	TT & C	4	1		10.474						
1.3.1.10	Power Generation	4	1		17.627						
1.3.1.11	Power Distribution	4	1		63.246						
1.3.2	P/A Software	3			(48.158)						
1.3.2.1	Avionics Software	4			45.789						
1.3.2.2	Engine Software	4			2.369						
1.3.3	P/A Services	3			(273.617)						
1.3.3.1	P/A Module Systems Management and Engineering	4			273.617						
1.3.4	P/A Refurbishment Operations	3	1		11.10						

DATA FORM A

CONFIGURATION Martin Class 1 (Lifting Reentry)
COST UNITS $ Millions, 1982

NONRECURRING (DDT&E) X
RECURRING (PRODUCTION)
RECURRING (OPERATIONS)

WBS IDENTIFICATION			NO. UNITS	REFERENCE UNIT	SELECTED COST	HIGHEST COST	LOWEST COST	LEAD TIME	COST DURATION	SPREAD FUNCTION	LEARNING INDEX
NUMBER	NOMENCLATURE	LEVEL									
1.4	Payload Module Segment	2			(255.857)			51	54	.2, .5	
1.4.1	P/M Hardware	3			(240.760)	(287.154)	(205.915)				
1.4.1.1	Integration/Assembly/Test	4	1		29.879						
1.4.1.2	Structures	4	1		163.157						
1.4.1.3	Thermal	4	1		21.461						
1.4.1.4	ACS Propulsion	4	1		26.263						
1.4.2	P/M Services	3			(15.097)						
1.4.2.1	Systems Management and Engineering	4			15.097						
1.6	KSC Launch Segment	2			(166.303)			69	69	.5, .2	
1.6.1	Launch Hardware	3			(53.580)						
1.6.1.1	Checkout/Handling Equipment	4			53.580						
1.6.2	Launch Software	3			(19.911)						
1.6.2.1	Launch Processing System Software	4			19.911						
1.6.3	Launch Facilities	3			(74.520)						
1.6.3.1	SDLV Dedicated Facilities	4			49.200						
1.6.3.2	STS Facility Modification	4			25.320						
1.6.4	KSC Services	3	1	Avg. cost/flt in 1990	7.711						
1.6.5	Launch Site Services	3	1	Avg. cost/flt in 1990	10.581						
1.7	VAFB Launch Segment	2			(78.942)			69	69	.2, .5	
1.7.1	Launch Hardware	3			(17.860)						
1.7.1.1	Checkout/Handling Equipment	4			17.860						
1.7.2	Launch Software	3			(5.552)						
1.7.2.1	Checkout Software	4			5.552						

DATA FORM A

CONFIGURATION Martin Class 1 (Lifting Reentry)
COST UNITS $ Millions, 1982

NONRECURRING (DDT&E) X
RECURRING (PRODUCTION)
RECURRING (OPERATIONS)

WBS IDENTIFICATION			NO. UNITS	REFERENCE UNIT	SELECTED COST	HIGHEST COST	LOWEST COST	LEAD TIME	COST DURATION	SPREAD FUNCTION	LEARNING INDEX
NUMBER	NOMENCLATURE	LEVEL									
1.7.3	Launch Facilities	3			(55.530)						
1.7.3.1	SDLV Dedicated Facilities	4			49.200						
1.7.3.2	STS Facility Modification	4			6.330						
1.8	Flight Segment	2			(49.267)			69	72	.5, .2	
1.8.1	Flight Operations Software	3			(25.399)						
1.8.1.1	Mission Control Software	4			25.399						
1.8.2	Flight Operations Services	3			(14.088)						
1.8.2.1	Flight Planning	4			14.088						
1.8.3	Flight Operations	3			(9.623)						
1.8.3.1	MCC Operations	4			8.500						
1.8.3.2	Network Operations	4			1.123						
1.8.4	Recovery Site Operations	3			(0.157)						
1.8.4.2	Recovery Site Institutional Costs	4			0.157						
1.9	System-Level Integration Segment	2			(122.283)	(137.089)	(109.796)	69	72	.2, .5	
1.9.1	SDLV Prime Contractor Integration	3			122.283						

DATA FORM A

CONFIGURATION Martin Class 1 (Lifting Reentry)
COST UNITS $ Millions, 1982

NONRECURRING (DDT&E) ____
RECURRING (PRODUCTION) X
RECURRING (OPERATIONS) ____

WBS IDENTIFICATION			NO. UNITS	REFERENCE UNIT	SELECTED COST	HIGHEST COST	LOWEST COST	LEAD TIME	COST DURATION	SPREAD FUNCTION	LEARNING INDEX
NUMBER	NOMENCLATURE	LEVEL									
1.0	SDLV System	1			(9173.382)						
1.1	Solid Propulsion Segment	2			(2115.167)	(2189.198)	(1639.664)	30	120	.5, .5	
1.1.1	SRM Hardware (Thiokol)	3			(1685.538)						
1.1.1.1	Reusable	4	16 sets	Avg.=42.4 for 60 units	678.528						0.913(C) Labor 0.96 (C) Material
1.1.1.2	Expendable	4	134 sets	Avg.=7.5 for 512 units	1007.010						1.00 (C)
1.1.2	SRB Subassembly Hardware (USBI)	3			(429.629)						
1.1.2.1	Reusable	4	23 sets	Avg.=9.9 for 86 units	226.619						0.90 (C)
1.1.2.2	Expendable	4	134 sets	Avg.=1.5 for 512 units	203.010						0.946(C)
1.2	Liquid Propulsion Segment	2			(2243.830)	(2380.672)	(1782.461)	30	120	.5, .5	
1.2.1	External Tank Hardware	3			(2022.596)						
1.2.1.1	Labor	4	134	Avg.=6.6 for 512 units	880.380						0.87 (W)
1.2.1.2	Material/Subcontract	4	134	Avg.=8.5 for 512 units	1142.216						0.97 (W)
1.2.2	External Tank Project Support Services	3	134	Avg.=1.7 for 512 units	221.234						
1.3	Propulsion/Avionics Module Segment	2			(1335.850)			33	45	.5, .2	
1.3.1	P/A Hardware	3			(1091.791)	(1239.992)	(936.933)				
1.3.1.1	Integration/Assembly/Test	4	3		49.024						
1.3.1.2	Structures	4	3		164.610						
1.3.1.3	Thermal	4	3		113.845						
1.3.1.4	Main Engines (SSME)	4	12		429.041						

DATA FORM A

CONFIGURATION Martin Class 1 (Lifting Reentry)
COST UNITS $ Millions, 1982

NONRECURRING (DDT&E) ____
RECURRING (PRODUCTION) X
RECURRING (OPERATIONS) ____

WBS IDENTIFICATION			NO. UNITS	REFERENCE UNIT	SELECTED COST	HIGHEST COST	LOWEST COST	LEAD TIME	COST DURATION	SPREAD FUNCTION	LEARNING INDEX
NUMBER	NOMENCLATURE	LEVEL									
1.3.1.5	Propulsion Systems	4	3		171.386						
1.3.1.6	Auxiliary Systems	4	3		19.314						
1.3.1.7	Guidance and Navigation	4	3		36.261						
1.3.1.8	Data Management	4	3		45.237						
1.3.1.9	TT & C	4	3		14.212						
1.3.1.10	Power Generation	4	3		18.907						
1.3.1.11	Power Distribution	4	3		29.954						
1.3.3	P/A Services	3			(244.059)						
1.3.3.1	P/A Module Systems Management and Engineering	4			244.059						
1.4	Payload Module Segment	2			(2811.619)			33	132	.2, .2	
1.4.1	P/M Hardware	3			(2459.256)	(2961.922)	(2050.757)				
1.4.1.1	Integration/Assembly/Test	4	134		116.036						
1.4.1.2	Structures	4	134		1588.711						
1.4.1.3	Thermal	4	134		182.238						
1.4.1.4	ACS Propulsion	4	134		572.271						
1.4.2	P/M Services	3			(352.363)						
1.4 2.1	Systems Management and Engineering	4			352.363						
1.9	System-Level Integration Segment	2			(666.916)	(769.009)	(568.533)	24	144	.5, .5	
1.9.1	SDLV Prime Contractor Integration	3			666.916						

DATA FORM A

CONFIGURATION Martin Class 1 (Lifting Reentry)
COST UNITS $ Million, 1982

NONRECURRING (DDT&E) _____
RECURRING (PRODUCTION) _____
RECURRING (OPERATIONS) X

WBS IDENTIFICATION			NO. UNITS	REFERENCE UNIT	SELECTED COST	HIGHEST COST	LOWEST COST	LEAD TIME	COST DURATION	SPREAD FUNCTION	LEARNING INDEX
NUMBER	NOMENCLATURE	LEVEL									
1.0	SDLV System	1			(7741.842)						
1.1	Solid Propulsion Segment	2			(506.392)	(524.116)	(392.552)	0	120	.5, .5	
1.1.3	SRB Refurbishment Operations	3			(154.240)						
1.1.3.1	SRM (Thiokol)	4	118 sets	Avg.=0.4 for 452 SRM set refurbishments	49.678						0.85 (C)
1.1.3.2	Solid Rocket Booster Sub-assembly (USBI)	4	111 sets	Avg.=1.0 for 426 SRB set refurbishments	104.562						0.85 (C)
1.1.4	Solid Rocket Booster Support Services	3			(352.152)						
1.1.4.1	SRM (Thiokol)	4	134	Avg.=1.6 for 512 flights	220.966						
1.1.4.2	SRB Subassembly (USBI)	4	134	Avg.=0.8 for 512 flights	104.788						
1.1.4.3	Project (USBI)	4	134	Avg.=0.2 for 512 flights	26.398						
1.3	Propulsion/Avionics Module Segment	2			(1719.220)			0	120	.5, .5	
1.3.2	P/A Software	3			(231.820)						
1.3.2.1	Avionics Software	4			231.820						
1.3.4	P/A Refurbishment Operations	3	134		1487.400						
1.4	Payload Module Segment	2			(42.612)			0	120	.5, .5	
1.4.2	P/M Services	3			(42.612)						
1.4.2.2	Payload Integration	4			42.612						
1.6	KSC Launch Segment	2			(2159.487)	(2543.385)	(2084.742)	0	120	.5, .5	
1.6.4	KSC Services	3			(585.387)						
1.6.4.1	KSC Program Management	4	99	Avg.=0.8 for 380 launches	74.844						
1.6.4.2	KSC Sustaining Engineering	4	99	Avg.=0.5 for 380 launches	48.510						
1.6.4.3	KSC Institutional Costs	4	99	Avg.=4.7 for 380 launches	462.033						

DATA FORM A

CONFIGURATION Martin Class 1 (Lifting Reentry)
COST UNITS $ Millions, 1982

NONRECURRING (DDT&E) _____
RECURRING (PRODUCTION) _____
RECURRING (OPERATIONS) X

WBS IDENTIFICATION			NO. UNITS	REFERENCE UNIT	SELECTED COST	HIGHEST COST	LOWEST COST	LEAD TIME	COST DURATION	SPREAD FUNCTION	LEARNING INDEX
NUMBER	NOMENCLATURE	LEVEL									
1.6.5	Launch Site Operations	3			(1574.100)						
1.6.5.1	Propellants	4	99	Avg.=1.4 for 380 launches	136.026						
1.6.5.2	Launch Operations	4	99	Avg.=7.5 for 380 launches	738.936						
1.6.5.3	Launch Suppor	4	99	Avg.=3.6 for 380 launches	360.261						
1.6.5.4	Transportation	4	99	Avg.=0.4 for 380 launches	41.976						
1.6.5.5	Base Maintenance	4	99	Avg.=3.0 for 380 launches	296.901						
1.7	VAFB Launch Segment	2			(1554.175)			0	120	.5, .5	
1.7.4	VAFB Services	3			(455.350)						
1.7.4.1	VAFB Program Management	4	35	Avg.=0.1 for 132 launches	3.290						
1.7.4.2	VAFB Sustaining Engineering	4	35	Avg.=2.9 for 132 launches	100.310						
1.7.4.3	VAFB Institutional Costs	4	35	Avg.=10.0 for 132 launches	351.750						
1.7.5	Launch Site Operations	3			(1098.825)						
1.7.5.1	Propellants	4	35	Avg.=1.7 for 132 launches	59.500						
1.7.5.2	Launch Operations	4	35	Avg.=20.7 for 132 launches	733.705						
1.7.5.3	Launch Support	4	35	Avg.=1.0 for 132 launches	27.860						
1.7.5.4	Transportation	4	35	Avg.=1.9 for 132 launches	66.395						
1.7.5.5	Base Maintenance	4	35	Avg.=6.0 for 132 launches	211.365						
1.8	Flight Segment	2			(334.598)			0	120	.5, .5	
1.8.2	Flight Operations Services	3			(24.388)						
1.8.2.1	Flight Planning	4	134	Avg.=0.2 for 512 flights	24.388						
1.8.3	Flight Operations	3			(296.408)						
1.8.3.1	MCC Operations	4	134	Avg.=1.5 for 512 flights	197.918						
1.8.3.2	Network Operations	4	134	Avg.=0.6 for 512 flights	86.832						
1.8.3.3	Network Institutional Costs	4	134	Avg.=0.1 for 512 flights	11.658						

DATA FORM A

CONFIGURATION Martin Class 1 (Lifting Reentry)
COST UNITS $ Millions, 1982

NONRECURRING (DDT&E) ____
RECURRING (PRODUCTION) ____
RECURRING (OPERATIONS) X

WBS IDENTIFICATION			NO. UNITS	REFERENCE UNIT	SELECTED COST	HIGHEST COST	LOWEST COST	LEAD TIME	COST DURATION	SPREAD FUNCTION	LEARNING INDEX
NUMBER	NOMENCLATURE	LEVEL									
1.8.4	Recovery Site Operations	3			(13.802)						
1.8.4.1	Recovery Operations	4	134	Avg.=0.1 for 512 flights	10.586						
1.8.4.2	Recovery Site Institutional Costs	4	134	Avg.=0.02 for 512 flights	3.216						
1.9	System-Level Integration Segment	2			(1425.358)			0	120	.5, .5	
1.9.2	NASA Headquarters Management and Support	3			(112.426)						
1.9.2.1	Headquarters Contract Administration	4	134	Avg.=0.6 for 512 flights	77.720						
1.9.2.2	Headquarters Institutional Costs	4	134	Avg.=0.3 for 512 flights	34.706						
1.9.3	NASA JSC Management and Support	3			(1070.258)						
1.9.3.1	JSC Program Management	4	134	Avg.=4.7 for 512 flights	628.728						
1.9.3.2	JSC Institutional Costs	4	134	Avg.=3.3 for 512 flights	441.530						
1.9.4	NASA MSFC Management and Support	3			(242.674)						
1.9.4.1	MSFC Program Management	4	134	Avg.=0.6 for 512 flights	77.184						
1.9.4.2	MSFC Institutional Support	4	134	Avg.=1.2 for 512 flights	165.490						

5. BASIS OF ESTIMATES (FORM 'C' REPORTS)

This section presents the methodology and the technical factors used to derive the SDLV life cycle costs. The data are summarized in Form C reports per Data Requirements document MF003M. The Forms C are organized by program phase (DDT&E, Production and Operations) and by WBS within a phase.

For hardware items estimated using the PRICE 84 model, the complete input data sets used in costing these items (e.g. weights, complexity factors, new-design levels) are reported in Appendices A.1 and A.2 rather than on these forms. This permits greater depth of detail in establishing the basis of each subsystem estimate.

In the Form C reports most of the columns are self-explanatory; however, the following additional explanations apply:

- Type of Estimate: The designation 'P' for parametric model has been expanded to show use of RCA PRICE models or the ECON SCP model. The notation P(PH) refers to PRICE 84, P(PS) to PRICE 'S' and P(SCP) to the SCP model. The designation 'A' applies to estimates derived by historical analogy.

- Complexity Factor: This column is used only if costs are scaled up from some analogy. RCA PRICE complexity factors are given only in Appendices A and B.

DATA FORM C

COST ESTIMATING METHODOLOGY AND TECHNICAL CHARACTERISTICS

CONFIGURATION Martin Class 1 (DDT & E)

WBS IDENTIFICATION		COST EST	TYPE EST	HISTORICAL DATA USED	COM-PLEXITY FACTOR	QUANTITY OR VALUE	KEY TECH CHARAC-TERISTIC	REMARKS
NUMBER	NOMENCLATURE							
1.1	Solid Propulsion Segment	24.808	P(SCP)	SRB				Independently developed costs input to SCP.
1.2	Liquid Propulsion Segment	21.599	P(SCP)	ET				Independently developed costs input to SCP.
1.3	Propulsion/Avionics Module Segment	(1527.511)						
1.3.1	P/A Hardware	(1205.736)						
1.3.1.1	Integration/Assembly/Test	129.631	P(PH)					See Appendix A for detailed PRICE output.
1.3.1.2	Structures	251.473	P(PH)					See Appendix A for detailed PRICE output.
1.3.1.3	Thermal	210.422	P(PH)					See Appendix A for detailed PRICE output.
1.3.1.4	Main Engines (SSME)	235.997	P(PH)					See Appendix A for detailed PRICE output.
1.3.1.5	Propulsion Systems	149.174	P(PH)					See Appendix A for detailed PRICE output.
1.3.1.6	Auxiliary Systems	76.081	P(PH)					See Appendix A for detailed PRICE output.
1.3.1.7	Guidance and Navigation	27.165	P(PH)					See Appendix A for detailed PRICE output.
1.3.1.8	Data Management	34.446	P(PH)					See Appendix A for detailed PRICE output.
1.3.1.9	TT & C	10.474	P(PH)					See Appendix A for detailed PRICE output.
1.3.1.10	Power Generation	17.627	P(PH)					See Appendix A for detailed PRICE output.
1.3.1.11	Power Distribution	63.246	P(PH)					See Appendix A for detailed PRICE output.
1.3.2	P/A Software	(48.158)						
1.3.2.1	Avionics Software	45.789	P(PS)			60,400	Machine Instruc-tions	New design = 0.9, new code = 1.0.
1.3.2.2	Engine Software	2.369	P(PS)			12,500	Machine Instruc-tions	New design = 0.1, new code = 0.1.
1.3.3	P/A Services	(273.617)						

DATA FORM C

COST ESTIMATING METHODOLOGY AND TECHNICAL CHARACTERISTICS

CONFIGURATION Martin Class 1 (DDT & E)

WBS IDENTIFICATION		COST EST	TYPE EST	HISTORICAL DATA USED	COMPLEXITY FACTOR	QUANTITY OR VALUE	KEY TECH CHARACTERISTIC	REMARKS
NUMBER	NOMENCLATURE							
1.3.3.1	P/A Module Systems Management and Engineering	273.617	P(PH)					
1.3.4	P/A Refurbishment Operations	11.10	A	X-15	1.0			Ratio of refurbishment cost to unit cost.
1.4	Payload Module Segment	(255.857)						
1.4.1	P/M Hardware	(240.760)						
1.4.1.1	Integration/Assembly/Test	29.879	P(PH)					See Appendix A for detailed PRICE output.
1.4.1.2	Structures	163.157	P(PH)					See Appendix A for detailed PRICE output.
1.4.1.3	Thermal	21.461	P(PH)					See Appendix A for detailed PRICE output.
1.4.1.4	ACS Propulsion	26.263	P(PH)					See Appendix A for detailed PRICE output.
1.4.2	P/M Services	(15.097)						
1.4.2.1	Systems Management and Engineering	15.097	P(PH)					
1.6	KSC Launch Segment	(166.303)						
1.6.1	Launch Hardware	(53.580)						
1.6.1.1	Checkout/Handling Equipment	53.580	P					Ratio of GSE cost to total DDT & E.
1.6.2	Launch Software	(19.911)						
1.6.2.1	LPS Software	19.911	P(PS)			1,710,000	Machine Instructions	New design = 0.25, new code = 0.5.
1.6.3	Launch Facilities	(74.520)						
1.6.3.1	SDLV Dedicated Facilities	49.200	A	Orbiter Processing Facility	1.0			
1.6.3.2	STS Facility Modification	25.320	A	LC 39 Modification Costs	0.2			
1.6.4	KSC Services	7.711	P(SCP	POP 81-2				

DATA FORM C

COST ESTIMATING METHODOLOGY AND TECHNICAL CHARACTERISTICS

CONFIGURATION Martin Class 1 (DDT & E)

WBS IDENTIFICATION		COST EST	TYPE EST	HISTORICAL DATA USED	COMPLEXITY FACTOR	QUANTITY OR VALUE	KEY TECH CHARACTERISTIC	REMARKS
NUMBER	NOMENCLATURE							
1.6.5	Launch Site Operations	10.581	P(SCP)	POP 81-2				
1.7	VAFB Launch Segment	(78.942)						
1.7.1	Launch Hardware	(17.860)						
1.7.1.1	Checkout/Handling Equipment	17.860	P					Ratio of GSE costs to total DDT & E.
1.7.2	Launch Software	(5.552)						
1.7.2.1	Checkout Software	5.552	P(PS)			1,710,000	Machine Instructions	New design = 0.05, new code = 0.1.
1.7.3	Launch Facilities	(55.530)						
1.7.3.1	SDLV Dedicated Facilities	49.200	A	Orbiter Processing Facility	1.0			
1.7.3.2	STS Facility Modification	6.330	A	LC 39 Modification Costs	0.05			
1.8	Flight Support	(49.267)						
1.8.1	Flight Operations Software	(25.399)						
1.8.1.1	Mission Control Software	25.399	P(PS)			2,695,000	Machine Instructions	New design = 0.1, new code = 0.2.
1.8.2	Flight Operations Services	(14.088)						
1.8.2.1	Flight Planning	14.088	P(PS)			910,000	Machine Instructions	New design = 0.5, new code = 1.0.
1.8.3	Flight Operations	(9.623)						
1.8.3.1	MCC Operations	8.500	P(SCP)					
1.8.3.2	Network Operations	1.123	P(SCP)	POP 81-2				
1.8.4	Recovery Site Operations	(0.157)						

DATA FORM C

COST ESTIMATING METHODOLOGY AND TECHNICAL CHARACTERISTICS

CONFIGURATION Martin Class 1 (DDT & E)

WBS IDENTIFICATION		COST EST	TYPE EST	HISTORICAL DATA USED	COMPLEXITY FACTOR	QUANTITY OR VALUE	KEY TECH CHARACTERISTIC	REMARKS
NUMBER	NOMENCLATURE							
1.8.4.2	Recovery Site Institutional Costs	0.157	P(SCP)	POP 81-2				
1.9	System-Level Integration Segment	(122.283)						
1.9.1	SDLV Prime Contractor Integration	122.283	P(PH)					

DATA FORM C

COST ESTIMATING METHODOLOGY AND TECHNICAL CHARACTERISTICS

CONFIGURATION Martin Class 1 (Production)

WBS IDENTIFICATION		COST EST	TYPE EST	HISTORICAL DATA USED	COMPLEXITY FACTOR	QUANTITY OR VALUE	KEY TECH CHARACTERISTIC	REMARKS
NUMBER	NOMENCLATURE							
1.1	Solid Propulsion Segment	(2115.167)						
1.1.1	SRM Hardware (Thiokol)	(1685.538)						
1.1.1.1	Reusable	678.528	P(SCP)	SRM				Independently derived T-1 cost input to SCP.
1.1.1.2	Expendable	1007.010	P(SCP)	SRM				Independently derived T-1 cost input to SCP.
1.1.2	SRB Subassembly Hardware (USBI)	(429.629)						
1.1.2.1	Reusable	226.619	P(SCP)	SRB				
1.1.2.2	Expendable	203.010	P(SCP)	SRB				
1.2	Liquid Propulsion Segment	(2243.830)						
1.2.1	ET Hardware	(2022.596)						
1.2.1.1	Labor	880.380	P(SCP)	ET, S-II				Independently derived L.C. input to SCP.
1.2.1.2	Material/Subcontractor	1142.216	P(SCP)	ET, S-II				Independently derived L.C. input to SCP.
1.2.2	ET Project Support Services	221.234	P(SCP)	ET				
1.3	Propulsion/Avionics Module Segment	(1335.850)						
1.3.1	P/A Hardware	(1091.791)						
1.3.1.1	Integration/Assembly/Test	49.024	P(PH)					See Appendix A for detailed PRICE output.
1.3.1.2	Structures	164.610	P(PH)					See Appendix A for detailed PRICE output.
1.3.1.3	Thermal	113.845	P(PH)					See Appendix A for detailed PRICE output.
1.3.1.4	Main Engines (SSME)	429.041	P(PH)					See Appendix A for detailed PRICE output.
1.3.1.5	Propulsion Systems	171.386	P(PH)					See Appendix A for detailed PRICE output.
1.3.1.6	Auxiliary Systems	19.314	P(PH)					See Appendix A for detailed PRICE output.
1.3.1.7	Guidance and Navigation	36.261	P(PH)					See Appendix A for detailed PRICE output.
1.3.1.8	Data Management	45.237	P(PH)					See Appendix A for detailed PRICE output.

DATA FORM C

COST ESTIMATING METHODOLOGY AND TECHNICAL CHARACTERISTICS

CONFIGURATION Martin Class 1 (Production)

WBS IDENTIFICATION		COST EST	TYPE EST	HISTORICAL DATA USED	COMPLEXITY FACTOR	QUANTITY OR VALUE	KEY TECH CHARACTERISTIC	REMARKS
NUMBER	NOMENCLATURE							
1.3.1.9	TT & C	14.212	P(PH)					See Appendix A for detailed PRICE output.
1.3.1.10	Power Generation	18.907	P(PH)					See Appendix A for detailed PRICE output.
1.3.1.11	Power Distribution	29.954	P(PH)					See Appendix A for detailed PRICE output.
1.3.3	P/A Services	(244.059)						
1.3.3.1	P/A Module Systems Management and Engineering	244.059	P(PH)					
1.4	Payload Module Segment	(2811.619)						
1.4.1	P/M Hardware	(2459.256)						
1.4.1.1	Integration/Assembly/Test	116.036	P(PH)					See Appendix B for detailed PRICE output.
1.4.1.2	Structures	1588.711	P(PH)					See Appendix B for detailed PRICE output.
1.4.1.3	Thermal	182.238	P(PH)					See Appendix B for detailed PRICE output.
1.4.1.4	ACS Propulsion	572.271	P(PH)					See Appendix B for detailed PRICE output.
1.4.2	P/M Services	(352.363)						
1.4.2.1	Systems Management and Engineering	352.363	P(PH)					
1.9	System-Level Integration Segment	(666.916)						
1.9.1	SDLV Prime Contractor Integration	666.916	P(PH)					

DATA FORM C

COST ESTIMATING METHODOLOGY AND TECHNICAL CHARACTERISTICS

CONFIGURATION Martin Class 1 (Operations)

WBS IDENTIFICATION		COST EST	TYPE EST	HISTORICAL DATA USED	COMPLEXITY FACTOR	QUANTITY OR VALUE	KEY TECH CHARACTERISTIC	REMARKS
NUMBER	NOMENCLATURE							
1.1	Solid Propulsion Segment	(506.392)						
1.1.3	SRB Refurbishment Operations	(154.240)						
1.1.3.1	SRM (Thiokol)	49.678	P(SCP)	POP 81-2				
1.1.3.2	SRB Subassembly (USBI)	104.562	P(SCP)	POP 81-2				
1.1.4	SRB Support Services	(352.152)						
1.1.4.1	SRM (Thiokol)	220.966	P(SCP)	POP 81-2				
1.1.4.2	SRB Subassembly (USBI)	104.788	P(SCP)	POP 81-2				
1.1.4.3	Project (USBI)	26.398	P(SCP)	POP 81-2				
1.3	Propulsion/Avionics Module Segment	(1719.220)						
1.3.2	P/A Software	(231.820)						
1.3.2.1	Avionics Software	231.820	P(PS)					
1.3.4	P/A Refurbishment Operations	1487.400	A	X-15	1.0			Ratio of refurbishment cost to unit cost.
1.4	Payload Module Segment	(42.612)						
1.4.2	P/M Services	(42.612)						
1.4.2.2	Payload Integration	42.612	P(SCP)	POP 81-2				
1.6	KSC Launch Segment	(2159.487)						
1.6.4	KSC Services	(585.387)						
1.6.4.1	KSC Program Management	74.844	P(SCP)	POP 81-2				
1.6.4.2	KSC Sustaining Engineering	48.510	P(SCP)	POP 81-2				
1.6.4.3	KSC Institutional Costs	462.033	P(SCP)	POP 81-2				
1.6.5	Launch Site Operations	(1574.100)						
1.6.5.1	Propellants	136.026	P(SCP)	POP 81-2				
1.6.5.2	Launch Operations	738.936	P(SCP)	POP 81-2				

DATA FORM C

COST ESTIMATING METHODOLOGY AND TECHNICAL CHARACTERISTICS

CONFIGURATION Martin Class 1 (Operations)

WBS IDENTIFICATION		COST EST	TYPE EST	HISTORICAL DATA USED	COMPLEXITY FACTOR	QUANTITY OR VALUE	KEY TECH CHARACTERISTIC	REMARKS
NUMBER	NOMENCLATURE							
1.6.5.3	Launch Support	360.261	P(SCP)	POP 81-2				
1.6.5.4	Transportation	41.976	P(SCP)	POP 81-2				
1.6.5.5	Base Maintenance	296.901	P(SCP)	POP 81-2				
1.7	VAFB Launch Segment	(1554.175)						
1.7.4	VAFB Services	(455.350)						
1.7.4.1	VAFB Program Management	3.290	P(SCP)	POP 81-2				
1.7.4.2	VAFB Sustaining Engineering	100.310	P(SCP)	POP 81-2				
1.7.4.3	VAFB Institutional Costs	351.750	P(SCP)	POP 81-2				
1.7.5	Launch Site Operations	(1098.823)						
1.7.5.1	Propellants	59.500	P(SCP)	POP 81-2				
1.7.5.2	Launch Operations	733.705	P(SCP)	POP 81-2				
1.7.5.3	Launch Support	27.860	P(SCP)	POP 81-2				
1.7.5.4	Transportation	66.395	P(SCP)	POP 81-2				
1.7.5.5	Base Maintenance	211.365	P(SCP)	POP 81-2				
1.8	Flight Segment	(334.598)						
1.8.2	Flight Operations Services	(24.388)						
1.8.2.1	Flight Planning	24.388	P(SCP)	POP 81-2				
1.8.3	Flight Operations	(296.408)						
1.8.3.1	MCC Operations	197.918	P(SCP)	POP 81-2				
1.8.3.2	Network Operations	86.832	P(SCP)	POP 81-2				
1.8.3.3	Network Institutional Costs	11.658	P(SCP)	POP 81-2				
1.8.4	Recovery Site Operations	(13.802)						
1.8.4.1	Recovery Operations	10.586	P(SCP)	POP 81-2				
1.8.4.2	Recovery Site Institutional Costs	3.216	P(SCP)	POP 81-2				

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DATA FORM C

COST ESTIMATING METHODOLOGY AND TECHNICAL CHARACTERISTICS

CONFIGURATION Martin Class I (Operations)

WBS IDENTIFICATION		COST EST	TYPE EST	HISTORICAL DATA USED	COMPLEXITY FACTOR	QUANTITY OR VALUE	KEY TECH CHARACTERISTIC	REMARKS
NUMBER	NOMENCLATURE							
1.9	System-Level Integration Segment	(1425.358)						
1.9.2	NASA Headquarters Management and Support	(112.426)						
1.9.2.1	Headquarters Contract Administration	77.720	P(SCP)	POP 81-2				
1.9.2.2	Headquarters Institutional Costs	34.706	P(SCP)	POP 81-2				
1.9.3	NASA JSC Management and Support	(1078.258)						
1.9.3.1	JSC Program Management	622.728	P(SCP)	POP 81-2				
1.9.3.2	JSC Institutional Costs	441.530	P(SCP)	POP 81-2				
1.9.4	NASA MSFC Management and Support	(242.674)						
1.9.4.1	MSFC Program Management	77.184	P(SCP)	POP 81-2				
1.9.4.2	MSFC Institutional Costs	165.490	P(SCP)	POP 81-2				

6. FUNDING PROFILES (FORM 'D' REPORTS)

This section presents funding profiles for level 2 WBS items in the SDLV life cycle costs. These profiles are reported in NASA Form D reports per Data Requirements document MF003M. These costs were generated using the RCA PRICE 'A' resource allocation model and the spread factors as shown in Form A reports (Section 4).

DATA FORM D

CONFIGURATION Martin Class I (Lifting Reentry)
COST UNITS $ Millions, 1982

TOTAL PROGRAM FUNDING SCHEDULES

NONRECURRING (DDT&E) X
RECURRING (PRODUCTION)
RECURRING (OPERATIONS)

WBS IDENTIFICATION		TOTAL COST AT COMPLETION	FISCAL YEAR													
NUMBER	NOMENCLATURE		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1.1	Solid Propulsion Segment	24.8				5.4	12.2	6.9	0.3								
1.2	Liquid Propulsion Segment	21.6				3.0	10.7	7.6	0.3								
1.3	Propulsion/Avionics Module Segment	1538.6	22.3	165.0	299.0	389.5	396.9	252.2	13.7								
1.4	Payload Module Segment	255.9			25.6	67.7	90.4	68.1	4.1								
1.6	KSC Launch Segment	166.3	5.6	33.2	43.9	40.3	29.0	13.7	0.6								
1.7	VAFB Launch Segment	78.9	1.1	8.5	15.3	20.0	20.4	12.9	0.7								
1.8	Flight Segment	49.3	1.5	9.2	12.4	11.7	8.9	4.9	0.7								
1.9	System-Level Integration Segment	122.3	1.6	12.1	22.0	29.1	30.8	22.9	3.8								

DATA FORM D

CONFIGURATION Martin Class 1 (Lifting Reentry)
COST UNITS $ Millions, 1982

TOTAL PROGRAM FUNDING SCHEDULES

NONRECURRING (DDT&E) ____
RECURRING (PRODUCTION) X
RECURRING (OPERATIONS) ____

WBS IDENTIFICATION		TOTAL COST AT COMPLETION	FISCAL YEAR														
NUMBER	NOMENCLATURE		1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
1.1	Solid Propulsion Segment	2115.2	6.3	122.6	215.0	252.5	263.0	264.4	264.1	259.8	238.6	177.8	51.2				
1.2	Liquid Propulsion Segment	2243.8	6.7	130.0	228.0	267.8	279.0	280.5	280.2	275.6	253.1	188.6	54.3				
1.3	Propulsion/Avionics Module Segment	1335.9	98.2	495.1	484.2	246.9	11.5										
1.4	Payload Module Segment	2811.6	11.5	97.5	199.1	290.1	359.0	397.8	402.2	371.7	309.8	223.3	123.1	26.4			
1.9	System-Level Integration Segment	666.9		12.4	44.6	62.1	69.7	72.1	72.5	72.5	72.1	69.7	62.1	44.6	12.4		

DATA FORM D

CONFIGURATION Martin Class 1 (Lifting Reentry)
COST UNITS $ Millions, 1982

TOTAL PROGRAM FUNDING SCHEDULES

NONRECURRING (DDT&E) _____
RECURRING (PRODUCTION) _____
RECURRING (OPERATIONS) X

WBS IDENTIFICATION		TOTAL COST AT COMPLETION	FISCAL YEAR														
NUMBER	NOMENCLATURE		1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
1.1	Solid Propulsion Segment	506.4				14.7	43.7	57.2	61.8	62.7	62.8	62.4	59.8	50.8	28.9	1.5	
1.3	Propulsion/Avionics Module Segment	1719.2				49.8	148.5	194.2	209.8	213.0	213.1	211.9	203.2	172.6	98.2	5.0	
1.4	Payload Module Segment	42.6				1.2	3.7	4.8	5.2	5.3	5.3	5.3	5.0	4.3	2.4	0.1	
1.6	KSC Launch Segment	2159.5				62.5	186.5	243.9	263.6	267.5	267.7	266.2	255.2	216.8	123.3	6.3	
1.7	VAFB Launch Segment	1554.2				45.0	134.2	175.5	189.7	192.5	192.6	191.6	183.7	156.0	88.8	4.5	
1.8	Flight Segment	334.6				9.7	28.9	37.8	40.8	41.4	41.5	41.2	39.5	33.6	19.1	1.0	
1.9	System-Level Integration Segment	1425.4				41.3	123.1	161.0	174.0	176.6	176.7	175.7	168.4	143.1	81.4	4.2	

7. GOVERNMENT SUPPORT REQUIREMENTS (FORM 'E' REPORTS)

This section presents the requirements, by program phase, for NASA and other Government support of the SDLV program. Costs are reported in Forms E per Data Requirements document MF003M. Each form covers one phase of the SDLV life cycle.

DATA FORM E

SUMMARY OF NASA SUPPORT REQUIREMENTS

CONFIGURATION Martin Class 1 (DDT & E)

WBS IDENTIFICATION		TYPE OF SUPPORT	UNITS OF MEASUREMENT	INCLUDED IN COST EST		REMARKS
NUMBER	NOMENCLATURE			YES	NO	
1.6.4	KSC Services	Civil Service Manpower	$7.711 M Labor	X		Associated with first SDLV launch
1.8.3.2	Network Operations	Tracking & Data Relay Services	$1.123 M Services	X		Associated with first SDLV launch
1.8.4	Recovery Site Operations	Civil Service Manpower	$0.157 M Labor	X		Associated with first SDLV flight
1.9.2.1	NASA Headquarters Contract Administration	Civil Service Manpower	$18.061 M Labor		X	Associated with SDLV development. ROM only.
1.9.2.2	NASA Headquarters Institutional Costs	Civil Service Manpower	$16.230 M Labor		X	Associated with SDLV development. ROM only.
1.9.3.1	NASA JSC Program Management	Civil Service Manpower	$88.080 M Labor		X	Associated with SDLV development. ROM only.
1.9.3.2	NASA JSC Institutional Costs	Civil Service Manpower	$106.050 M Labor		X	Associated with SDLV development. ROM only.
1.9.4.1	NASA MSFC Program Management	Civil Service Manpower	$67.230 M Labor		X	Associated with SDLV development. ROM only.
1.9.4.2	NASA MSFC Institutional Costs	Civil Service Manpower	$78.840 M Labor		X	Associated with SDLV development. ROM only.

DATA FORM E

SUMMARY OF NASA SUPPORT REQUIREMENTS

CONFIGURATION Martin Class 1 (Production)

WBS IDENTIFICATION		TYPE OF SUPPORT	UNITS OF MEASUREMENT	INCLUDED IN COST EST		REMARKS
NUMBER	NOMENCLATURE			YES	NO	
1.9.2.1	NASA Headquarters Contract Administration	Civil Service Manpower	$71.787 M Labor		X	Associated with SDLV production. ROM only.
1.9.2.2	NASA Headquarters Institutional Costs	Civil Service Manpower	$10.820 M Labor		X	Associated with SDLV production. ROM only.
1.9.3.1	NASA JSC Program Management	Civil Service Manpower	$58.720 M Labor		X	Associated with SDLV production. ROM only.
1.9.3.2	NASA JSC Institutional Costs	Civil Service Manpower	$70.700 M Labor		X	Associated with SDLV production. ROM only.
1.9.4.1	NASA MSFC Program Management	Civil Service Manpower	$44.820 M Labor		X	Associated with SDLV production. ROM only.
1.9.4.2	NASA MSFC Institutional Costs	Civil Service Manpower	$52.560 M Labor		X	Associated with SDLV production. ROM only.

DATA FORM E

SUMMARY OF MACS SUPPORT REQUIREMENTS

CONFIGURATION Martin Class 1 (Operations)

WBS IDENTIFICATION		TYPE OF SUPPORT	UNITS OF MEASUREMENT	INCLUDED IN COST EST		REMARKS
NUMBER	NOMENCLATURE			YES	NO	
1.6.4.1	KSC Program Management	Civil Service Manpower	$74.844 M Labor	X		
1.6.4.2	KSC Sustaining Engineering	Civil Service Manpower	$48.510 M Labor	X		
1.6.4.3	KSC Institutional Costs	Civil Service Manpower	$462.033 M Labor	X		
1.7.4.1	VAFB Program Management	Civil Service Manpower	$3.290 M Labor	X		
1.7.4.2	VAFB Sustaining Engineering	Aerospace Corp. Manpower	$100.310 M Labor	X		
1.7.4.3	VAFB Institutional Costs	Civil Service Manpower	$351.750 M Labor	X		
1.8.3.2	Network Operations	Tracking & Data Relay Services	$86.832 M Services	X		
1.8.3.3	Network Institutional Costs	Civil Service Manpower	$11.658 M Labor	X		
1.8.4.1	Recovery Operations	Civil Service Manpower	$10.586 M Labor	X		
1.8.4.2	Recovery Site Institutional Costs	Civil Service Manpower	$3.216 M Labor	X		
1.9.2.1	NASA Headquarters Contract Administration	Civil Service Manpower	$77.720 M Labor	X		
1.9.2.2	NASA Headquarters Institutional Costs	Civil Service Manpower	$34.706 M Labor	X		
1.9.3.1	NASA JSC Program Management	Civil Service Manpower	$628.728 M Labor	X		
1.9.3.2	NASA JSC Institutional Costs	Civil Service Manpower	$441.530 M Labor	X		
1.9.4.1	NASA MSFC Program Management	Civil Service Manpower	$77.184 M Labor	X		
1.9.4.2	NASA MSFC Institutional Costs	Civil Service Manpower	$165.490 M Labor	X		

APPENDIX A

DETAILED PRICE MODEL OUTPUTS

A.1 PROPULSION/AVIONICS MODULE

This section of Appendix A presents the detailed output reports produced by the PRICE 84 hardware cost model in estimating development and production costs for the SDLV Propulsion/Avionics Module. These hardware costs all pertain to WBS 1.3.1, P/A Module Hardware. This section is organized as follows:

WBS 1.3.1.1	Integration, Assembly and Test
WBS 1.3.1.2	Structures Subsystem
WBS 1.3.1.3	Thermal Subsystem
WBS 1.3.1.4	Main Engines (SSME)
WBS 1.3.1.5	Propulsion Systems
WBS 1.3.1.6	Auxiliary Systems
WBS 1.3.1.7	Guidance & Navigation Subsystem
WBS 1.3.1.8	Data Management Subsystem
WBS 1.3.1.9	TT&C Subsystem
WBS 1.3.1.10	Power Generation Subsystem
WBS 1.3.1.11	Power Distribution Subsystem

WBS 1.3.1.1

P/A MODULE INTEGRATION, ASSEMBLY & TEST

- - - PRICE 84 - - -
INTEGRATION AND TEST

DATE 7-SEP-82 TIME 21:01 (282144) FILENAME: ITPA2.DAT

PROPULSION/AVIONICS MODULE

PRODUCTION QUANTITY	3	INT WEIGHT	2297.589*	MODE	5
PROTOTYPE QUANTITY	1.250	INT VOLUME	149.995*	QUANTITY/NHA	1

UNIT PROD COST 5210.88 MONTHLY PROD RATE 0.01

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	17420.	2181.	19601.
DESIGN	63171.	9366.	72537.
SYSTEMS	5245.	-	5245.
PROJECT MGMT	28878.	12728.	41402.
DATA	2627.	9065.	11692.
SUBTOTAL(ENG)	117138.	33338.	150476.
MANUFACTURING			
PRODUCTION	-	15632.	15632.
PROTOTYPE	11507.	-	11507.
TOOL-TEST EQ	1312.	54.	1366.
SUBTOTAL(MFG)	12819.	15686.	28506.
TOTAL COST	129957.	49024.	178982.

DESIGN FACTORS	ELECTRONIC	MECHANICAL	PRODUCT DESCRIPTORS	
WEIGHT	47.658*	2249.931*	ENGINEERING COMPLEXITY	0.900*
DENSITY	35.000*	15.000*	PROTOTYPE SUPPORT	1.0
MFG. COMPLEXITY	9.126*	8.083*	PROTO SCHEDULE FACTOR	.250*
NEW DESIGN	1.000	1.000	ELECT VOL FRACTION	.009
DESIGN REPEAT	0.000	0.000	PLATFORM	2.500
EQUIPMENT CLASS	*****	*****	YEAR OF TECHNOLOGY	1978
ENGINEERING CHANGES	.089*	.051*	RELIABILITY FACTOR	1.0
INTEGRATION LEVEL	0.0	1.0	MTBF(FIELD)	9378*

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(20)	JAN 87	(50)	MAR 91	(70)
PRODUCTION	JAN 87	(29)	MAY 89*	(133)	JUN 00	(162)

SUPPLEMENTAL INFORMATION

YEAR OF ECONOMICS	1982	TOOLING & PROCESS FACTORS	
ESCALATION	0.00	DEVELOPMENT TOOLING	1.00*
AMORTIZED UNIT COST	16341.44*	PRODUCTION TOOLING	1.00*
DEV COST MULTIPLIER	1.35		
PROD COST MULTIPLIER	1.35		

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	117478.	43989.	161468.
CENTER	129957.	49024.	178982.
TO	144486.	53781.	198267.

WBS 1.3.1.2

P/A MODULE STRUCTURES SUBSYSTEM

- - - PRICE 84 - - -
MECHANICAL ITEM

DATE 7-SEP-82 TIME 21:00 (282144) FILENAME: SDST2.DAT

STRUCTURE,THRUST

PRODUCTION QUANTITY	3	UNIT WEIGHT	3496.00	MODE	2
PROTOTYPE QUANTITY	1.250	UNIT VOLUME	97.00	QUANTITY/NHA	1

UNIT PROD COST11612.84 COST PROCESS FACTOR 1 MONTHLY PROD RATE 0.59

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	3804.	246.	3850.
DESIGN	12917.	1059.	13976.
SYSTEMS	2444.	-	2444.
PROJECT MGMT	15213.	8945.	24158.
DATA	1625.	5108.	6734.
SUBTOTAL(ENG)	35804.	15358.	51162.
MANUFACTURING			
PRODUCTION	-	34838.	34838.
PROTOTYPE	25169.	-	25169.
TOOL-TEST EQ	11094.	13039.	24133.
SUBTOTAL(MFG)	36263.	47877.	84140.
TOTAL COST	72066.	63235.	135302.

DESIGN FACTORS	MECHANICAL
WEIGHT	3496.000
DENSITY	36.041*
MFG. COMPLEXITY	8.450
NEW DESIGN	1.000
DESIGN REPEAT	0.853*
EQUIPMENT CLASS	*****
ENGINEERING CHANGES	.048*
INTEGRATION LEVEL	1.0

PRODUCT DESCRIPTORS	
ENGINEERING COMPLEXITY	1.300
PROTOTYPE SUPPORT	1.0
PROTO SCHEDULE FACTOR	.250*
PLATFORM	2.500
YEAR OF TECHNOLOGY	1976
RELIABILITY FACTOR	1.0
MTBF(FIELD)	5466*

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(18)	NOV 86*	(2)	JAN 87*	(20)
PRODUCTION	JAN 88	(28)	APR 90*	(3)	JUL 90*	(31)

SUPPLEMENTAL INFORMATION	
YEAR OF ECONOMICS	1982
ESCALATION	0.00
T-1 COST	13051.21*
AMORTIZED UNIT COST	21078.45*
DEV COST MULTIPLIER	1.35
PROD COST MULTIPLIER	1.35

TOOLING & PROCESS FACTORS	
DEVELOPMENT TOOLING	M.500
PRODUCTION TOOLING	M.500
RATE TOOLING	0
PRICE IMPROVEMENT FACTOR	******
UNIT LEARNING CURVE	.867*

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	63208.	54895.	118104.
CENTER	72066.	63235.	135302.
TO	82156.	71047.	153203.

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MECHANICAL ITEM

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STRUCTURE,BODY

PRODUCTION QUANTITY	3	UNIT WEIGHT	3519.00	MODE	2
PROTOTYPE QUANTITY	1.250	UNIT VOLUME	97.00	QUANTITY/NHA	1

UNIT PROD COST 7462.80 COST PROCESS FACTOR 1 MONTHLY PROD RATE 0.68

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	3241.	182.	3423.
DESIGN	11429.	742.	12171.
SYSTEMS	2252.	-	2252.
PROJECT MGMT	12409.	6119.	18528.
DATA	1388.	3500.	4888.
SUBTOTAL(ENG)	30718.	10542.	41261.
MANUFACTURING			
PRODUCTION	-	22388.	22388.
PROTOTYPE	17055.	-	17055.
TOOL-TEST EQ	8312.	9765.	18077.
SUBTOTAL(MFG)	25367.	32153.	57520.
TOTAL COST	56085.	42696.	98781.

DESIGN FACTORS	MECHANICAL
WEIGHT	3519.000
DENSITY	36.278*
MFG. COMPLEXITY	8.130
NEW DESIGN	1.000
DESIGN REPEAT	0.842*
EQUIPMENT CLASS	*****
ENGINEERING CHANGES	.038*
INTEGRATION LEVEL	1.0

PRODUCT DESCRIPTORS	
ENGINEERING COMPLEXITY	1.300
PROTOTYPE SUPPORT	1.0
PROTO SCHEDULE FACTOR	.250*
PLATFORM	2.500
YEAR OF TECHNOLOGY	1976
RELIABILITY FACTOR	1.0
MTBF(FIELD)	6173*

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(17)	OCT 86*	(2)	DEC 86*	(19)
PRODUCTION	JAN 88	(26)	FEB 90*	(3)	MAY 90*	(29)

SUPPLEMENTAL INFORMATION

YEAR OF ECONOMICS	1982	DEVELOPMENT TOOLING	M.500
ESCALATION	0.00	PRODUCTION TOOLING	M.500
T-1 COST	8356.68*	RATE TOOLING	0
AMORTIZED UNIT COST	14231.98*	PRICE IMPROVEMENT FACTOR	******
DEV COST MULTIPLIER	1.35	UNIT LEARNING CURVE	.871*
PROD COST MULTIPLIER	1.35		

TOOLING & PROCESS FACTORS

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	49170.	37037.	86207.
CENTER	56085.	42696.	98781.
TO	64298.	48291.	112587.

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MECHANICAL ITEM

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STRUCTURE, INTERNAL

PRODUCTION QUANTITY	3	UNIT WEIGHT	4276.00	MODE	2
PROTOTYPE QUANTITY	1.250	UNIT VOLUME	97.00	QUANTITY/NHA	1

UNIT PROD COST 8855.42 COST PROCESS FACTOR 1 MONTHLY PROD RATE 0.64

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	3686.	211.	3897.
DESIGN	12998.	850.	13847.
SYSTEMS	2561.	-	2561.
PROJECT MGMT	14500.	7310.	21809.
DATA	1610.	4181.	5791.
SUBTOTAL(ENG)	35353.	12552.	47904.
MANUFACTURING			
PRODUCTION	-	26568.	26568.
PROTOTYPE	20267.	-	20267.
TOOL-TEST EQ	10206.	11887.	22093.
SUBTOTAL(MFG)	30474.	38453.	68927.
TOTAL COST	65826.	51005.	116831.

DESIGN FACTORS	MECHANICAL	PRODUCT DESCRIPTORS	
WEIGHT	4276.000	ENGINEERING COMPLEXITY	1.300
DENSITY	44.082*	PROTOTYPE SUPPORT	1.0
MFG. COMPLEXITY	8.130	PROTO SCHEDULE FACTOR	.250*
NEW DESIGN	1.000	PLATFORM	2.500
DESIGN REPEAT	0.843*	YEAR OF TECHNOLOGY	1976
EQUIPMENT CLASS	*****	RELIABILITY FACTOR	1.0
ENGINEERING CHANGES	.038*	MTBF(FIELD)	5823*
INTEGRATION LEVEL	1.0		

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(17)	OCT 88*	(2)	DEC 88*	(19)
PRODUCTION	JAN 88	(26)	FEB 90*	(4)	JUN 90*	(30)

SUPPLEMENTAL INFORMATION		TOOLING & PROCESS FACTORS	
YEAR OF ECONOMICS	1982	DEVELOPMENT TOOLING	M.500
ESCALATION	0.00	PRODUCTION TOOLING	M.500
T-1 COST	9920.72*	RATE TOOLING	0
AMORTIZED UNIT COST	17001.53*	PRICE IMPROVEMENT FACTOR	******
DEV COST MULTIPLIER	1.35	UNIT LEARNING CURVE	.871*
PROD COST MULTIPLIER	1.35		

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	57588.	44139.	101727.
CENTER	65826.	51005.	116831.
TO	75668.	57898.	133566.

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INTEGRATION AND TEST

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STRUCTURES INTEG/ASSY/TEST

PRODUCTION QUANTITY	3	INT WEIGHT	852.465*	MODE	5
PROTOTYPE QUANTITY	1.250	INT VOLUME	56.831*	QUANTITY/NHA	1

UNIT PROD COST 1309.97 MONTHLY PROD RATE 0.09

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	8302.	278.	8580.
DESIGN	29008.	1141.	30149.
SYSTEMS	2401.	-	2401.
PROJECT MGMT	11779.	1430.	13209.
DATA	1029.	874.	1903.
SUBTOTAL(ENG)	52519.	3723.	58242.
MANUFACTURING			
PRODUCTION	-	3930.	3930.
PROTOTYPE	4538.	-	4538.
TOOL-TEST EQ	437.	22.	459.
SUBTOTAL(MFG)	4976.	3952.	8927.
TOTAL COST	57495.	7675.	65169.

DESIGN FACTORS	MECHANICAL	PRODUCT DESCRIPTORS	
WEIGHT	852.465*	ENGINEERING COMPLEXITY	1.000*
DENSITY	15.000*	PROTOTYPE SUPPORT	1.0
MFG. COMPLEXITY	7.811*	PROTO SCHEDULE FACTOR	.250*
NEW DESIGN	1.000	PLATFORM	2.500
DESIGN REPEAT	0.000	YEAR OF TECHNOLOGY	1978
EQUIPMENT CLASS	*****	RELIABILITY FACTOR	1.0
ENGINEERING CHANGES	.028*	MTBF(FIELD)	10738*
INTEGRATION LEVEL	2.0		

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(32)	JAN 88	(38)	MAR 91	(70)
PRODUCTION	JAN 88	(19)	JUL 89*	(23)	JUN 91	(42)

SUPPLEMENTAL INFORMATION		TOOLING & PROCESS FACTORS	
YEAR OF ECONOMICS	1982	DEVELOPMENT TOOLING	1.00*
ESCALATION	0.00	PRODUCTION TOOLING	1.00*
AMORTIZED UNIT COST	2558.20*		
DEV COST MULTIPLIER	1.35		
PROD COST MULTIPLIER	1.35		

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	52094.	6765.	58859.
CENTER	57495.	7675.	65169.
TO	65178.	8581.	73737.

WBS 1.3.1.3

P/A MODULE THERMAL SUBSYSTEM

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MECHANICAL ITEM

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THERM.PROTECTION SYSTEM

PRODUCTION QUANTITY	3	UNIT WEIGHT	5295.00	MODE	2
PROTOTYPE QUANTITY	1.250	UNIT VOLUME	50.00	QUANTITY/NHA	1

UNIT PROD COST24121.14 COST PROCESS FACTOR 1 MONTHLY PROD RATE 0.50

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	6877.	470.	7347.
DESIGN	28569.	1962.	28530.
SYSTEMS	6332.	-	6332.
PROJECT MGMT	36660.	13302.	49962.
DATA	4424.	7587.	12011.
SUBTOTAL(ENG)	80862.	23320.	104182.
MANUFACTURING			
PRODUCTION	-	72363.	72363.
PROTOTYPE	55547.	-	55547.
TOOL-TEST EQ	8536.	427.	8963.
SUBTOTAL(MFG)	64083.	72791.	136873.
TOTAL COST	144944.	96111.	241055.

DESIGN FACTORS	MECHANICAL	PRODUCT DESCRIPTORS	
WEIGHT	5295.000	ENGINEERING COMPLEXITY	1.600
DENSITY	105.900*	PROTOTYPE SUPPORT	1.0
MFG. COMPLEXITY	8.740	PROTO SCHEDULE FACTOR	.250*
NEW DESIGN	1.000	PLATFORM	2.500
DESIGN REPEAT	0.853*	YEAR OF TECHNOLOGY	1976
EQUIPMENT CLASS	*****	RELIABILITY FACTOR	1.0
ENGINEERING CHANGES	.056*	MTBF(FIELD)	4332*
INTEGRATION LEVEL	1.0		

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(23)	APR 87*	(3)	JUL 87*	(26)
PRODUCTION	JAN 88	(32)	AUG 90*	(4)	DEC 90*	(36)

SUPPLEMENTAL INFORMATION		TOOLING & PROCESS FACTORS	
YEAR OF ECONOMICS	1982	DEVELOPMENT TOOLING	1.00*
ESCALATION	0.00	PRODUCTION TOOLING	1.00*
T-1 COST	27214.41*	RATE TOOLING	0
AMORTIZED UNIT COST	32037.01*	PRICE IMPROVEMENT FACTOR	******
DEV COST MULTIPLIER	1.35	UNIT LEARNING CURVE	.863*
PROD COST MULTIPLIER	1.35		

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	128834.	81376.	208010.
CENTER	144944.	96111.	241055.
TO	166159.	110630.	276789.

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MECHANICAL ITEM

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ACTIVE THERM.CONT.SYSTEM

PRODUCTION QUANTITY	3	UNIT WEIGHT	1126.00	MODE	2
PROTOTYPE QUANTITY	1.250	UNIT VOLUME	11.00	QUANTITY/NHA	1

UNIT PROD COST 2298.30 COST PROCESS FACTOR 1 MONTHLY PROD RATE 0.87

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	1488.	94.	1582.
DESIGN	4813.	351.	5163.
SYSTEMS	694.	-	694.
PROJECT MGMT	2851.	1363.	4215.
DATA	311.	780.	1091.
SUBTOTAL(ENG)	10157.	2588.	12745.
MANUFACTURING			
PRODUCTION	-	6895.	6895.
PROTOTYPE	4700.	-	4700.
TOOL-TEST EQ	539.	61.	600.
SUBTOTAL(MFG)	5239.	6956.	12195.
TOTAL COST	15397.	9544.	24940.

DESIGN FACTORS	MECHANICAL	PRODUCT DESCRIPTORS	
WEIGHT	1126.000	ENGINEERING COMPLEXITY	1.000
DENSITY	102.364*	PROTOTYPE SUPPORT	1.0
MFG. COMPLEXITY	8.000	PROTO SCHEDULE FACTOR	.250*
NEW DESIGN	1.000	PLATFORM	2.500
DESIGN REPEAT	0.773*	YEAR OF TECHNOLOGY	1976
EQUIPMENT CLASS	*****	RELIABILITY FACTOR	1.0
ENGINEERING CHANGES	.037*	MTBF(FIELD)	9149*
INTEGRATION LEVEL	1.0		

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(13)	JUN 86*	(2)	AUG 86*	(15)
PRODUCTION	JAN 88	(21)	SEP 89*	(2)	NOV 89*	(23)

SUPPLEMENTAL INFORMATION		TOOLING & PROCESS FACTORS	
YEAR OF ECONOMICS	1982	DEVELOPMENT TOOLING	1.00*
ESCALATION	0.00	PRODUCTION TOOLING	1.00*
T-1 COST	2562.57*	RATE TOOLING	0
AMORTIZED UNIT COST	3181.17*	PRICE IMPROVEMENT FACTOR	******
DEV COST MULTIPLIER	1.35	UNIT LEARNING CURVE	.876*
PROD COST MULTIPLIER	1.35		

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	13643.	8075.	21718.
CENTER	15397.	9544.	24940.
TO	17848.	11168.	29016.

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INTEGRATION AND TEST

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THERMAL SUBSYS.INTEG/ASSY/TEST

PRODUCTION QUANTITY	3	INT WEIGHT	508.745*	MODE	5
PROTOTYPE QUANTITY	1.250	INT VOLUME	33.916*	QUANTITY/NHA	1

UNIT PROD COST 1412.00 MONTHLY PROD RATE 0.09

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	7083.	290.	7352.
DESIGN	25205.	1267.	26473.
SYSTEMS	2058.	-	2058.
PROJECT MGMT	9984.	1478.	11461.
DATA	869.	895.	1764.
SUBTOTAL(ENG)	45178.	3930.	49108.
MANUFACTURING			
PRODUCTION	-	4236.	4236.
PROTOTYPE	4440.	-	4440.
TOOL-TEST EQ	465.	24.	489.
SUBTOTAL(MFG)	4905.	4260.	9165.
TOTAL COST	50081.	8190.	58271.

DESIGN FACTORS	MECHANICAL	PRODUCT DESCRIPTORS	
WEIGHT	508.745*	ENGINEERING COMPLEXITY	1.000*
DENSITY	15.000*	PROTOTYPE SUPPORT	1.0
MFG. COMPLEXITY	8.196*	PROTO SCHEDULE FACTOR	.250*
NEW DESIGN	1.000	PLATFORM	2.500
DESIGN REPEAT	0.000	YEAR OF TECHNOLOGY	1978
EQUIPMENT CLASS	*****	RELIABILITY FACTOR	1.0
ENGINEERING CHANGES	.035*	MTBF(FIELD)	10748*
INTEGRATION LEVEL	2.0		

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(32)	JAN 88	(38)	MAR 91	(70)
PRODUCTION	JAN 88	(20)	AUG 89*	(22)	JUN 91	(42)

SUPPLEMENTAL INFORMATION		TOOLING & PROCESS FACTORS	
YEAR OF ECONOMICS	1982	DEVELOPMENT TOOLING	1.00*
ESCALATION	0.00	PRODUCTION TOOLING	1.00*
AMORTIZED UNIT COST	2730.09*		
DEV COST MULTIPLIER	1.35		
PROD COST MULTIPLIER	1.35		

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	45548.	7257.	52805.
CENTER	50081.	8190.	58271.
TO	56367.	9039.	65406.

WBS 1.3.1.4

P/A MODULE MAIN ENGINES (SSME)

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MECHANICAL ITEM

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MAIN ENGINES

PRODUCTION QUANTITY	9	UNIT WEIGHT	6974.00	MODE	2
PROTOTYPE QUANTITY	4.000	UNIT VOLUME	70.00	QUANTITY/NHA	3

UNIT PROD COST37434.74 COST PROCESS FACTOR 1 MONTHLY PROD RATE 0.61

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	194.	522.	716.
DESIGN	626.	2245.	2871.
SYSTEMS	47.	-	47.
PROJECT MGMT	44102.	56410.	100511.
DATA	2988.	31623.	34611.
SUBTOTAL(ENG)	47956.	90800.	138757.
MANUFACTURING			
PRODUCTION	-	336913.	336913.
PROTOTYPE	172318.	-	172318.
TOOL-TEST EQ	15723.	1328.	17052.
SUBTOTAL(MFG)	188041.	338241.	526282.
TOTAL COST	235997.	429041.	665039.

DESIGN FACTORS	MECHANICAL
WEIGHT	6974.000
DENSITY	99.629*
MFG. COMPLEXITY	8.950
NEW DESIGN	0.050
DESIGN REPEAT	0.867*
EQUIPMENT CLASS	*****
ENGINEERING CHANGES	.039*
INTEGRATION LEVEL	0.7

PRODUCT DESCRIPTORS	
ENGINEERING COMPLEXITY	0.700
PROTOTYPE SUPPORT	1.0
PROTO SCHEDULE FACTOR	.250*
PLATFORM	2.500
YEAR OF TECHNOLOGY	1978
RELIABILITY FACTOR	1.0
MTBF(FIELD)	3697*

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(10)	MAR 86*	(11)	FEB 87*	(21)
PRODUCTION	JAN 88	(35)	NOV 90*	(13)	DEC 91*	(48)

SUPPLEMENTAL INFORMATION

YEAR OF ECONOMICS	1982
ESCALATION	0.00
T-1 COST	50353.39*
AMORTIZED UNIT COST	47671.27*
DEV COST MULTIPLIER	1.35
PROD COST MULTIPLIER	1.35

TOOLING & PROCESS FACTORS	
DEVELOPMENT TOOLING	1.00*
PRODUCTION TOOLING	1.00*
RATE TOOLING	0
PRICE IMPROVEMENT FACTOR	******
UNIT LEARNING CURVE	.860*

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	203988.	362959.	586947.
CENTER	235997.	429041.	665039.
TO	267926.	492083.	760009.

WBS 1.3.1.5

P/A MODULE PROPULSION SYSTEMS

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MECHANICAL ITEM

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MAIN FEED SYS.

PRODUCTION QUANTITY	3	UNIT WEIGHT	4193.00	MODE	2
PROTOTYPE QUANTITY	1.250	UNIT VOLUME	130.00	QUANTITY/NHA	1

UNIT PROD COST 3780.93 COST PROCESS FACTOR 1 MONTHLY PROD RATE 0.82

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	381.	119.	501.
DESIGN	1078.	445.	1523.
SYSTEMS	106.	-	106.
PROJECT MGMT	2408.	2256.	4664.
DATA	225.	1295.	1520.
SUBTOTAL(ENG)	4198.	4115.	8313.
MANUFACTURING			
PRODUCTION	-	11343.	11343.
PROTOTYPE	7241.	-	7241.
TOOL-TEST EQ	594.	76.	670.
SUBTOTAL(MFG)	7835.	11419.	19254.
TOTAL COST	12034.	15534.	27568.

DESIGN FACTORS	MECHANICAL	PRODUCT DESCRIPTORS	
WEIGHT	4193.000	ENGINEERING COMPLEXITY	0.700
DENSITY	32.254*	PROTOTYPE SUPPORT	1.0
MFG. COMPLEXITY	.500	PROTO SCHEDULE FACTOR	.250*
NEW DESIGN	0.250	PLATFORM	2.500
DESIGN REPEAT	0.822*	YEAR OF TECHNOLOGY	1978
EQUIPMENT CLASS	*****	RELIABILITY FACTOR	1.0
ENGINEERING CHANGES	.030*	MTBF(FIELD)	7582*
INTEGRATION LEVEL	0.7		

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(8)	JAN 86*	(2)	MAR 86*	(10)
PRODUCTION	JAN 88	(22)	OCT 89*	(2)	DEC 89*	(24)

SUPPLEMENTAL INFORMATION		TOOLING & PROCESS FACTORS	
YEAR OF ECONOMICS	1982	DEVELOPMENT TOOLING	1.00*
ESCALATION	0.00	PRODUCTION TOOLING	1.00*
T-1 COST	4205.72*	RATE TOOLING	0
AMORTIZED UNIT COST	5177.95*	PRICE IMPROVEMENT FACTOR	******
DEV COST MULTIPLIER	1.35	UNIT LEARNING CURVE	.879*
PROD COST MULTIPLIER	1.35		

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	10493.	13194.	23687.
CENTER	12034.	15534.	27568.
TO	13831.	18118.	31949.

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MECHANICAL ITEM

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OMS ENGINES

PRODUCTION QUANTITY	6	UNIT WEIGHT	299.00	MODE	2
PROTOTYPE QUANTITY	3.000	UNIT VOLUME	70.00	QUANTITY/NHA	2

UNIT PROD COST 2438.53 COST PROCESS FACTOR 1' MONTHLY PROD RATE 0.92

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	24.	49.	74.
DESIGN	78.	263.	341.
SYSTEMS	6.	-	6.
PROJECT MGMT	2134.	2557.	4691.
DATA	148.	1442.	1589.
SUBTOTAL(ENG)	2390.	4311.	6701.
MANUFACTURING			
PRODUCTION	-	14631.	14631.
PROTOTYPE	8520.	-	8520.
TOOL-TEST EQ	802.	75.	877.
SUBTOTAL(MFG)	9322.	14707.	24028.
TOTAL COST	11711.	19018.	30729.

DESIGN FACTORS	MECHANICAL	PRODUCT DESCRIPTORS	
WEIGHT	299.000	ENGINEERING COMPLEXITY	0.700
DENSITY	4.371*	PROTOTYPE SUPPORT	1.0
MFG. COMPLEXITY	9.000	PROTO SCHEDULE FACTOR	.250*
NEW DESIGN	0.050	PLATFORM	2.500
DESIGN REPEAT	0.851*	YEAR OF TECHNOLOGY	1976
EQUIPMENT CLASS	*****	RELIABILITY FACTOR	1.0
ENGINEERING CHANGES	.039*	MTBF(FIELD)	9342*
INTEGRATION LEVEL	0.7		

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(11)	APR 86*	(8)	DEC 86*	(19)
PRODUCTION	JAN 88	(23)	NOV 89*	(5)	APR 90*	(28)

SUPPLEMENTAL INFORMATION		TOOLING & PROCESS FACTORS	
YEAR OF ECONOMICS	1982	DEVELOPMENT TOOLING	1.00*
ESCALATION	0.00	PRODUCTION TOOLING	1.00*
T-1 COST	3023.63*	RATE TOOLING	0
AMORTIZED UNIT COST	3169.59*	PRICE IMPROVEMENT FACTOR	******
DEV COST MULTIPLIER	1.35	UNIT LEARNING CURVE	.868*
PROD COST MULTIPLIER	1.35		

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	10464.	16781.	27245.
CENTER	11711.	19018.	30729.
TO	12742.	20676.	33418.

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MECHANICAL ITEM

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AUX.FEED SYS.

PRODUCTION QUANTITY	3	UNIT WEIGHT	4934.00	MODE	2
PROTOTYPE QUANTITY	1.250	UNIT VOLUME	12.00	QUANTITY/NHA	1

UNIT PROD COST 4354.29 COST PROCESS FACTOR 1 MONTHLY PROD RATE 0.79

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	357.	114.	471.
DESIGN	1009.	457.	1466.
SYSTEMS	100.	-	100.
PROJECT MGMT	2637.	2580.	5217.
DATA	241.	1480.	1722.
SUBTOTAL(ENG)	4344.	4631.	8975.
MANUFACTURING			
PRODUCTION	-	13063.	13063.
PROTOTYPE	8349.	-	8349.
TOOL-TEST EQ	654.	73.	727.
SUBTOTAL(MFG)	9003.	13136.	22139.
TOTAL COST	13347.	17767.	31114.

DESIGN FACTORS	MECHANICAL	PRODUCT DESCRIPTORS	
WEIGHT	4934.000	ENGINEERING COMPLEXITY	0.700
DENSITY	411.167*	PROTOTYPE SUPPORT	1.0
MFG. COMPLEXITY	7.500	PROTO SCHEDULE FACTOR	.250*
NEW DESIGN	0.250	PLATFORM	2.500
DESIGN REPEAT	0.851*	YEAR OF TECHNOLOGY	1976
EQUIPMENT CLASS	*****	RELIABILITY FACTOR	1.0
ENGINEERING CHANGES	.030*	MTBF(FIELD)	7220*
INTEGRATION LEVEL	0.7		

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(8)	JAN 86*	(2)	MAR 86*	(10)
PRODUCTION	JAN 88	(20)	NOV 89*	(2)	JAN 90*	(25)

SUPPLEMENTAL INFORMATION		TOOLING & PROCESS FACTORS	
YEAR OF ECONOMICS	1982	DEVELOPMENT TOOLING	1.00*
ESCALATION	0.00	PRODUCTION TOOLING	1.00*
T-1 COST	4845.42*	RATE TOOLING	0
AMORTIZED UNIT COST	5922.40*	PRICE IMPROVEMENT FACTOR	******
DEV COST MULTIPLIER	1.35	UNIT LEARNING CURVE	.878*
PROD COST MULTIPLIER	1.35		

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	11742.	15291.	27032.
CENTER	13347.	17767.	31114.
TO	15096.	20262.	35358.

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MECHANICAL ITEM

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OMS PROP.TKS.

PRODUCTION QUANTITY	12	UNIT WEIGHT	260.00	MODE	2
PROTOTYPE QUANTITY	5.000	UNIT VOLUME	26.00	QUANTITY/NHA	4

UNIT PROD COST 599.69 COST PROCESS FACTOR 1 MONTHLY PROD RATE 1.67

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	38.	21.	59.
DESIGN	119.	89.	208.
SYSTEMS	10.	-	10.
PROJECT MGMT	1123.	1249.	2371.
DATA	81.	700.	781.
SUBTOTAL(ENG)	1371.	2058.	3429.
MANUFACTURING			
PRODUCTION	-	7196.	7196.
PROTOTYPE	3713.	-	3713.
TOOL-TEST EQ	279.	41.	320.
SUBTOTAL(MFG)	3991.	7237.	11229.
TOTAL COST	5362.	9295.	14657.

DESIGN FACTORS	MECHANICAL	PRODUCT DESCRIPTORS	
WEIGHT	260.000	ENGINEERING COMPLEXITY	0.700
DENSITY	10.000*	PROTOTYPE SUPPORT	1.0
MFG. COMPLEXITY	8.000	PROTO SCHEDULE FACTOR	.250*
NEW DESIGN	0.100	PLATFORM	2.500
DESIGN REPEAT	0.785*	YEAR OF TECHNOLOGY	1976
EQUIPMENT CLASS	*****	RELIABILITY FACTOR	1.0
ENGINEERING CHANGES	.019*	MTBF(FIELD)	14202*
INTEGRATION LEVEL	0.7		

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(9)	FEB 86*	(11)	JAN 87*	(20)
PRODUCTION	JAN 88	(17)	MAY 89*	(7)	DEC 89*	(24)

SUPPLEMENTAL INFORMATION		TOOLING & PROCESS FACTORS	
YEAR OF ECONOMICS	1982	DEVELOPMENT TOOLING	1.00*
ESCALATION	0.00	PRODUCTION TOOLING	1.00*
T-1 COST	806.37*	RATE TOOLING	0
AMORTIZED UNIT COST	774.82*	PRICE IMPROVEMENT FACTOR	******
DEV COST MULTIPLIER	1.35	UNIT LEARNING CURVE	.880*
PROD COST MULTIPLIER	1.35		

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	4741.	8075.	12818.
CENTER	5362.	9295.	14657.
TO	5980.	10419.	16399.

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MECHANICAL ITEM

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OMS HE.TKS.

PRODUCTION QUANTITY	6	UNIT WEIGHT	279.00	MODE	2
PROTOTYPE QUANTITY	3.000	UNIT VOLUME	28.00	QUANTITY/NHA	2

UNIT PROD COST 209.19 COST PROCESS FACTOR 1 MONTHLY PROD RATE 1.98

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	29.	10.	39.
DESIGN	85.	37.	123.
SYSTEMS	8.	-	8.
PROJECT MGMT	331.	243.	574.
DATA	27.	138.	166.
SUBTOTAL(ENG)	481.	429.	910.
MANUFACTURING			
PRODUCTION	-	1255.	1255.
PROTOTYPE	915.	-	915.
TOOL-TEST EQ	64.	11.	75.
SUBTOTAL(MFG)	980.	1266.	2246.
TOTAL COST	1461.	1695.	3156.

DESIGN FACTORS	MECHANICAL	PRODUCT DESCRIPTORS	
WEIGHT	279.000	ENGINEERING COMPLEXITY	0.700
DENSITY	9.964*	PROTOTYPE SUPPORT	1.0
MFG. COMPLEXITY	7.000	PROTO SCHEDULE FACTOR	.250*
NEW DESIGN	0.100	PLATFORM	2.500
DESIGN REPEAT	0.722*	YEAR OF TECHNOLOGY	1978
EQUIPMENT CLASS	*****	RELIABILITY FACTOR	1.0
ENGINEERING CHANGES	.014*	MTBF(FIELD)	21318*
INTEGRATION LEVEL	0.7		

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(8)	JAN 86*	(6)	JUL 86*	(14)
PRODUCTION	JAN 88	(13)	JAN 89*	(3)	APR 89*	(16)

SUPPLEMENTAL INFORMATION		TOOLING & PROCESS FACTORS	
YEAR OF ECONOMICS	1982	DEVELOPMENT TOOLING	1.00*
ESCALATION	0.00	PRODUCTION TOOLING	1.00*
T-1 COST	249.29*	RATE TOOLING	0
AMORTIZED UNIT COST	282.49*	PRICE IMPROVEMENT FACTOR	******
DEV COST MULTIPLIER	1.35	UNIT LEARNING CURVE	.892*
PROD COST MULTIPLIER	1.35		

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	1285.	1462.	2747.
CENTER	1461.	1695.	3156.
TO	1660.	1946.	3608.

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MECHANICAL ITEM

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RCS PRIMARY THRSTRS

PRODUCTION QUANTITY	72	UNIT WEIGHT	23.96	MODE	2
PROTOTYPE QUANTITY	30.000	UNIT VOLUME	1.00	QUANTITY/NHA	24

UNIT PROD COST 754.75 COST PROCESS FACTOR 1 MONTHLY PROD RATE 3.32

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	10.	24.	35.
DESIGN	36.	130.	166.
SYSTEMS	2.	-	2.
PROJECT MGMT	4825.	6925.	11750.
DATA	298.	3768.	4064.
SUBTOTAL(ENG)	5170.	10847.	16017.
MANUFACTURING			
PRODUCTION	-	54342.	54342.
PROTOTYPE	18255.	-	18255.
TOOL-TEST EQ	1978.	185.	2164.
SUBTOTAL(MFG)	20233.	54527.	74760.
TOTAL COST	25403.	65375.	90777.

DESIGN FACTORS	MECHANICAL	PRODUCT DESCRIPTORS	
WEIGHT	23.960	ENGINEERING COMPLEXITY	0.700
DENSITY	23.960*	PROTOTYPE SUPPORT	1.0
MFG. COMPLEXITY	10.000	PROTO SCHEDULE FACTOR	.250*
NEW DESIGN	0.050	PLATFORM	2.500
DESIGN REPEAT	0.768*	YEAR OF TECHNOLOGY	1978
EQUIPMENT CLASS	*****	RELIABILITY FACTOR	1.0
ENGINEERING CHANGES	.040*	MTBF(FIELD)	14220*
INTEGRATION LEVEL	0.7		

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(12)	MAY 86*	(44)	JAN 90*	(56)
PRODUCTION	JAN 88	(19)	JUL 89*	(22)	MAY 91*	(41)

SUPPLEMENTAL INFORMATION		TOOLING & PROCESS FACTORS	
YEAR OF ECONOMICS	1982	DEVELOPMENT TOOLING	1.00*
ESCALATION	0.00	PRODUCTION TOOLING	1.00*
T-1 COST	1482.30*	RATE TOOLING	0
AMORTIZED UNIT COST	907.98*	PRICE IMPROVEMENT FACTOR	******
DEV COST MULTIPLIER	1.35	UNIT LEARNING CURVE	.865*
PROD COST MULTIPLIER	1.35		

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	22518.	57051.	79569.
CENTER	25403.	65375.	90777.
TO	27740.	71597.	99337.

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MECHANICAL ITEM

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RCS VERNIER THRSTRS.

PRODUCTION QUANTITY	12	UNIT WEIGHT	9.50	MODE	2
PROTOTYPE QUANTITY	5.000	UNIT VOLUME	0.50	QUANTITY/NHA	4

UNIT PROD COST 530.82 COST PROCESS FACTOR 1 MONTHLY PROD RATE 1.40

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	7.	17.	24.
DESIGN	22.	97.	120.
SYSTEMS	1.	-	1.
PROJECT MGMT	622.	1003.	1625.
DATA	40.	558.	598.
SUBTOTAL(ENG)	692.	1676.	2368.
MANUFACTURING			
PRODUCTION	-	6370.	6370.
PROTOTYPE	2624.	-	2624.
TOOL-TEST EQ	322.	48.	369.
SUBTOTAL(MFG)	2945.	6417.	9363.
TOTAL COST	3637.	8093.	11731.

DESIGN FACTORS	MECHANICAL	PRODUCT DESCRIPTORS	
WEIGHT	9.500	ENGINEERING COMPLEXITY	0.700
DENSITY	19.000*	PROTOTYPE SUPPORT	1.0
MFG. COMPLEXITY	10.500	PROTO SCHEDULE FACTOR	.250*
NEW DESIGN	0.050	PLATFORM	2.500
DESIGN REPEAT	0.761*	YEAR OF TECHNOLOGY	1976
EQUIPMENT CLASS	*****	RELIABILITY FACTOR	1.0
ENGINEERING CHANGES	.059*	MTBF(FIELD)	16055*
INTEGRATION LEVEL	0.7		

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(13)	JUN 86*	(15)	SEP 87*	(28)
PRODUCTION	JAN 88	(19)	JUL 89*	(8)	MAR 90*	(27)

SUPPLEMENTAL INFORMATION		TOOLING & PROCESS FACTORS	
YEAR OF ECONOMICS	1982	DEVELOPMENT TOOLING	1.00*
ESCALATION	0.00	PRODUCTION TOOLING	1.00*
T-1 COST	745.89*	RATE TOOLING	0
AMORTIZED UNIT COST	674.43*	PRICE IMPROVEMENT FACTOR	******
DEV COST MULTIPLIER	1.35	UNIT LEARNING CURVE	.863*
PROD COST MULTIPLIER	1.35		

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	3239.	7109.	10348.
CENTER	3637.	8093.	11731.
TO	3942.	8778.	12720.

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INTEGRATION AND TEST

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PROPULSION SYSTEM INTEG/ASSY/TEST

PRODUCTION QUANTITY	3	INT WEIGHT	1932.085*	MODE	5
PROTOTYPE QUANTITY	1.250	INT VOLUME	128.806*	QUANTITY/NHA	1

UNIT PROD COST 5818.99 MONTHLY PROD RATE 0.11

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	9750.	1513.	11263.
DESIGN	29294.	6553.	35847.
SYSTEMS	2494.	-	2494.
PROJECT MGMT	12573.	5656.	18230.
DATA	1366.	3344.	4710.
SUBTOTAL(ENG)	55477.	17067.	72544.
MANUFACTURING			
PRODUCTION	-	17457.	17457.
PROTOTYPE	19137.	-	19137.
TOOL-TEST EQ	1793.	84.	1878.
SUBTOTAL(MFG)	20931.	17541.	38472.
TOTAL COST	76407.	34609.	111016.

DESIGN FACTORS	MECHANICAL	PRODUCT DESCRIPTORS	
WEIGHT	1932.085*	ENGINEERING COMPLEXITY	0.906*
DENSITY	15.000*	PROTOTYPE SUPPORT	1.0
MFG. COMPLEXITY	8.420*	PROTO SCHEDULE FACTOR	.250*
NEW DESIGN	0.500	PLATFORM	2.500
DESIGN REPEAT	0.000	YEAR OF TECHNOLOGY	1985*
EQUIPMENT CLASS	*****	RELIABILITY FACTOR	1.0
ENGINEERING CHANGES	.060*	MTBF(FIELD)	6607*
INTEGRATION LEVEL	2.0		

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(32)	JAN 88	(0)	JAN 88	(32)
PRODUCTION	JAN 88	(24)	DEC 89*	(18)	JUN 91	(42)

SUPPLEMENTAL INFORMATION		TOOLING & PROCESS FACTORS	
YEAR OF ECONOMICS	1985*	DEVELOPMENT TOOLING	1.00*
ESCALATION	0.00	PRODUCTION TOOLING	1.00*
AMORTIZED UNIT COST	11538.18*		
DEV COST MULTIPLIER	1.35		
PROD COST MULTIPLIER	1.35		

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	68845.	30728.	99573.
CENTER	76407.	34609.	111016.
TO	84714.	38171.	122885.

WBS 1.3.1.6

P/A MODULE AUXILIARY SYSTEMS

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MECHANICAL ITEM

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AUXILIARY POWER SYSTEM

PRODUCTION QUANTITY	3	UNIT WEIGHT	1225.00	MODE	2
PROTOTYPE QUANTITY	1..250	UNIT VOLUME	12.00	QUANTITY/NHA	1

UNIT PROD COST 3402.03 COST PROCESS FACTOR 1 MONTHLY PROD RATE 0.78

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	1988.	123.	2111.
DESIGN	6509.	478.	6987.
SYSTEMS	911.	-	911.
PROJECT MGMT	3818.	1982.	5799.
DATA	460.	1133.	1593.
SUBTOTAL(ENG)	13686.	3715.	17401.
MANUFACTURING			
PRODUCTION	-	10206.	10206.
PROTOTYPE	13456.	-	13456.
TOOL-TEST EQ	819.	85.	904.
SUBTOTAL(MFG)	14275.	10291.	24566.
TOTAL COST	27961.	14006.	41967.

DESIGN FACTORS	MECHANICAL	PRODUCT DESCRIPTORS	
WEIGHT	1225.000	ENGINEERING COMPLEXITY	1.000
DENSITY	102.083*	PROTOTYPE SUPPORT	2.0
MFG. COMPLEXITY	8.230	PROTO SCHEDULE FACTOR	.250*
NEW DESIGN	1.000	PLATFORM	2.500
DESIGN REPEAT	0.788*	YEAR OF TECHNOLOGY	1976
EQUIPMENT CLASS	*****	RELIABILITY FACTOR	1.0
ENGINEERING CHANGES	.042*	MTBF(FIELD)	8147*
INTEGRATION LEVEL	0.7		

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(13)	JUN 86*	(3)	SEP 86*	(16)
PRODUCTION	JAN 88	(23)	NOV 89*	(2)	JAN 90*	(25)

SUPPLEMENTAL INFORMATION		TOOLING & PROCESS FACTORS	
YEAR OF ECONOMICS	1982	DEVELOPMENT TOOLING	1.00*
ESCALATION	0.00	PRODUCTION TOOLING	1.00*
T-1 COST	3804.26*	RATE TOOLING	0
AMORTIZED UNIT COST	4668.79*	PRICE IMPROVEMENT FACTOR	******
DEV COST MULTIPLIER	1.35	UNIT LEARNING CURVE	.873*
PROD COST MULTIPLIER	1.35		

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	24657.	11874.	36531.
CENTER	27961.	14006.	41967.
TO	32221.	16271.	48492.

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MECHANICAL ITEM

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RECOVERY SYSTEM

PRODUCTION QUANTITY	3	UNIT WEIGHT	6708.00	MODE	2
PROTOTYPE QUANTITY	1.250	UNIT VOLUME	62.00	QUANTITY/NHA	1

UNIT PROD COST 1015.20 COST PROCESS FACTOR 1 MONTHLY PROD RATE 1.41

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	3396.	52.	3448.
DESIGN	10767.	142.	10910.
SYSTEMS	2767.	-	2767.
PROJECT MGMT	8872.	656.	9528.
DATA	1343.	379.	1722.
SUBTOTAL(ENG)	27145.	1230.	28375.
MANUFACTURING			
PRODUCTION	-	3046.	3046.
PROTOTYPE	5589.	-	5589.
TOOL-TEST EQ	460.	34.	493.
SUBTOTAL(MFG)	6049.	3079.	9128.
TOTAL COST	33194.	4309.	37503.

DESIGN FACTORS	MECHANICAL
WEIGHT	6708.000
DENSITY	108.161*
MFG. COMPLEXITY	5.950
NEW DESIGN	1.000
DESIGN REPEAT	0.695*
EQUIPMENT CLASS	*****
ENGINEERING CHANGES	.012*
INTEGRATION LEVEL	0.7

PRODUCT DESCRIPTORS	
ENGINEERING COMPLEXITY	1.300
PROTOTYPE SUPPORT	2.0
PROTO SCHEDULE FACTOR	.250*
PLATFORM	2.500
YEAR OF TECHNOLOGY	1976
RELIABILITY FACTOR	1.0
MTBF(FIELD)	13815*

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(12)	MAY 86*	(1)	JUN 86*	(13)
PRODUCTION	JAN 88	(16)	APR 89*	(1)	MAY 89*	(17)

SUPPLEMENTAL INFORMATION

YEAR OF ECONOMICS	1982
ESCALATION	0.00
T-1 COST	1113.25*
AMORTIZED UNIT COST	1438.41*
DEV COST MULTIPLIER	1.35
PROD COST MULTIPLIER	1.35

TOOLING & PROCESS FACTORS	
DEVELOPMENT TOOLING	1.00*
PRODUCTION TOOLING	1.00*
RATE TOOLING	0
PRICE IMPROVEMENT FACTOR	******
UNIT LEARNING CURVE	.894*

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	28220.	3511.	31730.
CENTER	33194.	4309.	37503.
TO	41119.	5583.	46703.

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INTEGRATION AND TEST

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AUX.SYSTEMS INTEG/ASSY/TEST

PRODUCTION QUANTITY	3	INT WEIGHT	338.994*	MODE	5
PROTOTYPE QUANTITY	1.250	INT VOLUME	22.600*	QUANTITY/NHA	1

UNIT PROD COST 139.79 MONTHLY PROD RATE 0.07

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	2337.	42.	2378.
DESIGN	7643.	140.	7784.
SYSTEMS	663.	-	663.
PROJECT MGMT	3333.	236.	3569.
DATA	296.	158.	454.
SUBTOTAL(ENG)	14273.	575.	14848.
MANUFACTURING			
PRODUCTION	-	419.	419.
PROTOTYPE	597.	-	597.
TOOL-TEST EQ	56.	3.	59
SUBTOTAL(MFG)	653.	423.	1076.
TOTAL COST	14926.	998.	15924.

DESIGN FACTORS	MECHANICAL	PRODUCT DESCRIPTORS	
WEIGHT	338.994*	ENGINEERING COMPLEXITY	1.000*
DENSITY	15.000*	PROTOTYPE SUPPORT	1.0
MFG. COMPLEXITY	6.445*	PROTO SCHEDULE FACTOR	.250*
NEW DESIGN	1.000	PLATFORM	2.500
DESIGN REPEAT	0.000	YEAR OF TECHNOLOGY	1976
EQUIPMENT CLASS	*****	RELIABILITY FACTOR	1.0
ENGINEERING CHANGES	.018*	MTBF(FIELD)	26190*
INTEGRATION LEVEL	1.0		

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(32)	JAN 88	(38)	MAR 91	(70)
PRODUCTION	JAN 88	(12)	DEC 88*	(30)	JUN 91	(42)

SUPPLEMENTAL INFORMATION		TOOLING & PROCESS FACTORS	
YEAR OF ECONOMICS	1982	DEVELOPMENT TOOLING	1.00*
ESCALATION	0.00	PRODUCTION TOOLING	1.00*
AMORTIZED UNIT COST	332.70*		
DEV COST MULTIPLIER	1.35		
PROD COST MULTIPLIER	1.35		

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	13328.	872.	14198.
CENTER	14926.	998.	15924.
TO	17422.	1150.	18572.

WBS 1.3.1.7

P/A MODULE GUIDANCE & NAVIGATION SUBSYSTEM

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MECHANICAL ITEM

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REDUNDANT IMU

PRODUCTION QUANTITY	3	UNIT WEIGHT	42.00	MODE	2
PROTOTYPE QUANTITY	2.000	UNIT VOLUME	4.00	QUANTITY/NHA	1

UNIT PROD COST 2381.58 COST PROCESS FACTOR 1 MONTHLY PROD RATE 0.72

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	65.	44.	109.
DESIGN	215.	263.	479.
SYSTEMS	15.	-	15.
PROJECT MGMT	1165.	1256.	2421.
DATA	83.	712.	795.
SUBTOTAL(ENG)	1543.	2275.	3818.
MANUFACTURING			
PRODUCTION	-	7145.	7145.
PROTOTYPE	5118.	-	5118.
TOOL-TEST EQ	651.	56.	707.
SUBTOTAL(MFG)	5769.	7201.	12970.
TOTAL COST	7312.	9476.	16788.

DESIGN FACTORS	MECHANICAL	PRODUCT DESCRIPTORS	
WEIGHT	42.000	ENGINEERING COMPLEXITY	0.700
DENSITY	10.500*	PROTOTYPE SUPPORT	1.0
MFG. COMPLEXITY	10.600	PROTO SCHEDULE FACTOR	.250*
NEW DESIGN	0.250	PLATFORM	2.500
DESIGN REPEAT	0.832*	YEAR OF TECHNOLOGY	1976
EQUIPMENT CLASS	*****	RELIABILITY FACTOR	1.0
ENGINEERING CHANGES	.080*	MTBF(FIELD)	9972*
INTEGRATION LEVEL	0.3		

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(13)	JUN 86*	(7)	JAN 87*	(20)
PRODUCTION	JUN 87	(23)	APR 89*	(3)	JUL 89*	(26)

SUPPLEMENTAL INFORMATION		TOOLING & PROCESS FACTORS	
YEAR OF ECONOMICS	1982	DEVELOPMENT TOOLING	1.00*
ESCALATION	0.00	PRODUCTION TOOLING	1.00*
T-1 COST	2699.02*	RATE TOOLING	0
AMORTIZED UNIT COST	3158.67*	PRICE IMPROVEMENT FACTOR	*****
DEV COST MULTIPLIER	1.35	UNIT LEARNING CURVE	.858*
PROD COST MULTIPLIER	1.35		

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	6544.	8407.	14951.
CENTER	7312.	9476.	16788.
TO	7886.	10180.	18066.

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ELECTRONIC ITEM

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ASCENT TVC DRIVER

PRODUCTION QUANTITY	9	UNIT WEIGHT	40.00	MODE	1
PROTOTYPE QUANTITY	4.000	UNIT VOLUME	1.00	QUANTITY/NHA	3

UNIT PROD COST 425.20 COST PROCESS FACTOR 1 MONTHLY PROD RATE 1.24

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	138.	94.	232.
DESIGN	455.	369.	824.
SYSTEMS	32.	-	32.
PROJECT MGMT	653.	696.	1349.
DATA	53.	389.	442.
SUBTOTAL(ENG)	1331.	1548.	2879.
MANUFACTURING			
PRODUCTION	-	3827.	3827.
PROTOTYPE	1818.	-	1818.
TOOL-TEST EQ	201.	55.	256.
SUBTOTAL(MFG)	2019.	3882.	5901.
TOTAL COST	3350.	5430.	8780.

DESIGN FACTORS	ELECTRONIC	MECHANICAL
WEIGHT	19.100*	20.900
DENSITY	40.000	20.900*
MFG. COMPLEXITY	10.100	8.600
NEW DESIGN	0.100	1.000
DESIGN REPEAT	0.664*	0.485*
EQUIPMENT CLASS	*****	*****
ENGINEERING CHANGES	.060*	.015*
INTEGRATION LEVEL	0.5	0.3

PRODUCT DESCRIPTORS	
ENGINEERING COMPLEXITY	0.700
PROTOTYPE SUPPORT	1.0
PROTO SCHEDULE FACTOR	.250*
ELECT VOL FRACTION	.477*
PLATFORM	2.500
YEAR OF TECHNOLOGY	1976
RELIABILITY FACTOR	1.0
MTBF(FIELD)	30699*

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(11)	APR 86*	(12)	APR 87*	(23)
PRODUCTION	JUN 87	(19)	DEC 88*	(7)	JUL 89*	(26)

SUPPLEMENTAL INFORMATION

YEAR OF ECONOMICS	1982	TOOLING & PROCESS FACTORS	
ESCALATION	0.00	DEVELOPMENT TOOLING	1.00*
T-1 COST	538.98*	PRODUCTION TOOLING	1.00*
AMORTIZED UNIT COST	603.33*	RATE TOOLING	0
DEV COST MULTIPLIER	1.35	PRICE IMPROVEMENT FACTOR	******
PROD COST MULTIPLIER	1.35	UNIT LEARNING CURVE	.889*

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	2889.	4592.	7480.
CENTER	3350.	5430.	8780.
TO	3871.	6321.	10192.

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ELECTRONIC ITEM

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RCS DRIVER

PRODUCTION QUANTITY	12	UNIT WEIGHT	33.00	MODE	1
PROTOTYPE QUANTITY	5.000	UNIT VOLUME	1.00	QUANTITY/NHA	4

UNIT PROD COST 351.32 COST PROCESS FACTOR 1 MONTHLY PROD RATE 1.42

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	124.	83.	207.
DESIGN	412.	326.	739.
SYSTEMS	29.	-	29.
PROJECT MGMT	645.	731.	1376.
DATA	51.	407.	458.
SUBTOTAL(ENG)	1262.	1547.	2809.
MANUFACTURING			
PRODUCTION	-	4218.	4218.
PROTOTYPE	1828.	-	1828.
TOOL-TEST EQ	199.	56.	256.
SUBTOTAL(MFG)	2027.	4272.	6299.
TOTAL COST	3289.	5819.	9108.

DESIGN FACTORS	ELECTRONIC	MECHANICAL
WEIGHT	15.500*	17.500
DENSITY	40.000	17.500*
MFG. COMPLEXITY	10.100	8.600
NEW DESIGN	0.100	1.000
DESIGN REPEAT	0.651*	0.461*
EQUIPMENT CLASS	*****	*****
ENGINEERING CHANGES	.058*	.015*
INTEGRATION LEVEL	0.5	0.3

PRODUCT DESCRIPTORS	
ENGINEERING COMPLEXITY	0.700
PROTOTYPE SUPPORT	1.0
PROTO SCHEDULE FACTOR	.250*
ELECT VOL FRACTION	.387*
PLATFORM	2.500
YEAR OF TECHNOLOGY	1976
RELIABILITY FACTOR	1.0
MTBF(FIELD)	37671*

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(11)	APR 86*	(14)	JUN 87*	(25)
PRODUCTION	JUN 87	(19)	DEC 88*	(8)	AUG 89*	(27)

SUPPLEMENTAL INFORMATION

YEAR OF ECONOMICS	1982	TOOLING & PROCESS FACTORS	
ESCALATION	0.00	DEVELOPMENT TOOLING	1.00*
T-1 COST	485.55*	PRODUCTION TOOLING	1.00*
AMORTIZED UNIT COST	484.95*	RATE TOOLING	0
DEV COST MULTIPLIER	1.35	PRICE IMPROVEMENT FACTOR	******
PROD COST MULTIPLIER	1.35	UNIT LEARNING CURVE	.886*

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	2835.	4912.	7747.
CENTER	3289.	5819.	9108.
TO	3799.	6785.	10584.

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MECHANICAL ITEM

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ACCELEROMETER

PRODUCTION QUANTITY	15	UNIT WEIGHT	2.50	MODE	2
PROTOTYPE QUANTITY	6.000	UNIT VOLUME	0.30	QUANTITY/NHA	5

UNIT PROD COST 146.68 COST PROCESS FACTOR 1 MONTHLY PROD RATE 1.92

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	6.	7.	12.
DESIGN	20.	39.	59.
SYSTEMS	1.	-	1.
PROJECT MGMT	207.	334.	540.
DATA	13.	185.	198.
SUBTOTAL(ENG)	247.	565.	812.
MANUFACTURING			
PRODUCTION	-	2200.	2200.
PROTOTYPE	832.	-	832.
TOOL-TEST EQ	100.	17.	117.
SUBTOTAL(MFG)	932.	2217.	3150.
TOTAL COST	1179.	2782.	3961.

DESIGN FACTORS	MECHANICAL
WEIGHT	2.500
DENSITY	8.333*
MFG. COMPLEXITY	10.400
NEW DESIGN	0.100
DESIGN REPEAT	0.726*
EQUIPMENT CLASS	*****
ENGINEERING CHANGES	.057*
INTEGRATION LEVEL	0.3

PRODUCT DESCRIPTORS	
ENGINEERING COMPLEXITY	0.700
PROTOTYPE SUPPORT	1.0
PROTO SCHEDULE FACTOR	.250*
PLATFORM	2.500
YEAR OF TECHNOLOGY	1976
RELIABILITY FACTOR	1.0
MTBF(FIELD)	24709*

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(12)	MAY 86*	(17)	OCT 87*	(29)
PRODUCTION	JUN 87	(15)	AUG 88*	(8)	APR 89*	(23)

SUPPLEMENTAL INFORMATION	
YEAR OF ECONOMICS	1982
ESCALATION	0.00
T-1 COST	211.77*
AMORTIZED UNIT COST	185.49*
DEV COST MULTIPLIER	1.35
PROD COST MULTIPLIER	1.35

TOOLING & PROCESS FACTORS	
DEVELOPMENT TOOLING	1.00*
PRODUCTION TOOLING	1.00*
RATE TOOLING	0
PRICE IMPROVEMENT FACTOR	******
UNIT LEARNING CURVE	.868*

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	1058.	2475.	3534.
CENTER	1179.	2782.	3961.
TO	1269.	2985.	4253.

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MECHANICAL ITEM

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RATE GYRO

PRODUCTION QUANTITY	16	UNIT WEIGHT	10.20	MODE	2
PROTOTYPE QUANTITY	7.000	UNIT VOLUME	1.00	QUANTITY/NHA	6

UNIT PROD COST 111.59 COST PROCESS FACTOR 1 MONTHLY PROD RATE 2.44

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	9.	1.	10.
DESIGN	31.	31.	62.
SYSTEMS	2.	-	2.
PROJECT MGMT	235.	323.	559.
DATA	16.	180.	196.
SUBTOTAL(ENG)	294.	540.	834.
MANUFACTURING			
PRODUCTION	-	2009.	2009.
PROTOTYPE	828.	-	828.
TOOL-TEST EQ	77.	15.	92.
SUBTOTAL(MFG)	905.	2023.	2928.
TOTAL COST	1198.	2564.	3762.

DESIGN FACTORS	MECHANICAL	PRODUCT DESCRIPTORS	
WEIGHT	10.200	ENGINEERING COMPLEXITY	0.700
DENSITY	10.200*	PROTOTYPE SUPPORT	1.0
MFG. COMPLEXITY	8.950	PROTO SCHEDULE FACTOR	.250*
NEW DESIGN	0.100	PLATFORM	2.500
DESIGN REPEAT	0.701*	YEAR OF TECHNOLOGY	1976
EQUIPMENT CLASS	*****	RELIABILITY FACTOR	1.0
ENGINEERING CHANGES	.029*	MTBF(FIELD)	26202*
INTEGRATION LEVEL	0.3		

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(10)	MAR 86*	(16)	JUL 87*	(26)
PRODUCTION	JUN 87	(14)	JUL 88*	(7)	FEB 89*	(21)

SUPPLEMENTAL INFORMATION		TOOLING & PROCESS FACTORS	
YEAR OF ECONOMICS	1982	DEVELOPMENT TOOLING	1.00*
ESCALATION	0.00	PRODUCTION TOOLING	1.00*
T-1 COST	161.14*	RATE TOOLING	0
AMORTIZED UNIT COST	142.44*	PRICE IMPROVEMENT FACTOR	******
DEV COST MULTIPLIER	1.35	UNIT LEARNING CURVE	.878*
PROD COST MULTIPLIER	1.35		

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	1069.	2262.	3331.
CENTER	1198.	2564.	3762.
TO	1312.	2802.	4114.

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MECHANICAL ITEM

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STAR TRACKER

PRODUCTION QUANTITY	6	UNIT WEIGHT	14.80	MODE	2
PROTOTYPE QUANTITY	3,000	UNIT VOLUME	1.00	QUANTITY/NHA	2

UNIT PROD COST 378.56 COST PROCESS FACTOR 1 MONTHLY PROD RATE 1.23

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	8.	12.	20.
DESIGN	21.	67.	88.
SYSTEMS	1.	-	1.
PROJECT MGMT	369.	407.	776.
DATA	31.	229.	260.
SUBTOTAL(ENG)	429.	715.	1145.
MANUFACTURING			
PRODUCTION	-	2271.	2271.
PROTOTYPE	1146.	-	1146.
TOOL-TEST EQ	94.	21.	115.
SUBTOTAL(MFG)	1240.	2293.	3533.
TOTAL COST	1669.	3008.	4678.

DESIGN FACTORS	MECHANICAL	PRODUCT DESCRIPTORS	
WEIGHT	14.800	ENGINEERING COMPLEXITY	0.400
DENSITY	14.800*	PROTOTYPE SUPPORT	1.0
MFG. COMPLEXITY	9.800	PROTO SCHEDULE FACTOR	.250*
NEW DESIGN	0.100	PLATFORM	2.500
DESIGN REPEAT	0.754*	YEAR OF TECHNOLOGY	1976
EQUIPMENT CLASS	*****	RELIABILITY FACTOR	1.0
ENGINEERING CHANGES	.040*	MTBF(FIELD)	17528*
INTIGRATION LEVEL	0.3		

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(7)	DEC 85*	(9)	SEP 86*	(16)
PRODUCTION	JUN 87	(18)	NOV 88*	(4)	MAR 89*	(22)

SUPPLEMENTAL INFORMATION		TOOLING & PROCESS FACTORS	
YEAR OF ECONOMICS	1982	DEVELOPMENT TOOLING	1.00*
ESCALATION	0.00	PRODUCTION TOOLING	1.00*
T-1 COST	488.88*	RATE TOOLING	0
AMORTIZED UNIT COST	501.37*	PRICE IMPROVEMENT FACTOR	******
DEV COST MULTIPLIER	1.35	UNIT LEARNING CURVE	.869*
PROD COST MULTIPLIER	1.35		

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	1486.	2655.	4141.
CENTER	1669.	3008.	4678.
TO	1818.	3268.	5084.

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ELECTRONIC ITEM

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OMS DRIVER

PRODUCTION QUANTITY	6	UNIT WEIGHT	33.00	MODE	1
PROTOTYPE QUANTITY	3.000	UNIT VOLUME	1.00	QUANTITY/NHA	2

UNIT PROD COST 357.88 COST PROCESS FACTOR 1 MONTHLY PROD RATE 1.13

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	122.	83.	205.
DESIGN	398.	328.	725.
SYSTEMS	29.	-	29.
PROJECT MGMT	462.	428.	891.
DATA	40.	241.	280.
SUBTOTAL(ENG)	1050.	1080.	2130.
MANUFACTURING			
PRODUCTION	-	2147.	2147.
PROTOTYPE	1178.	-	1178.
TOOL-TEST EQ	135.	36.	170.
SUBTOTAL(MFG)	1313.	2183.	3495.
TOTAL COST	2362.	3263.	5625.

DESIGN FACTORS	ELECTRONIC	MECHANICAL
WEIGHT	15.500*	17.500
DENSITY	40.000	17.500*
MFG: COMPLEXITY	10.100	6.600
NEW DESIGN	0.100	1.000
DESIGN REPEAT	0.651*	0.461*
EQUIPMENT CLASS	*****	*****
ENGINEERING CHANGES	.084*	.016*
INTEGRATION LEVEL	0.5	0.3

PRODUCT DESCRIPTORS	
ENGINEERING COMPLEXITY	0.700
PROTOTYPE SUPPORT	1.0
PROTO SCHEDULE FACTOR	.250*
ELECT VOL FRACTION	.387*
PLATFORM	2.500
YEAR OF TECHNOLOGY	1976
RELIABILITY FACTOR	1.0
MTBF(FIELD)	37871*

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(11)	APR 86*	(10)	FEB 87*	(21)
PRODUCTION	JUN 87	(19)	DEC 88*	(4)	APR 89*	(23)

SUPPLEMENTAL INFORMATION

YEAR OF ECONOMICS	1982
ESCALATION	0.00
T-1 COST	423.90*
AMORTIZED UNIT COST	543.83*
DEV COST MULTIPLIER	1.35
PROD COST MULTIPLIER	1.35

TOOLING & PROCESS FACTORS	
DEVELOPMENT TOOLING	1.00*
PRODUCTION TOOLING	1.00*
RATE TOOLING	0
PRICE IMPROVEMENT FACTOR	******
UNIT LEARNING CURVE	.895*

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	2045.	2778.	4823.
CENTER	2362.	3263.	5625.
TO	2724.	3777.	6501.

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INTEGRATION AND TEST

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GUIDANCE/CONTROL SYSTEM INTEG/ASSY/TEST

PRODUCTION QUANTITY	3	INT WEIGHT	24.023*	MODE	5
PROTOTYPE QUANTITY	1.250	INT VOLUME	0.588*	QUANTITY/NHA	1

UNIT PROD COST 273.40 MONTHLY PROD RATE 0.09

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	1087.	325.	1412.
DESIGN	3385.	1588.	4974.
SYSTEMS	316.	-	316.
PROJECT MGMT	1217.	728.	1945.
DATA	144.	446.	590.
SUBTOTAL(ENG)	6150.	3088.	9238.
MANUFACTURING			
PRODUCTION	-	820.	820.
PROTOTYPE	602.	-	602.
TOOL-TEST EQ	78.	10.	88.
SUBTOTAL(MFG)	680.	831.	1510.
TOTAL COST	6830.	3919.	10748.

DESIGN FACTORS	ELECTRONIC	MECHANICAL
WEIGHT	15.199*	8.824*
DENSITY	35.000*	15.000*
MFG. COMPLEXITY	9.306*	8.984*
NEW DESIGN	0.500	0.500
DESIGN REPEAT	0.000	0.000
EQUIPMENT CLASS	*****	*****
ENGINEERING CHANGES	.135*	.104*
INTEGRATION LEVEL	1.0	0.3

PRODUCT DESCRIPTORS	
ENGINEERING COMPLEXITY	0.899*
PROTOTYPE SUPPORT	1.0
PROTO SCHEDULE FACTOR	.250*
ELECT VOL FRACTION	.738
PLATFORM	2.500
YEAR OF TECHNOLOGY	1976
RELIABILITY FACTOR	1.0
MTBF(FIELD)	30404*

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(25)	JUN 87	(0)	JUN 87	(25)
PRODUCTION	JUN 87	(16)	SEP 88*	(21)	JUN 90	(37)

SUPPLEMENTAL INFORMATION

YEAR OF ECONOMICS	1982
ESCALATION	0.00
AMORTIZED UNIT COST	1306.21*
DEV COST MULTIPLIER	1.35
PROD COST MULTIPLIER	1.35

TOOLING & PROCESS FACTORS	
DEVELOPMENT TOOLING	1.00*
PRODUCTION TOOLING	1.00*

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	6141.	3574.	9715.
CENTER	6830.	3919.	10748.
TO	7659.	4263.	11923.

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P/A MODULE DATA MANAGEMENT SUBSYSTEM

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ELECTRONIC ITEM

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ENGINE INTERFACE UNIT

PRODUCTION QUANTITY	9	UNIT WEIGHT	19.60	MODE	1
PROTOTYPE QUANTITY	4.000	UNIT VOLUME	0.80	QUANTITY/NHA	3

UNIT PROD COST 238.57 COST PROCESS FACTOR 1 MONTHLY PROD RATE 1.46

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	87.	62.	149.
DESIGN	284.	239.	523.
SYSTEMS	20.	-	20.
PROJECT MGMT	388.	401.	789.
DATA	32.	224.	256.
SUBTOTAL(ENG)	811.	926.	1737.
MANUFACTURING			
PRODUCTION	-	2147.	2147.
PROTOTYPE	1030.	-	1030.
TOOL-TEST EQ	112.	34.	145.
SUBTOTAL(MFG)	1142.	2181.	3322.
TOTAL COST	1953.	3107.	5060.

DESIGN FACTORS	ELECTRONIC	MECHANICAL
WEIGHT	12.600*	7.000
DENSITY	40.000	8.750*
MFG. COMPLEXITY	9.900	8.600
NEW DESIGN	0.100	1.000
DESIGN REPEAT	0.623*	0.425*
EQUIPMENT CLASS	*****	*****
ENGINEERING CHANGES	.054*	.014*
INTEGRATION LEVEL	0.5	0.3

PRODUCT DESCRIPTORS	
ENGINEERING COMPLEXITY	0.700
PROTOTYPE SUPPORT	1.0
PROTO SCHEDULE FACTOR	.250*
ELECT VOL FRACTION	.394*
PLATFORM	2.500
YEAR OF TECHNOLOGY	1976
RELIABILITY FACTOR	1.0
MTBF(FIELD)	43597*

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(11)	APR 86*	(12)	APR 87*	(23)
PRODUCTION	JUN 87	(17)	OCT 88*	(5)	MAR 89*	(22)

SUPPLEMENTAL INFORMATION

YEAR OF ECONOMICS	1982	TOOLING & PROCESS FACTORS	
ESCALATION	0.00	DEVELOPMENT TOOLING	1.00*
T-1 COST	299.94*	PRODUCTION TOOLING	1.00*
AMORTIZED UNIT COST	345.18*	RATE TOOLING	0
DEV COST MULTIPLIER	1.35	PRICE IMPROVEMENT FACTOR	******
PROD COST MULTIPLIER	1.35	UNIT LEARNING CURVE	.891*

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	1688.	2631.	4319.
CENTER	1953.	3107.	5060.
TO	2256.	3621.	5877.

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ELECTRONIC ITEM

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MULTIPLEXER/DEMULTIPLEXER

PRODUCTION QUANTITY	15	UNIT WEIGHT	38.70	MODE	1
PROTOTYPE QUANTITY	8.000	UNIT VOLUME	1.50	QUANTITY/NHA	5

UNIT PROD COST 390.83 COST PROCESS FACTOR 1 MONTHLY PROD RATE 1.52

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	129.	90.	220.
DESIGN	432.	355.	787.
SYSTEMS	30.	-	30.
PROJECT MGMT	798.	971.	1769.
DATA	61.	539.	600.
SUBTOTAL(ENG)	1450.	1956.	3408.
MANUFACTURING			
PRODUCTION	-	5862.	5862.
PROTOTYPE	2375.	-	2375.
TOOL-TEST EQ	255.	71.	326.
SUBTOTAL(MFG)	2631.	5934.	8564.
TOTAL COST	4081.	7890.	11970.

DESIGN FACTORS	ELECTRONIC	MECHANICAL
WEIGHT	17.400*	19.300
DENSITY	40.000	12.867*
MFG. COMPLEXITY	10.100	6.600
NEW DESIGN	0.100	1.000
DESIGN REPEAT	0.658*	0.491*
EQUIPMENT CLASS	*****	*****
ENGINEERING CHANGES	.057*	.015*
INTEGRATION LEVEL	0.5	0.3

PRODUCT DESCRIPTORS	
ENGINEERING COMPLEXITY	0.700
PROTOTYPE SUPPORT	1.0
PROTO SCHEDULE FACTOR	.250*
ELECT VOL FRACTION	.290*
PLATFORM	2.500
YEAR OF TECHNOLOGY	1976
RELIABILITY FACTOR	1.0
MTBF(FIELD)	33835*

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(11)	APR 86*	(16)	AUG 87*	(27)
PRODUCTION	JUN 87	(19)	DEC 88*	(9)	SEP 89*	(28)

SUPPLEMENTAL INFORMATION

YEAR OF ECONOMICS	1982	TOOLING & PROCESS FACTORS	
ESCALATION	0.00	DEVELOPMENT TOOLING	1.00*
T-1 COST	539.84*	PRODUCTION TOOLING	1.00*
AMORTIZED UNIT COST	525.97*	RATE TOOLING	0
DEV COST MULTIPLIER	1.35	PRICE IMPROVEMENT FACTOR	******
PROD COST MULTIPLIER	1.35	UNIT LEARNING CURVE	.883*

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	3511.	6644.	10155.
CENTER	4081.	7890.	11970.
TO	4716.	9214.	13930.

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ELECTRONIC ITEM

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EVENTS CONTROLLER

PRODUCTION QUANTITY	6	UNIT WEIGHT	62.00	MODE	1
PROTOTYPE QUANTITY	3.000	UNIT VOLUME	2.50	QUANTITY/MFG	2

UNIT PROD COST 631.73 COST PROCESS FACTOR 1 MONTHLY PROD RATE 1.01

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	92.	107.	199.
DESIGN	250.	419.	669.
SYSTEMS	9.	-	9.
PROJECT MGMT	776.	747.	1523.
DATA	71.	420.	492.
SUBTOTAL(ENG)	1199.	1693.	2893.
MANUFACTURING			
PRODUCTION	-	3790.	3790.
PROTOTYPE	1921.	-	1921.
TOOL-TEST EQ	157.	61.	217.
SUBTOTAL(MFG)	2077.	3851.	5928.
TOTAL COST	3277.	5545.	8821.

DESIGN FACTORS	ELECTRONIC	MECHANICAL
WEIGHT	30.600*	31.400
DENSITY	40.000	12.560*
MFG. COMPLEXITY	10.100	8.600
NEW DESIGN	0.100	1.000
DESIGN REPEAT	0.692*	0.533*
EQUIPMENT CLASS	*****	*****
ENGINEERING CHANGES	.051*	.013*
INTEGRATION LEVEL	0.5	0.3

PRODUCT DESCRIPTORS	
ENGINEERING COMPLEXITY	0.400
PROTOTYPE SUPPORT	1.0
PROTO SCHEDULE FACTOR	.250*
ELECT VOL FRACTION	.306*
PLATFORM	2.500
YEAR OF TECHNOLOGY	1978
RELIABILITY FACTOR	1.0
MTBF(FIELD)	19343*

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(7)	DEC 85*	(9)	SEP 86*	(16)
PRODUCTION	JUN 87	(21)	FEB 89*	(5)	JUL 89*	(26)

SUPPLEMENTAL INFORMATION

YEAR OF ECONOMICS	1982	TOOLING & PROCESS FACTORS	
ESCALATION	0.00	DEVELOPMENT TOOLING	1.00*
T-1 COST	749.97*	PRODUCTION TOOLING	1.00*
AMORTIZED UNIT COST	924.09*	RATE TOOLING	0
DEV COST MULTIPLIER	1.35	PRICE IMPROVEMENT FACTOR	******
PROD COST MULTIPLIER	1.35	UNIT LEARNING CURVE	.894*

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	2804.	4693.	7497.
CENTER	3277.	5545.	8821.
TO	3803.	6449.	10252.

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ELECTRONIC ITEM

DATE 7-SEP-82 TIME 21:01 (282144) FILENAME: SDDM2.DAT

PCM MASTER UNIT

PRODUCTION QUANTITY	3	UNIT WEIGHT	29.70	MODE	1
PROTOTYPE QUANTITY	2.000	UNIT VOLUME	1.00	QUANTITY/NHA	1

UNIT PROD COST 329.78 COST PROCESS FACTOR 1 MONTHLY PROD RATE 0.98

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	112.	79.	191.
DESIGN	360.	310.	670.
SYSTEMS	27.	-	27.
PROJECT MGMT	334.	245.	578.
DATA	31.	139.	170.
SUBTOTAL(ENG)	863.	773.	1636.
MANUFACTURING			
PRODUCTION	-	989.	989.
PROTOTYPE	753.	-	753.
TOOL-TEST EQ	91.	20.	111.
SUBTOTAL(MFG)	844.	1009.	1853.
TOTAL COST	1707.	1782.	3489.

DESIGN FACTORS	ELECTRONIC	MECHANICAL
WEIGHT	13.800*	15.900
DENSITY	40.000	15.900*
MFG. COMPLEXITY	10.100	6.600
NEW DESIGN	0.100	1.000
DESIGN REPEAT	0.843*	0.459*
EQUIPMENT CLASS	*****	*****
ENGINEERING CHANGES	.071*	.018*
INTEGRATION LEVEL	0.5	0.3

PRODUCT DESCRIPTORS	
ENGINEERING COMPLEXITY	0.700
PROTOTYPE SUPPORT	1.0
PROTO SCHEDULE FACTOR	.250*
ELECT VOL FRACTION	.345*
PLATFORM	2.500
YEAR OF TECHNOLOGY	1978
RELIABILITY FACTOR	1.0
MTBF(FIELD)	42214*

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(11)	APR 86*	(7)	NOV 86*	(18)
PRODUCTION	JUN 87	(19)	DEC 88*	(2)	FEB 89*	(21)

SUPPLEMENTAL INFORMATION

YEAR OF ECONOMICS	1982	DEVELOPMENT TOOLING	1.00*
ESCALATION	0.00	PRODUCTION TOOLING	1.00*
T-1 COST	357.66*	RATE TOOLING	0
AMORTIZED UNIT COST	594.11*	PRICE IMPROVEMENT FACTOR	******
DEV COST MULTIPLIER	1.35	UNIT LEARNING CURVE	.907*
PROD COST MULTIPLIER	1.35		

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	1483.	1540.	3023.
CENTER	1707.	1782.	3489.
TO	1983.	2037.	4000.

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ELECTRONIC ITEM

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MASTER TIMING UNIT

PRODUCTION QUANTITY	6.	UNIT WEIGHT	28.60	MODE	1
PROTOTYPE QUANTITY	3.000	UNIT VOLUME	1.00	QUANTITY/NHA	2

UNIT PROD COST 311.97 COST PROCESS FACTOR 1 MONTHLY PROD RATE 1.16

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	112.	76.	188.
DESIGN	366.	298.	664.
SYSTEMS	26.	-	26.
PROJECT MGMT	412.	376.	788.
DATA	35.	212.	247.
SUBTOTAL(ENG)	951.	962.	1912.
MANUFACTURING			
PRODUCTION	-	1872.	1872.
PROTOTYPE	1027.	-	1027.
TOOL-TEST EQ	118.	32.	149.
SUBTOTAL(MFG)	1145.	1903.	3048.
TOTAL COST	2096.	2865.	4960.

DESIGN FACTORS	ELECTRONIC	MECHANICAL
WEIGHT	13.300*	15.300
DENSITY	40.000	15.300*
MFG. COMPLEXITY	10.100	6.600
NEW DESIGN	0.100	1.000
DESIGN REPEAT	0.641*	0.459*
EQUIPMENT CLASS	*****	*****
ENGINEERING CHANGES	.064*	.016*
INTEGRATION LEVEL	0.5	0.3

PRODUCT DESCRIPTORS	
ENGINEERING COMPLEXITY	0.700
PROTOTYPE SUPPORT	1.0
PROTO SCHEDULE FACTOR	.250*
ELECT VOL FRACTION	.332*
PLATFORM	2.500
YEAR OF TECHNOLOGY	1976
RELIABILITY FACTOR	1.0
MTBF(FIELD)	43768*

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(11)	APR 86*	(10)	FEB 87*	(21)
PRODUCTION	JUN 87	(19)	DEC 88*	(4)	APR 89*	(23)

SUPPLEMENTAL INFORMATION

YEAR OF ECONOMICS	1982	TOOLING & PROCESS FACTORS	
ESCALATION	0.00	DEVELOPMENT TOOLING	1.00*
T-1 COST	369.30*	PRODUCTION TOOLING	1.00*
AMORTIZED UNIT COST	477.48*	RATE TOOLING	0
DEV COST MULTIPLIER	1.35	PRICE IMPROVEMENT FACTOR	******
PROD COST MULTIPLIER	1.35	UNIT LEARNING CURVE	.896*

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	1815.	2442.	4257.
CENTER	2096.	2865.	4960.
TO	2414.	3313.	5727.

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MECHANICAL ITEM

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TAPE RECORDER

PRODUCTION QUANTITY	3	UNIT WEIGHT	25.00	MODE	2
PROTOTYPE QUANTITY	2.000	UNIT VOLUME	2.00	QUANTITY/NHA	1

UNIT PROD COST 521.44 COST PROCESS FACTOR 1 MONTHLY PROD RATE 1.01

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	34.	18.	52.
DESIGN	108.	96.	204.
SYSTEMS	8.	-	8.
PROJECT MGMT	318.	297.	615.
DATA	24.	169.	193.
SUBTOTAL(ENG)	492.	580.	1072.
MANUFACTURING			
PRODUCTION	-	1584.	1584.
PROTOTYPE	1200.	-	1200.
TOOL-TEST EQ	134.	16.	150.
SUBTOTAL(MFG)	1333.	1580.	2914.
TOTAL COST	1826.	2160.	3986.

DESIGN FACTORS	MECHANICAL	PRODUCT DESCRIPTORS	
WEIGHT	25.000	ENGINEERING COMPLEXITY	0.700
DENSITY	12.500*	PROTOTYPE SUPPORT	1.0
MFG. COMPLEXITY	9.600	PROTO SCHEDULE FACTOR	.250*
NEW DESIGN	0.200	PLATFORM	2.500
DESIGN REPEAT	0.771*	YEAR OF TECHNOLOGY	1976
EQUIPMENT CLASS	*****	RELIABILITY FACTOR	1.0
ENGINEERING CHANGES	.053*	MTBF(FIELD)	15999*
INTEGRATION LEVEL	0.3		

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(11)	APR 86*	(7)	NOV 86*	(18)
PRODUCTION	JUN 87	(18)	NOV 88*	(2)	JAN 89*	(20)

SUPPLEMENTAL INFORMATION		TOOLING & PROCESS FACTORS	
YEAR OF ECONOMICS	1982	DEVELOPMENT TOOLING	1.00*
ESCALATION	0.00	PRODUCTION TOOLING	1.00*
T-1 COST	585.26*	RATE TOOLING	0
AMORTIZED UNIT COST	719.98*	PRICE IMPROVEMENT FACTOR	******
DEV COST MULTIPLIER	1.35	UNIT LEARNING CURVE	.869*
PROD COST MULTIPLIER	1.35		

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	1631.	1912.	3543.
CENTER	1826.	2160.	3988.
TO	1990.	2343.	4334.

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ELECTRONIC ITEM

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COMPUTER

PRODUCTION QUANTITY	9	UNIT WEIGHT	54.00	MODE	1
PROTOTYPE QUANTITY	4.000	UNIT VOLUME	2.00	QUANTITY/NHA	3

UNIT PROD COST 1190.79 COST PROCESS FACTOR 1 MONTHLY PROD RATE 1.09

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	108.	175.	283.
DESIGN	360.	712.	1073.
SYSTEMS	25.	-	25.
PROJECT MGMT	1337.	1854.	3191.
DATA	95.	1036.	1131.
SUBTOTAL(ENG)	1925.	3777.	5702.
MANUFACTURING			
PRODUCTION	-	10717.	10717.
PROTOTYPE	4939.	-	4939.
TOOL-TEST EQ	581.	149.	709.
SUBTOTAL(MFG)	5500.	10888.	16366.
TOTAL COST	7425.	14643.	22068.

DESIGN FACTORS	ELECTRONIC	MECHANICAL
WEIGHT	43.700*	10.300
DENSITY	40.000	5.150*
MFG. COMPLEXITY	10.400	6.600
NEW DESIGN	0.100	0.100
DESIGN REPEAT	0.727*	0.497*
EQUIPMENT CLASS	*****	*****
ENGINEERING CHANGES	.069*	.016*
INTEGRATION LEVEL	0.5	0.3

PRODUCT DESCRIPTORS	
ENGINEERING COMPLEXITY	0.700
PROTOTYPE SUPPORT	1.0
PROTO SCHEDULE FACTOR	.250*
ELECT VOL FRACTION	.546*
PLATFORM	2.500
YEAR OF TECHNOLOGY	1976
RELIABILITY FACTOR	1.0
MTBF(FIELD)	14823*

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(12)	MAY 86*	(12)	MAY 87*	(24)
PRODUCTION	JUN 87	(21)	FEB 89*	(8)	OCT 89*	(29)

SUPPLEMENTAL INFORMATION

YEAR OF ECONOMICS	1982	TOOLING & PROCESS FACTORS	
ESCALATION	0.00	DEVELOPMENT TOOLING	1.00*
T-1 COST	1519.58*	PRODUCTION TOOLING	1.00*
AMORTIZED UNIT COST	1627.01*	RATE TOOLING	0
DEV COST MULTIPLIER	1.35	PRICE IMPROVEMENT FACTOR	*****
PROD COST MULTIPLIER	1.35	UNIT LEARNING CURVE	.884*

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	6051.	12327.	18678.
CENTER	7425.	14643.	22068.
TO	8567.	17013.	25586.

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MECHANICAL ITEM

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MULTIPLEXER INTERFACE ADAPTER

PRODUCTION QUANTITY	165	UNIT WEIGHT	6.30	MODE	2
PROTOTYPE QUANTITY	60.000	UNIT VOLUME	1.00	QUANTITY/NHA	55

UNIT PROD COST 8.26 COST PROCESS FACTOR 1 MONTHLY PROD RATE 18.54

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	4.	1.	5.
DESIGN	12.	3.	15.
SYSTEMS	1.	-	1.
PROJECT MGMT	187.	179.	367.
DATA	13.	98.	111.
SUBTOTAL(ENG)	217.	281.	498.
MANUFACTURING			
PRODUCTION	-	1383.	1383.
PROTOTYPE	513.	-	513.
TOOL-TEST EQ	28.	6.	34.
SUBTOTAL(MFG)	541.	1389.	1910.
TOTAL COST	758.	1650.	2408.

DESIGN FACTORS	MECHANICAL	PRODUCT DESCRIPTORS	
WEIGHT	6.300	ENGINEERING COMPLEXITY	0.700
DENSITY	6.300*	PROTOTYPE SUPPORT	1.0
MFG. COMPLEXITY	7.000	PROTO SCHEDULE FACTOR	.250*
NEW DESIGN	0.100	PLATFORM	2.500
DESIGN REPEAT	0.501*	YEAR OF TECHNOLOGY	1978
EQUIPMENT CLASS	*****	RELIABILITY FACTOR	1.0
ENGINEERING CHANGES	.006*	MTBF(FIELD)	66471*
INTEGRATION LEVEL	0.3		

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(8)	JAN 86*	(44)	SEP 89*	(52)
PRODUCTION	JUN 87	(8)	JAN 88*	(9)	OCT 88*	(17)

SUPPLEMENTAL INFORMATION		TOOLING & PROCESS FACTORS	
YEAR OF ECONOMICS	1982	DEVELOPMENT TOOLING	1.00*
ESCALATION	0.00	PRODUCTION TOOLING	1.00*
T-1 COST	15.02*	RATE TOOLING	0
AMORTIZED UNIT COST	10.00*	PRICE IMPROVEMENT FACTOR	******
DEV COST MULTIPLIER	1.35	UNIT LEARNING CURVE	.903*
PROD COST MULTIPLIER	1.35		

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	675.	1449.	2123.
CENTER	758.	1650.	2408.
TO	850.	1857.	2708.

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INTEGRATION AND TEST

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DATA MGT.SYSTEM INTEG/ASSY/TEST

PRODUCTION QUANTITY	3	INT WEIGHT	51.617*	MODE	5
PROTOTYPE QUANTITY	1.250	INT VOLUME	1.008*	QUANTITY/NHA	1

UNIT PROD COST 433.38 MONTHLY PROD RATE 0.10

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	1818.	573.	2391.
DESIGN	5876.	2140.	7817.
SYSTEMS	529.	-	529.
PROJECT MGMT	2023.	976.	3000.
DATA	240.	587.	828.
SUBTOTAL(ENG)	10287.	4277.	14564.
MANUFACTURING			
PRODUCTION	-	1300.	1300.
PROTOTYPE	956.	-	956.
TOOL-TEST EQ	124.	19.	143.
SUBTOTAL(MFG)	1080.	1319.	2399.
TOTAL COST	11367.	5596.	16963.

DESIGN FACTORS	ELECTRONIC	MECHANICAL	PRODUCT DESCRIPTORS	
WEIGHT	36.492*	15.125*	ENGINEERING COMPLEXITY	0.898*
DENSITY	36.228*	15.000*	PROTOTYPE SUPPORT	1.0
MFG. COMPLEXITY	9.445*	7.108*	PROTO SCHEDULE FACTOR	.250*
NEW DESIGN	0.500	0.500	ELECT VOL FRACTION	.999
DESIGN REPEAT	0.000	0.000	PLATFORM	2.500
EQUIPMENT CLASS	*****	*****	YEAR OF TECHNOLOGY	1976
ENGINEERING CHANGES	.133*	.049*	RELIABILITY FACTOR	1.0
INTEGRATION LEVEL	0.5	0.3	MTBF(FIELD)	13443*

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(25)	JUN 87	(0)	JUN 87	(25)
PRODUCTION	JUN 87	(18)	NOV 88*	(19)	JUN 90	(37)

SUPPLEMENTAL INFORMATION

YEAR OF ECONOMICS	1982	TOOLING & PROCESS FACTORS	
ESCALATION	0.00	DEVELOPMENT TOOLING	1.00*
AMORTIZED UNIT COST	1865.38*	PRODUCTION TOOLING	1.00*
DEV COST MULTIPLIER	1.35		
PROD COST MULTIPLIER	1.35		

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	10179.	5053.	15232.
CENTER	11367.	5596.	16963.
TO	12825.	6173.	18998.

WBS 1.3.1.9

P/A MODULE TELEMETRY, TRACKING & COMMAND SUBSYSTEM

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ELECTRONIC ITEM

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NEWORK SIGNAL PROCESSOR

PRODUCTION QUANTITY	6	UNIT WEIGHT	9.00	MODE	1
PROTOTYPE QUANTITY	3.000	UNIT VOLUME	0.70	QUANTITY/NHA	2

UNIT PROD COST 183.80 COST PROCESS FACTOR 1 MONTHLY PROD RATE 1.41

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	38.	46.	85.
DESIGN	126.	182.	308.
SYSTEMS	9.	-	9.
PROJECT MGMT	185.	203.	388.
DATA	15.	114.	130.
SUBTOTAL(ENG)	373.	546.	919.
MANUFACTURING			
PRODUCTION	-	983.	983.
PROTOTYPE	535.	-	535.
TOOL-TEST EQ	62.	19.	80.
SUBTOTAL(MFG)	597.	1001.	1598.
TOTAL COST	970.	1548.	2517.

DESIGN FACTORS	ELECTRONIC	MECHANICAL
WEIGHT	6.700*	2.300
DENSITY	40.000	3.286*
MFG. COMPLEXITY	10.100	6.600
NEW DESIGN	0.100	0.100
DESIGN REPEAT	0.593*	0.388*
EQUIPMENT CLASS	*****	*****
ENGINEERING CHANGES	.081*	.016*
INTEGRATION LEVEL	0.5	0.3

PRODUCT DESCRIPTORS	
ENGINEERING COMPLEXITY	0.700
PROTOTYPE SUPPORT	1.0
PROTO SCHEDULE FACTOR	.250*
ELECT VOL FRACTION	.239*
PLATFORM	2.500
YEAR OF TECHNOLOGY	1976
RELIABILITY FACTOR	1.0
MTBF(FIELD)	85701*

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(11)	APR 86*	(10)	FEB 87*	(21)
PRODUCTION	JUN 87	(18)	SEP 88*	(3)	DEC 88*	(19)

SUPPLEMENTAL INFORMATION

YEAR OF ECONOMICS	1982
ESCALATION	0.00
T-1 COST	193.62*
AMORTIZED UNIT COST	257.97*
DEV COST MULTIPLIER	1.35
PROD COST MULTIPLIER	1.35

TOOLING & PROCESS FACTORS	
DEVELOPMENT TOOLING	1.00*
PRODUCTION TOOLING	1.00*
RATE TOOLING	0
PRICE IMPROVEMENT FACTOR	******
UNIT LEARNING CURVE	.897*

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	838.	1323.	2162.
CENTER	970.	1548.	2517.
TO	1118.	1784.	2900.

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ELECTRONIC ITEM

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S-BAND TRANSPONDER

PRODUCTION QUANTITY	8	UNIT WEIGHT	35.00	MODE	1
PROTOTYPE QUANTITY	3.000	UNIT VOLUME	3.00	QUANTITY/NHA	2

UNIT PROD COST 511.34 COST PROCESS FACTOR 1 MONTHLY PROD RATE 1.04

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	68.	103.	171.
DESIGN	224.	420.	644.
SYSTEMS	16.	-	16.
PROJECT MGMT	481.	593.	1074.
DATA	37.	333.	370.
SUBTOTAL(ENG)	825.	1450.	2275.
MANUFACTURING			
PRODUCTION	-	3068.	3068.
PROTOTYPE	1642.	-	1642.
TOOL-TEST EQ	194.	50.	244.
SUBTOTAL(MFG)	1835.	3118.	4954.
TOTAL COST	2661.	4568.	7228.

DESIGN FACTORS	ELECTRONIC	MECHANICAL
WEIGHT	16.500*	18.500
DENSITY	40.000	6.167*
MFG. COMPLEXITY	10.400	6.600
NEW DESIGN	0.100	0.100
DESIGN REPEAT	0.674*	0.534*
EQUIPMENT CLASS	*****	*****
ENGINEERING CHANGES	.073*	.017*
INTEGRATION LEVEL	0.5	0.3

PRODUCT DESCRIPTORS	
ENGINEERING COMPLEXITY	0.700
PROTOTYPE SUPPORT	1.0
PROTO SCHEDULE FACTOR	.250*
ELECT VOL FRACTION	.137*
PLATFORM	2.500
YEAR OF TECHNOLOGY	1978
RELIABILITY FACTOR	1.0
MTBF(FIELD)	38502*

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(12)	MAY 86*	(9)	FEB 87*	(21)
PRODUCTION	JUN 87	(20)	JAN 89*	(5)	JUN 89*	(25)

SUPPLEMENTAL INFORMATION

YEAR OF ECONOMICS	1982	DEVELOPMENT TOOLING	1.00*
ESCALATION	0.00	PRODUCTION TOOLING	1.00*
T-1 COST	608.14*	RATE TOOLING	0
AMORTIZED UNIT COST	761.32*	PRICE IMPROVEMENT FACTOR	******
DEV COST MULTIPLIER	1.35	UNIT LEARNING CURVE	.893*
PROD COST MULTIPLIER	1.35		

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	2289.	3888.	6177.
CENTER	2661.	4568.	7228.
TO	3059.	5263.	8322.

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ELECTRONIC ITEM

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S-BAND PREAMPLIFIER

PRODUCTION QUANTITY	3	UNIT WEIGHT	26.00	MODE	1
PROTOTYPE QUANTITY	2.000	UNIT VOLUME	2.00	QUANTITY/NHA	1

UNIT PROD COST 290.88 COST PROCESS FACTOR 1 MONTHLY PROD RATE 1.00

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	53.	72.	126.
DESIGN	172.	284.	456.
SYSTEMS	13.	-	13.
PROJECT MGMT	228.	218.	447.
DATA	20.	124.	144.
SUBTOTAL(ENG)	486.	698.	1184.
MANUFACTURING			
PRODUCTION	-	873.	873.
PROTOTYPE	664.	-	664.
TOOL-TEST EQ	80.	18.	98.
SUBTOTAL(MFG)	744.	890.	1635.
TOTAL COST	1230.	1589.	2819.

DESIGN FACTORS	ELECTRONIC	MECHANICAL
WEIGHT	12.000*	14.000
DENSITY	40.000	7.000*
MFG. COMPLEXITY	10.100	6.600
NEW DESIGN	0.100	0.100
DESIGN REPEAT	0.634*	0.503*
EQUIPMENT CLASS	*****	*****
ENGINEERING CHANGES	.071*	.018*
INTEGRATION LEVEL	0.5	0.3

PRODUCT DESCRIPTORS	
ENGINEERING COMPLEXITY	0.700
PROTOTYPE SUPPORT	1.0
PROTO SCHEDULE FACTOR	.250*
ELECT VOL FRACTION	.150*
PLATFORM	2.500
YEAR OF TECHNOLOGY	1978
RELIABILITY FACTOR	1.0
MTBF(FIELD)	48410*

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(11)	APR 86*	(7)	NOV 86*	(18)
PRODUCTION	JUN 87	(18)	NOV 88*	(2)	JAN 89*	(20)

SUPPLEMENTAL INFORMATION

YEAR OF ECONOMICS	1982	DEVELOPMENT TOOLING	1.00*
ESCALATION	0.00	PRODUCTION TOOLING	1.00*
T-1 COST	315.39*	RATE TOOLING	0
AMORTIZED UNIT COST	529.62*	PRICE IMPROVEMENT FACTOR	******
DEV COST MULTIPLIER	1.35	UNIT LEARNING CURVE	.907*
PROD COST MULTIPLIER	1.35		

TOOLING & PROCESS FACTORS

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	1064.	1375.	2439.
CENTER	1230.	1589.	2819.
TO	1415.	1813.	3229.

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ELECTRONIC ITEM

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S-BAND PWR AMPLIFIER

PRODUCTION QUANTITY	3	UNIT WEIGHT	33.00	MODE	1
PROTOTYPE QUANTITY	2.000	UNIT VOLUME	2.00	QUANTITY/NHA	1

UNIT PROD COST 385.93 COST PROCESS FACTOR 1 MONTHLY PROD RATE 0.96

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	61.	84.	146.
DESIGN	197.	332.	529.
SYSTEMS	14.	-	14.
PROJECT MGMT	278.	269.	547.
DATA	24.	153.	178.
SUBTOTAL(ENG)	574.	838.	1412.
MANUFACTURING			
PRODUCTION	-	1098.	1098.
PROTOTYPE	835.	-	835.
TOOL-TEST EQ	100.	22.	122.
SUBTOTAL(MFG)	935.	1120.	2055.
TOTAL COST	1509.	1958.	3467.

DESIGN FACTORS	ELECTRONIC	MECHANICAL
WEIGHT	15.500*	17.500
DENSITY	40.000	8.750*
MFG. COMPLEXITY	10.100	6.600
NEW DESIGN	0.100	0.100
DESIGN REPEAT	0.651*	0.508*
EQUIPMENT CLASS	*****	*****
ENGINEERING CHANGES	.071*	.018*
INTEGRATION LEVEL	0.5	0.3

PRODUCT DESCRIPTORS	
ENGINEERING COMPLEXITY	0.700
PROTOTYPE SUPPORT	1.0
PROTO SCHEDULE FACTOR	.250*
ELECT VOL FRACTION	.194*
PLATFORM	2.500
YEAR OF TECHNOLOGY	1976
RELIABILITY FACTOR	1.0
MTBF(FIELD)	37671*

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(11)	APR 86*	(7)	NOV 86*	(18)
PRODUCTION	JUN 87	(19)	DEC 88*	(2)	FEB 89*	(21)

SUPPLEMENTAL INFORMATION

YEAR OF ECONOMICS	1982	DEVELOPMENT TOOLING	1.00*
ESCALATION	0.00	PRODUCTION TOOLING	1.00*
T-1 COST	396.96*	RATE TOOLING	0
AMORTIZED UNIT COST	652.68*	PRICE IMPROVEMENT FACTOR	******
DEV COST MULTIPLIER	1.35	UNIT LEARNING CURVE	.907*
PROD COST MULTIPLIER	1.35		

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	1304.	1691.	2994.
CENTER	1509.	1958.	3467.
TO	1738.	2239.	3977.

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ELECTRONIC ITEM

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S-BAND FM XMTR

PRODUCTION QUANTITY	6	UNIT WEIGHT	3.50	MODE	1
PROTOTYPE QUANTITY	3.000	UNIT VOLUME	0.20	QUANTITY/NHA	2

UNIT PROD COST 100.46 COST PROCESS FACTOR 1 MONTHLY PROD RATE 1.52

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	26.	32.	58.
DESIGN	85.	130.	215.
SYSTEMS	6.	-	6.
PROJECT MGMT	114.	127.	241.
DATA	9.	72.	81.
SUBTOTAL(ENG)	240.	361.	601.
MANUFACTURING			
PRODUCTION	-	603.	603.
PROTOTYPE	320.	-	320.
TOOL-TEST EQ	45.	13.	57.
SUBTOTAL(MFG)	365.	615.	980.
TOTAL COST	604.	977.	1581.

DESIGN FACTORS	ELECTRONIC	MECHANICAL
WEIGHT	2.800*	0.700
DENSITY	40.000	3.500*
MFG. COMPLEXITY	10.400	6.600
NEW DESIGN	0.100	0.100
DESIGN REPEAT	0.549*	0.245*
EQUIPMENT CLASS	*****	*****
ENGINEERING CHANGES	.067*	.016*
INTEGRATION LEVEL	0.5	0.3

PRODUCT DESCRIPTORS	
ENGINEERING COMPLEXITY	0.700
PROTOTYPE SUPPORT	1.0
PROTO SCHEDULE FACTOR	.250*
ELECT VOL FRACTION	.350*
PLATFORM	2.500
YEAR OF TECHNOLOGY	1976
RELIABILITY FACTOR	1.0
MTBF(FIELD)	218983*

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(12)	MAY 86*	(9)	FEB 87*	(21)
PRODUCTION	JUN 87	(15)	AUG 88*	(3)	NOV 88*	(18)

SUPPLEMENTAL INFORMATION

YEAR OF ECONOMICS	1982
ESCALATION	0.00
T-1 COST	118.82*
AMORTIZED UNIT COST	162.76*
DEV COST MULTIPLIER	1.35
PROD COST MULTIPLIER	1.35

TOOLING & PROCESS FACTORS

DEVELOPMENT TOOLING	1.00*
PRODUCTION TOOLING	1.00*
RATE TOOLING	0
PRICE IMPROVEMENT FACTOR	******
UNIT LEARNING CURVE	.898*

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	524.	839.	1364.
CENTER	604.	977.	1581.
TO	691.	1116.	1807.

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ELECTRONIC ITEM

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S-BAND FM SIGNAL PROCESSOR

PRODUCTION QUANTITY	3	UNIT WEIGHT	12.00	MODE	1
PROTOTYPE QUANTITY	2.000	UNIT VOLUME	1.00	QUANTITY/NHA	1

UNIT PROD COST 218.49 COST PROCESS FACTOR 1 MONTHLY PROD RATE 1.14

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	44.	57.	100.
DESIGN	141.	223.	363.
SYSTEMS	10.	-	10.
PROJECT MGMT	176.	168.	342.
DATA	15.	95.	110.
SUBTOTAL(ENG)	386.	540.	926.
MANUFACTURING			
PRODUCTION	-	655.	655.
PROTOTYPE	495.	-	495.
TOOL-TEST EQ	60.	15.	74.
SUBTOTAL(MFG)	555.	670.	1225.
TOTAL COST	941.	1210.	2151.

DESIGN FACTORS	ELECTRONIC	MECHANICAL
WEIGHT	9.000*	3.000
DENSITY	40.000	3.000*
MFG. COMPLEXITY	10.100	6.600
NEW DESIGN	0.100	0.100
DESIGN REPEAT	0.814*	0.422*
EQUIPMENT CLASS	*****	*****
ENGINEERING CHANGES	.069*	.018*
INTEGRATION LEVEL	0.5	0.3

PRODUCT DESCRIPTORS	
ENGINEERING COMPLEXITY	0.700
PROTOTYPE SUPPORT	1.0
PROTO SCHEDULE FACTOR	.250*
ELECT VOL FRACTION	.225*
PLATFORM	2.500
YEAR OF TECHNOLOGY	1976
RELIABILITY FACTOR	1.0
MTBF(FIELD)	64177*

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(11)	APR 86*	(7)	NOV 86*	(18)
PRODUCTION	JUN 87	(16)	SEP 88*	(2)	NOV 88*	(18)

SUPPLEMENTAL INFORMATION

YEAR OF ECONOMICS	1982
ESCALATION	0.00
T-1 COST	236.91*
AMORTIZED UNIT COST	403.39*
DEV COST MULTIPLIER	1.35
PROD COST MULTIPLIER	1.35

TOOLING & PROCESS FACTORS

DEVELOPMENT TOOLING	1.00*
PRODUCTION TOOLING	1.00*
RATE TOOLING	0
PRICE IMPROVEMENT FACTOR	******
UNIT LEARNING CURVE	.907*

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	815.	1048.	1863.
CENTER	941.	1210.	2151.
TO	1082.	1380.	2461.

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MECHANICAL ITEM

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S-BAND ANTENNA

PRODUCTION QUANTITY	3	UNIT WEIGHT	1.00	MODE	2
PROTOTYPE QUANTITY	2.000	UNIT VOLUME	1.00	QUANTITY/NHA	1

UNIT PROD COST 43.64 COST PROCESS FACTOR 1 MONTHLY PROD RATE 1.57

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	8.	3.	11.
DESIGN	26.	17.	43.
SYSTEMS	2.	-	2.
PROJECT MGMT	33.	27.	59.
DATA	3.	15.	18.
SUBTOTAL(ENG)	72.	61.	133.
MANUFACTURING			
PRODUCTION	-	131.	131.
PROTOTYPE	97.	-	97.
TOOL-TEST EQ	12.	2.	14.
SUBTOTAL(MFG)	109.	133.	242.
TOTAL COST	181.	194.	375.

DESIGN FACTORS	MECHANICAL	PRODUCT DESCRIPTORS	
WEIGHT	1.000	ENGINEERING COMPLEXITY	0.700
DENSITY	1.000*	PROTOTYPE SUPPORT	1.0
MFG. COMPLEXITY	10.000	PROTO SCHEDULE FACTOR	.250*
NEW DESIGN	0.250	PLATFORM	2.500
DESIGN REPEAT	0.645*	YEAR OF TECHNOLOGY	1976
EQUIPMENT CLASS	*****	RELIABILITY FACTOR	1.0
ENGINEERING CHANGES	.057*	MTBF(FIELD)	36876*
INTEGRATION LEVEL	0.3		

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(12)	MAY 86*	(6)	NOV 86*	(18)
PRODUCTION	JUN 87	(13)	JUN 88*	(1)	JUL 88*	(14)

SUPPLEMENTAL INFORMATION		TOOLING & PROCESS FACTORS	
YEAR OF ECONOMICS	1982	DEVELOPMENT TOOLING	1.00*
ESCALATION	0.00	PRODUCTION TOOLING	1.00*
T-1 COST	48.74*	RATE TOOLING	0
AMORTIZED UNIT COST	64.73*	PRICE IMPROVEMENT FACTOR	******
DEV COST MULTIPLIER	1.35	UNIT LEARNING CURVE	.874*
PROD COST MULTIPLIER	1.35		

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	163.	174.	337.
CENTER	181.	194.	375.
TO	198.	208.	404.

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MECHANICAL ITEM

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FM ANTENNA

PRODUCTION QUANTITY	3	UNIT WEIGHT	1.00	MODE	2
PROTOTYPE QUANTITY	2.000	UNIT VOLUME	1.00	QUANTITY/NHA	1

UNIT PROD COST 43.64 COST PROCESS FACTOR 1 MONTHLY PROD RATE 1.57

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	8.	3.	11.
DESIGN	26.	17.	43.
SYSTEMS	2.	-	2.
PROJECT MGMT	33.	27.	59.
DATA	3.	15.	18.
SUBTOTAL(ENG)	72.	61.	133.
MANUFACTURING			
PRODUCTION	-	131.	131.
PROTOTYPE	97.	-	97.
TOOL-TEST EQ	12.	2.	14.
SUBTOTAL(MFG)	109.	133.	242.
TOTAL COST	181.	194.	375.

DESIGN FACTORS	MECHANICAL
WEIGHT	1.000
DENSITY	1.000*
MFG. COMPLEXITY	10.000
NEW DESIGN	0.250
DESIGN REPEAT	0.845*
EQUIPMENT CLASS	*****
ENGINEERING CHANGES	.057*
INTEGRATION LEVEL	0.3

PRODUCT DESCRIPTORS	
ENGINEERING COMPLEXITY	0.700
PROTOTYPE SUPPORT	1.0
PROTO SCHEDULE FACTOR	.250*
PLATFORM	2.500
YEAR OF TECHNOLOGY	1976
RELIABILITY FACTOR	1.0
MTBF(FIELD)	36876*

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(12)	MAY 86*	(6)	NOV 86*	(18)
PRODUCTION	JUN 87	(13)	JUN 88*	(1)	JUL 88*	(14)

SUPPLEMENTAL INFORMATION

		TOOLING & PROCESS FACTORS	
YEAR OF ECONOMICS	1982	DEVELOPMENT TOOLING	1.00*
ESCALATION	0.00	PRODUCTION TOOLING	1.00*
T-1 COST	48.74*	RATE TOOLING	0
AMORTIZED UNIT COST	64.73*	PRICE IMPROVEMENT FACTOR	******
DEV COST MULTIPLIER	1.35	UNIT LEARNING CURVE	.874*
PROD COST MULTIPLIER	1.35		

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	163.	174.	337.
CENTER	181.	194.	375.
TO	198.	208.	404.

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INTEGRATION AND TEST

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TT&C SYSTEM INTEG/ASSY/TEST

PRODUCTION QUANTITY	3	INT WEIGHT	10.910*	MODE	5
PROTOTYPE QUANTITY	1.250	INT VOLUME	0.122*	QUANTITY/NHA	1

UNIT PROD COST 124.61 MONTHLY PROD RATE 0.09

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	333.	213.	547.
DESIGN	1041.	761.	1801.
SYSTEMS	97.	-	97.
PROJECT MGMT	385.	382.	767.
DATA	45.	237.	283.
SUBTOTAL(ENG)	1901.	1594.	3495.
MANUFACTURING			
PRODUCTION	-	374.	374.
PROTOTYPE	265.	-	265.
TOOL-TEST EQ	39.	7.	45.
SUBTOTAL(MFG)	304.	381.	684.
TOTAL COST	2205.	1974.	4179.

DESIGN FACTORS	ELECTRONIC	MECHANICAL
WEIGHT	9.073*	1.837*
DENSITY	74.180*	15.000*
MFG. COMPLEXITY	9.445*	6.851*
NEW DESIGN	0.250	0.250
DESIGN REPEAT	0.000	0.000
EQUIPMENT CLASS	*****	*****
ENGINEERING CHANGES	.148*	.049*
INTEGRATION LEVEL	1.0	0.3

PRODUCT DESCRIPTORS	
ENGINEERING COMPLEXITY	0.898*
PROTOTYPE SUPPORT	1.0
PROTO SCHEDULE FACTOR	.250*
ELECT/VOL FRACTION	.999
PLATFORM	2.500
YEAR OF TECHNOLOGY	1976
RELIABILITY FACTOR	1.0
MTBF(FIELD)	52589*

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(25)	JUN 87	(0)	JUN 87	(25)
PRODUCTION	JUN 87	(14)	JUL 88*	(23)	JUN 90	(37)

SUPPLEMENTAL INFORMATION

YEAR OF ECONOMICS	1982
ESCALATION	0.00
AMORTIZED UNIT COST	658.17*
DEV COST MULTIPLIER	1.35
PROD COST MULTIPLIER	1.35

TOOLING & PROCESS FACTORS	
DEVELOPMENT TOOLING	1.00*
PRODUCTION TOOLING	1.00*

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	1948.	1769.	3717.
CENTER	2205.	1974.	4179.
TO	2543.	2222.	4765.

WBS 1.3.1.10

P/A MODULE POWER GENERATION SUBSYSTEM

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MECHANICAL ITEM

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FUEL CELL

PRODUCTION QUANTITY	6	UNIT WEIGHT	200.10	MODE	2
PROTOTYPE QUANTITY	3.000	UNIT VOLUME	20.00	QUANTITY/NHA	2

UNIT PROD COST 952.48 COST PROCESS FACTOR 1 MONTHLY PROD RATE 1.15

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	97.	29.	126.
DESIGN	304.	137.	441.
SYSTEMS	24.	-	24.
PROJECT MGMT	1052.	1030.	2082.
DATA	81.	582.	663.
SUBTOTAL(ENG)	1558.	1779.	3337.
MANUFACTURING			
PRODUCTION	-	5715.	5715.
PROTOTYPE	3479.	-	3479.
TOOL-TEST EQ	305.	39.	343.
SUBTOTAL(MFG)	3784.	5753.	9537.
TOTAL COST	5342.	7532.	**874.

DESIGN FACTORS	MECHANICAL	PRODUCT DESCRIPTORS	
WEIGHT	200.100	ENGINEERING COMPLEXITY	0.700
DENSITY	10.005*	PROTOTYPE SUPPORT	1.0
MFG. COMPLEXITY	8.500	PROTO SCHEDULE FACTOR	.250*
NEW DESIGN	0.250	PLATFORM	2.500
DESIGN REPEAT	0.800*	YEAR OF TECHNOLOGY	1978
EQUIPMENT CLASS	*****	RELIABILITY FACTOR	1.0
ENGINEERING CHANGES	.030*	MTBF(FIELD)	12654*
INTEGRATION LEVEL	1.0		

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(10)	MAR 86*	(8)	NOV 86*	(18)
PRODUCTION	JUN 87	(19)	DEC 88*	(4)	APR 89*	(23)

SUPPLEMENTAL INFORMATION		TOOLING & PROCESS FACTORS	
YEAR OF ECONOMICS	1982	DEVELOPMENT TOOLING	1.00*
ESCALATION	0.00	PRODUCTION TOOLING	1.00*
T-1 COST	1168.16*	RATE TOOLING	0
AMORTIZED UNIT COST	1255.37*	PRICE IMPROVEMENT FACTOR	******
DEV COST MULTIPLIER	1.35	UNIT LEARNING CURVE	.875*
PROD COST MULTIPLIER	1.35		

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	4747.	6605.	11352.
CENTER	5342.	7532.	12874.
TO	5900.	8313.	14213.

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MECHANICAL ITEM

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HYDROGEN STORAGE TANK

PRODUCTION QUANTITY	3	UNIT WEIGHT	141.60	MODE	2
PROTOTYPE QUANTITY	2.000	UNIT VOLUME	14.00	QUANTITY/NHA	1

UNIT PROD COST 715.32 COST PROCESS FACTOR : MONTHLY PROD RATE 1.05

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	16.	24.	40.
DESIGN	49.	113.	161.
SYSTEMS	4.	-	4.
PROJECT MGMT	468.	422.	890.
DATA	35.	241.	276.
SUBTOTAL(ENG)	571.	799.	1370.
MANUFACTURING			
PRODUCTION	-	2146.	2146.
PROTOTYPE	1808.	-	1808.
TOOL-TEST EQ	167.	19.	185.
SUBTOTAL(MFG)	1975.	2165.	4140.
TOTAL COST	2547.	2984.	5510.

DESIGN FACTORS	MECHANICAL
WEIGHT	141.600
DENSITY	10.114*
MFG. COMPLEXITY	8.500
NEW DESIGN	0.050
DESIGN REPEAT	0.788*
EQUIPMENT CLASS	*****
ENGINEERING CHANGES	.033*
INTEGRATION LEVEL	1.0

PRODUCT DESCRIPTORS	
ENGINEERING COMPLEXITY	0.700
PROTOTYPE SUPPORT	1.0
PROTO SCHEDULE FACTOR	.250*
PLATFORM	2.500
YEAR OF TECHNOLOGY	1978
RELIABILITY FACTOR	1.0
MTBF(FIELD)	14037*

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(10)	MAR 86*	(5)	AUG 86*	(15)
PRODUCTION	JUN 87	(18)	NOV 88*	(2)	JAN 89*	(20)

SUPPLEMENTAL INFORMATION	
YEAR OF ECONOMICS	1982
ESCALATION	0.00
T-1 COST	798.05*
AMORTIZED UNIT COST	987.90*
DEV COST MULTIPLIER	1.35
PROD COST MULTIPLIER	1.35

TOOLING & PROCESS FACTORS	
DEVELOPMENT TOOLING	1.00*
PRODUCTION TOOLING	1.00*
RATE TOOLING	0
PRICE IMPROVEMENT FACTOR	******
UNIT LEARNING CURVE	.875*

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	2259.	2607.	4866.
CENTER	2547.	2984.	5510.
TO	2813.	3264.	6076.

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MECHANICAL ITEM

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OXYGEN STORAGE TANK

PRODUCTION QUANTITY	3	UNIT WEIGHT	151.50	MODE	2
PROTOTYPE QUANTITY	2.000	UNIT VOLUME	14.00	QUANTITY/NHA	1

UNIT PROD COST 725.51 COST PROCESS FACTOR 1 MONTHLY PROD RATE 1.03

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	7.	21.	28.
DESIGN	16.	99.	115.
SYSTEMS	0.	-	0.
PROJECT MGMT	634.	443.	1077.
DATA	63.	253.	316.
SUBTOTAL(ENG)	721.	816.	1537.
MANUFACTURING			
PRODUCTION	-	2177.	2177.
PROTOTYPE	1582.	-	1582.
TOOL-TEST EQ	89.	20.	109.
SUBTOTAL(MFG)	1671.	2196.	3867.
TOTAL COST	2392.	3012.	5404.

DESIGN FACTORS	MECHANICAL	PRODUCT DESCRIPTORS	
WEIGHT	151.500	ENGINEERING COMPLEXITY	0.300
DENSITY	10.821*	PROTOTYPE SUPPORT	1.0
MFG. COMPLEXITY	8.500	PROTO SCHEDULE FACTOR	.250*
NEW DESIGN	0.050	PLATFORM	2.500
DESIGN REPEAT	0.789*	YEAR OF TECHNOLOGY	1978
EQUIPMENT CLASS	*****	RELIABILITY FACTOR	1.0
ENGINEERING CHANGES	.025*	MTBF(FIELD)	13755*
INTEGRATION LEVEL	1.0		

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(4)	SEP 85*	(6)	MAR 86*	(10)
PRODUCTION	JUN 87	(18)	NOV 88*	(2)	JAN 89*	(20)

SUPPLEMENTAL INFORMATION		TOOLING & PROCESS FACTORS	
YEAR OF ECONOMICS	1982	DEVELOPMENT TOOLING	1.00*
ESCALATION	0.00	PRODUCTION TOOLING	1.00*
T-1 COST	809.29*	RATE TOOLING	0
AMORTIZED UNIT COST	1003.94*	PRICE IMPROVEMENT FACTOR	******
DEV COST MULTIPLIER	1.35	UNIT LEARNING CURVE	.875*
PROD COST MULTIPLIER	1.35		

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	2116.	2646.	4762.
CENTER	2392.	3012.	5404.
TO	2643.	3322.	5965.

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MECHANICAL ITEM

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PLUMBING

PRODUCTION QUANTITY	3	UNIT WEIGHT	79.10	MODE	2
PROTOTYPE QUANTITY	2.000	UNIT VOLUME	7.00	QUANTITY/NHA	1

UNIT PROD COST 220.25 COST PROCESS FACTOR 1 MONTHLY PROD RATE 1.45

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	99.	10.	109.
DESIGN	298.	44.	342.
SYSTEMS	26.	-	26.
PROJECT MGMT	315.	136.	450.
DATA	31.	78.	109.
SUBTOTAL(ENG)	769.	268.	1037.
MANUFACTURING			
PRODUCTION	-	661.	661.
PROTOTYPE	587.	-	587.
TOOL-TEST EQ	52.	7.	59.
SUBTOTAL(MFG)	639.	668.	1307.
TOTAL COST	1408.	936.	2343.

DESIGN FACTORS	MECHANICAL	PRODUCT DESCRIPTORS	
WEIGHT	79.100	ENGINEERING COMPLEXITY	0.700
DENSITY	11.300*	PROTOTYPE SUPPORT	1.0
MFG. COMPLEXITY	8.000	PROTO SCHEDULE FACTOR	.250*
NEW DESIGN	0.500	PLATFORM	2.500
DESIGN REPEAT	0.732*	YEAR OF TECHNOLOGY	1976
EQUIPMENT CLASS	*****	RELIABILITY FACTOR	1.0
ENGINEERING CHANGES	.024*	MTBF(FIELD)	20295*
INTEGRATION LEVEL	1.0		

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(9)	FEB 86*	(5)	JUL 86*	(14)
PRODUCTION	JUN 87	(15)	AUG 88*	(1)	SEP 88*	(16)

SUPPLEMENTAL INFORMATION		TOOLING & PROCESS FACTORS	
YEAR OF ECONOMICS	1982	DEVELOPMENT TOOLING	1.00*
ESCALATION	0.00	PRODUCTION TOOLING	1.00*
T-1 COST	243.92*	RATE TOOLING	0
AMORTIZED UNIT COST	311.91*	PRICE IMPROVEMENT FACTOR	******
DEV COST MULTIPLIER	1.35	UNIT LEARNING CURVE	.883*
PROD COST MULTIPLIER	1.35		

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	1258.	821.	2079.
CENTER	1408.	936.	2343.
TO	1568.	1041.	2609.

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MECHANICAL ITEM

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SUPPORTS

PRODUCTION QUANTITY	3	UNIT WEIGHT	482.00	MODE	2
PROTOTYPE QUANTITY	2.000	UNIT VOLUME	7.00	QUANTITY/NHA	1

UNIT PROD COST 1072.22 COST PROCESS FACTOR 1 MONTHLY PROD RATE 1.02

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	327.	41.	368.
DESIGN	981.	157.	1138.
SYSTEMS	86.	-	86.
PROJECT MGMT	1284.	647.	1931.
DATA	121.	370.	491.
SUBTOTAL(ENG)	2799.	1214.	4013.
MANUFACTURING			
PRODUCTION	-	3217.	3217.
PROTOTYPE	2889.	-	2889.
TOOL-TEST EQ	250.	32.	282.
SUBTOTAL(MFG)	3139.	3248.	6387.
TOTAL COST	5938.	4463.	10401.

DESIGN FACTORS	MECHANICAL
WEIGHT	482.000
DENSITY	68.857*
MFG. COMPLEXITY	8.000
NEW DESIGN	0.500
DESIGN REPEAT	0.751*
EQUIPMENT CLASS	*****
ENGINEERING CHANGES	.025*
INTEGRATION LEVEL	1.0

PRODUCT DESCRIPTORS	
ENGINEERING COMPLEXITY	0.700
PROTOTYPE SUPPORT	1.0
PROTO SCHEDULE FACTOR	.250*
PLATFORM	2.500
YEAR OF TECHNOLOGY	1978
RELIABILITY FACTOR	1.0
MTBF(FIELD)	11801*

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(9)	FEB 86*	(5)	JUL 86*	(14)
PRODUCTION	JUN 87	(19)	DEC 88*	(2)	FEB 89*	(21)

SUPPLEMENTAL INFORMATION	
YEAR OF ECONOMICS	1982
ESCALATION	0.00
T-1 COST	1192.91*
AMORTIZED UNIT COST	1487.54*
DEV COST MULTIPLIER	1.35
PROD COST MULTIPLIER	1.35

TOOLING & PROCESS FACTORS	
DEVELOPMENT TOOLING	1.00*
PRODUCTION TOOLING	1.00*
RATE TOOLING	0
PRICE IMPROVEMENT FACTOR	******
UNIT LEARNING CURVE	.878*

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	5209.	3819.	9028.
CENTER	5938.	4463.	10401.
TO	6776.	5149.	11924.

WBS 1.3.1.11

P/A MODULE POWER DISTRIBUTION & CONTROL SUBSYSTEM

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ELECTRONIC ITEM

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INVERTER ASSYS.

PRODUCTION QUANTITY	6	UNIT WEIGHT	45.00	MODE	1
PROTOTYPE QUANTITY	3.000	UNIT VOLUME	1.00	QUANTITY/NHA	2

UNIT PROD COST 171.78 COST PROCESS FACTOR 1 MONTHLY PROD RATE 1.60

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	948.	58.	1006.
DESIGN	3202.	201.	3404.
SYSTEMS	354.	-	354.
PROJECT MGMT	1569.	226.	1795.
DATA	170.	128.	298.
SUBTOTAL(ENG)	6243.	613.	6855.
MANUFACTURING			
PRODUCTION	-	1031.	1031.
PROTOTYPE	683.	-	683.
TOOL-TEST EQ	77.	18.	95.
SUBTOTAL(MFG)	760.	1049.	1808.
TOTAL COST	7002.	1662.	8664.

DESIGN FACTORS	ELECTRONIC	MECHANICAL
WEIGHT	33.000*	12.000
DENSITY	50.000	12.000*
MFG. COMPLEXITY	8.600	6.600
NEW DESIGN	1.000	1.000
DESIGN REPEAT	0.552*	0.453*
EQUIPMENT CLASS	*****	*****
ENGINEERING CHANGES	.037*	.014*
INTEGRATION LEVEL	0.5	0.3

PRODUCT DESCRIPTORS	
ENGINEERING COMPLEXITY	0.900
PROTOTYPE SUPPORT	1.0
PROTO SCHEDULE FACTOR	.250*
ELECT VOL FRACTION	.660*
PLATFORM	2.500
YEAR OF TECHNOLOGY	1978
RELIABILITY FACTOR	1.0
MTBF(FIELD)	11332*

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(12)	MAY 86*	(8)	JAN 87*	(20)
PRODUCTION	JUN 87	(15)	AUG 88*	(3)	NOV 88*	(18)

SUPPLEMENTAL INFORMATION

YEAR OF ECONOMICS	1982	TOOLING & PROCESS FACTORS	
ESCALATION	0.00	DEVELOPMENT TOOLING	1.00*
T-1 COST	200.53*	PRODUCTION TOOLING	1.00*
AMORTIZED UNIT COST	276.95*	RATE TOOLING	0
DEV COST MULTIPLIER	1.35	PRICE IMPROVEMENT FACTOR	******
PROD COST MULTIPLIER	1.35	UNIT LEARNING CURVE	.904*

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	6165.	1399.	7585.
CENTER	7002.	1662.	8664.
TO	8097.	2006.	10103.

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ELECTRONIC ITEM

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POWER CONTROL ASSY

PRODUCTION QUANTITY	3	UNIT WEIGHT	200.00	MODE	1
PROTOTYPE QUANTITY	2.000	UNIT VOLUME	4.00	QUANTITY/NHA	1

UNIT PROD COST 489.84 COST PROCESS FACTOR 1 MONTHLY PROD RATE 1.04

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	1745.	124.	1869.
DESIGN	5776.	413.	6189.
SYSTEMS	659.	-	659.
PROJECT MGMT	2808.	378.	3186.
DATA	314.	216.	530.
SUBTOTAL(ENG)	11303.	1131.	12434.
MANUFACTURING			
PRODUCTION	-	1500.	1500.
PROTOTYPE	1405.	-	1405.
TOOL-TEST EQ	167.	27.	194.
SUBTOTAL(MFG)	1571.	1526.	3098.
TOTAL COST	12874.	2657.	15531.

DESIGN FACTORS	ELECTRONIC	MECHANICAL
WEIGHT	100.000*	100.000
DENSITY	50.000	25.000*
MFG. COMPLEXITY	8.600	6.600
NEW DESIGN	1.000	1.000
DESIGN REPEAT	0.634*	0.581*
EQUIPMENT CLASS	*****	*****
ENGINEERING CHANGES	.043*	.017*
INTEGRATION LEVEL	0.5	0.3

PRODUCT DESCRIPTORS	
ENGINEERING COMPLEXITY	0.900
PROTOTYPE SUPPORT	1.0
PROTO SCHEDULE FACTOR	.250*
ELECT VOL FRACTION	.500*
PLATFORM	2.500
YEAR OF TECHNOLOGY	1976
RELIABILITY FACTOR	1.0
MTBF(FIELD)	3823*

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(12)	MAY 86*	(8)	NOV 86*	(18)
PRODUCTION	JUN 87	(18)	NOV 88*	(2)	JAN 89*	(20)

SUPPLEMENTAL INFORMATION

YEAR OF ECONOMICS	1982
ESCALATION	0.00
T-1 COST	539.11*
AMORTIZED UNIT COST	885.71*
DEV COST MULTIPLIER	1.35
PROD COST MULTIPLIER	1.35

TOOLING & PROCESS FACTORS	
DEVELOPMENT TOOLING	1.00*
PRODUCTION TOOLING	1.00*
RATE TOOLING	0
PRICE IMPROVEMENT FACTOR	*****
UNIT LEARNING CURVE	.913*

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	11359.	2252.	13611.
CENTER	12874.	2657.	15531.
TO	14910.	3185.	18095.

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ELECTRONIC ITEM

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POWER DIST.BOX

PRODUCTION QUANTITY	3	UNIT WEIGHT	150.00	MODE	1
PROTOTYPE QUANTITY	2.000	UNIT VOLUME	4.00	QUANTITY/NHA	1

UNIT PROD COST 387.98 COST PROCESS FACTOR 1 MONTHLY PROD RATE 1.10

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	1498.	104.	1600.
DESIGN	4951.	351.	5302.
SYSTEMS	565.	-	565.
PROJECT MGMT	2383.	301.	2683.
DATA	268.	172.	439.
SUBTOTAL(ENG)	9662.	927.	10589.
MANUFACTURING			
PRODUCTION	-	1164.	1164.
PROTOTYPE	1089.	-	1089.
TOOL-TEST EQ	131.	21.	152.
SUBTOTAL(MFG)	1220.	1185.	2405.
TOTAL COST	10883.	2112.	12995.

DESIGN FACTORS	ELECTRONIC	MECHANICAL
WEIGHT	75.000*	75.000
DENSITY	50.000	18.750*
MFG. COMPLEXITY	8.600	8.600
NEW DESIGN	1.000	1.000
DESIGN REPEAT	0.614*	0.576*
EQUIPMENT CLASS	*****	*****
ENGINEERING CHANGES	.043*	.016*
INTEGRATION LEVEL	0.5	0.3

PRODUCT DESCRIPTORS	
ENGINEERING COMPLEXITY	0.900
PROTOTYPE SUPPORT	1.0
PROTO SCHEDULE FACTOR	.250*
ELECT VOL FRACTION	.375*
PLATFORM	2.500
YEAR OF TECHNOLOGY	1976
RELIABILITY FACTOR	1.0
MTBF(FIELD)	5068*

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(12)	MAY 86*	(6)	NOV 86*	(18)
PRODUCTION	JUN 87	(18)	NOV 88*	(1)	DEC 88*	(19)

SUPPLEMENTAL INFORMATION

YEAR OF ECONOMICS	1982	TOOLING & PROCESS FACTORS	
ESCALATION	0.00	DEVELOPMENT TOOLING	1.00*
T-1 COST	418.23*	PRODUCTION TOOLING	1.00*
AMORTIZED UNIT COST	704.00*	RATE TOOLING	0
DEV COST MULTIPLIER	1.35	PRICE IMPROVEMENT FACTOR	******
PROD COST MULTIPLIER	1.35	UNIT LEARNING CURVE	.914*

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	9811.	1798.	11408.
CENTER	10883.	2112.	12995.
TO	12589.	2523.	15112.

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MECHANICAL ITEM

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POWER HARNESS

PRODUCTION QUANTITY	3	UNIT WEIGHT	428.00	MODE	2
PROTOTYPE QUANTITY	2.000	UNIT VOLUME	7.00	QUANTITY/NHA	1

UNIT PROD COST 986.25 COST PROCESS FACTOR 1 MONTHLY PROD RATE 1.05

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	241.	15.	256.
DESIGN	724.	58.	782.
SYSTEMS	64.	-	64.
PROJECT MGMT	1070.	563.	1632.
DATA	98.	322.	420.
SUBTOTAL(ENG)	2197.	957.	3154.
MANUFACTURING			
PRODUCTION	-	2899.	2899.
PROTOTYPE	2602.	-	2602.
TOOL-TEST EQ	228.	29.	254.
SUBTOTAL(MFG)	2827.	2927.	5755.
TOTAL COST	5024.	3885.	8909.

DESIGN FACTORS	MECHANICAL	PRODUCT DESCRIPTORS	
WEIGHT	428.000	ENGINEERING COMPLEXITY	0.700
DENSITY	61.143*	PROTOTYPE SUPPORT	1.0
MFG. COMPLEXITY	8.000	PROTO SCHEDULE FACTOR	.250*
NEW DESIGN	1.000	PLATFORM	2.500
DESIGN REPEAT	0.900	YEAR OF TECHNOLOGY	1978
EQUIPMENT CLASS	*****	RELIABILITY FACTOR	1.0
ENGINEERING CHANGES	.025*	MTBF(FIELD)	12230*
INTEGRATION LEVEL	1.0		

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(9)	FEB 86*	(5)	JUL 86*	(14)
PRODUCTION	JUN 87	(18)	NOV 88*	(2)	JAN 89*	(20)

SUPPLEMENTAL INFORMATION		TOOLING & PROCESS FACTORS	
YEAR OF ECONOMICS	1982	DEVELOPMENT TOOLING	1.00*
ESCALATION	0.00	PRODUCTION TOOLING	1.00*
T-1 COST	1074.69*	RATE TOOLING	0
AMORTIZED UNIT COST	1294.87*	PRICE IMPROVEMENT FACTOR	******
DEV COST MULTIPLIER	1.35	UNIT LEARNING CURVE	.879*
PROD COST MULTIPLIER	1.35		

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	4406.	3319.	7724.
CENTER	5024.	3885.	8909.
TO	5727.	4483.	10210.

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MECHANICAL ITEM

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AVIONICS HARNESS

PRODUCTION QUANTITY	3	UNIT WEIGHT	2071.00	MODE	2
PROTOTYPE QUANTITY	2.000	UNIT VOLUME	7.00	QUANTITY/NHA	1

UNIT PROD COST 3843.97 COST PROCESS FACTOR 1 MONTHLY PROD RATE 0.77

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	728.	53.	781.
DESIGN	2184.	230.	2414.
SYSTEMS	192.	-	192.
PROJECT MGMT	3881.	2226.	6107.
DATA	344.	1274.	1618.
SUBTOTAL(ENG)	7329.	3784.	11112.
MANUFACTURING			
PRODUCTION	-	11532.	11532.
PROTOTYPE	10443.	-	10443.
TOOL-TEST EQ	830.	68.	898.
SUBTOTAL(MFG)	11273.	11600.	22873.
TOTAL COST	18601.	15384.	33985.

DESIGN FACTORS	MECHANICAL	PRODUCT DESCRIPTORS	
WEIGHT	2071.000	ENGINEERING COMPLEXITY	0.700
DENSITY	295.857*	PROTOTYPE SUPPORT	1.0
MFG. COMPLEXITY	8.000	PROTO SCHEDULE FACTOR	.250*
NEW DESIGN	1.000	PLATFORM	2.500
DESIGN REPEAT	0.900	YEAR OF TECHNOLOGY	1976
EQUIPMENT CLASS	*****	RELIABILITY FACTOR	1.0
ENGINEERING CHANGES	.026*	MTBF(FIELD)	7620*
INTEGRATION LEVEL	1.0		

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(9)	FEB 86*	(5)	JUL 86*	(14)
PRODUCTION	JUN 87	(23)	APR 89*	(3)	JUL 89*	(26)

SUPPLEMENTAL INFORMATION		TOOLING & PROCESS FACTORS	
YEAR OF ECONOMICS	1982	DEVELOPMENT TOOLING	1.00*
ESCALATION	0.00	PRODUCTION TOOLING	1.00*
T-1 COST	4292.03*	RATE TOOLING	0
AMORTIZED UNIT COST	5127.97*	PRICE IMPROVEMENT FACTOR	******
DEV COST MULTIPLIER	1.35	UNIT LEARNING CURVE	.874*
PROD COST MULTIPLIER	1.35		

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	16486.	13369.	29856.
CENTER	18601.	15384.	33985.
TO	20779.	17238.	38017.

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INTEGRATION AND TEST

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ELECTRICAL POWER SYSTEM INTEG/ASSY/TEST

PRODUCTION QUANTITY	3	INT WEIGHT	303.441*	MODE	5
PROTOTYPE QUANTITY	1.250	INT VOLUME	18.860*	QUANTITY/NHA	1

UNIT PROD COST 503.53 MONTHLY PROD RATE 0.10

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	1280.	288.	1568.
DESIGN	3779.	1162.	4940.
SYSTEMS	375.	-	375.
PROJECT MGMT	1814.	796.	2410.
DATA	188.	488.	676.
SUBTOTAL(ENG)	7235.	2734.	9969.
MANUFACTURING			
PRODUCTION	-	1511.	1511.
PROTOTYPE	1501.	-	1501.
TOOL-TEST EQ	151.	11.	162.
SUBTOTAL(MFG)	1652.	1522.	3174.
TOTAL COST	8887.	4255.	13143.

DESIGN FACTORS	ELECTRONIC	MECHANICAL
WEIGHT	20.536*	282.904*
DENSITY	35.000*	15.000*
MFG. COMPLEXITY	7.886*	7.713*
NEW DESIGN	0.000	0.500
DESIGN REPEAT	0.000	0.000
EQUIPMENT CLASS	*****	*****
ENGINEERING CHANGES	.074*	.053*
INTEGRATION LEVEL	0.3	2.0

PRODUCT DESCRIPTORS	
ENGINEERING COMPLEXITY	0.909*
PROTOTYPE SUPPORT	1.0
PROTO SCHEDULE FACTOR	.250*
ELECT VOL FRACTION	.031
PLATFORM	2.500
YEAR OF TECHNOLOGY	1978
RELIABILITY FACTOR	1.0
MTBF(FIELD)	14020*

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(25)	JUN 87	(0)	JUN 87	(25)
PRODUCTION	JUN 87	(17)	OCT 88*	(20)	JUN 90	(37)

SUPPLEMENTAL INFORMATION

YEAR OF ECONOMICS	1982
ESCALATION	0.00
AMORTIZED UNIT COST	1418.45*
DEV COST MULTIPLIER	1.35
PROD COST MULTIPLIER	1.35

TOOLING & PROCESS FACTORS	
DEVELOPMENT TOOLING	1.00*
PRODUCTION TOOLING	1.00*

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	7997.	3813.	11810.
CENTER	8887.	4255.	13143.
TO	9933.	4719.	14652.

A.2 PAYLOAD MODULE

This section of Appendix A presents the detailed output reports that were produced by the PRICE 84 hardware cost model in estimating development and production costs for the SDLV Payload Module. These costs all pertain to WBS 1.4.1, Payload Module Hardware.

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MECHANICAL ITEM

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PAYLOAD MODULE STRUCTURE

PRODUCTION QUANTITY	134	UNIT WEIGHT	35436.00	MODE	2
PROTOTYPE QUANTITY	1.250	UNIT VOLUME	354.00	QUANTITY/NHA	1

UNIT PROD COST 9141.22 COST PROCESS FACTOR 58 MONTHLY PROD RATE 1.08

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	6638.	834.	7472.
DESIGN	22071.	2732.	24804.
SYSTEMS	4991.	-	4991.
PROJECT MGMT	7140.	149447.	156586.
DATA	3204.	75565.	78769.
SUBTOTAL(ENG)	44044.	228578.	272622.
MANUFACTURING			
PRODUCTION	-	1224924.	1224924.
PROTOTYPE	104615.	-	104615.
TOOL-TEST EQ	14498.	135209.	149707.
SUBTOTAL(MFG)	119113.	1360133.	1479246.
TOTAL COST	163157.	1588711.	1751868.

DESIGN FACTORS	MECHANICAL
WEIGHT	35436.000
DENSITY	100.102*
MFG. COMPLEXITY	7.000
NEW DESIGN	1.000
DESIGN REPEAT	0.835*
EQUIPMENT CLASS	*****
ENGINEERING CHANGES	.070*
INTEGRATION LEVEL	1.0

PRODUCT DESCRIPTORS	
ENGINEERING COMPLEXITY	1.300
PROTOTYPE SUPPORT	2.5
PROTO SCHEDULE FACTOR	.250*
PLATFORM	2.000
YEAR OF TECHNOLOGY	1976
RELIABILITY FACTOR	1.0
MTBF(FIELD)	7616*

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(14)	JUL 86*	(2)	SEP 86*	(16)
PRODUCTION	JAN 88	(27)	MAR 90*	(123)	JUN 00	(150)

SUPPLEMENTAL INFORMATION

YEAR OF ECONOMICS	1982
ESCALATION	0.00
T-1 COST	18878.73*
AMORTIZED UNIT COST	11858.05*
DEV COST MULTIPLIER	1.35
PROD COST MULTIPLIER	1.35

TOOLING & PROCESS FACTORS

DEVELOPMENT TOOLING	M.100
PRODUCTION TOOLING	M.500
RATE TOOLING	0
PRICE IMPROVEMENT FACTOR	******
UNIT LEARNING CURVE	.877*

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	138151.	1315993.	1454144.
CENTER	163157.	1588711.	1751868.
TO	196760.	1941215.	2137975.

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MECHANICAL ITEM

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PAYLOAD MODULE REACTION CONTROL SYSTEM

PRODUCTION QUANTITY	134	UNIT WEIGHT	1095.00	MODE	2
PROTOTYPE QUANTITY	1.250	UNIT VOLUME	22.00	QUANTITY/NHA	1

UNIT PROD COST 3698.52 COST PROCESS FACTOR 56 MONTHLY PROD RATE 1.06

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	1098.	331.	1429.
DESIGN	3827.	1423.	5050.
SYSTEMS	492.	-	492.
PROJECT MGMT	749.	48964.	49714.
DATA	298.	24690.	24988.
SUBTOTAL(ENG)	6264.	75409.	81673.
MANUFACTURING			
PRODUCTION	-	495601.	495601.
PROTOTYPE	18829.	-	18829.
TOOL-TEST EQ	1170.	1260.	2431.
SUBTOTAL(MFG)	19999.	496862.	516861.
TOTAL COST	26263.	572271.	598534.

DESIGN FACTORS	MECHANICAL
WEIGHT	1095.000
DENSITY	49.773*
MFG. COMPLEXITY	8.500
NEW DESIGN	1.000
DESIGN REPLAT	0.816*
EQUIPMENT CLASS	*****
ENGINEERING CHANGES	.156*
INTEGRATION LEVEL	1.0

PRODUCT DESCRIPTORS	
ENGINEERING COMPLEXITY	1.000
PROTOTYPE SUPPORT	2.0
PROTO SCHEDULE FACTOR	.250*
PLATFORM	2.000
YEAR OF TECHNOLOGY	1976
RELIABILITY FACTOR	1.0
MTBF(FIELD)	11612*

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(14)	JUL 86*	(2)	SEP 86*	(16)
PRODUCTION	JAN 88	(25)	JAN 90*	(125)	JUN 00	(150)

SUPPLEMENTAL INFORMATION	
YEAR OF ECONOMICS	1982
ESCALATION	0.00
T-1 COST	8043.53*
AMORTIZED UNIT COST	4270.88*
DEV COST MULTIPLIER	1.35
PROD COST MULTIPLIER	1.35

TOOLING & PROCESS FACTORS	
DEVELOPMENT TOOLING	1.00*
PRODUCTION TOOLING	1.00*
RATE TOOLING	0
PRICE IMPROVEMENT FACTOR	******
UNIT LEARNING CURVE	.869*

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	23126.	488556.	511681.
CENTER	26263.	572271.	598534.
TO	29808.	651517.	681125.

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MECHANICAL ITEM

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PAYLOAD MODULE THERMAL PROTECTION SYS.

PRODUCTION QUANTITY	134	UNIT WEIGHT	6676.00	MODE	2
PROTOTYPE QUANTITY	1.250	UNIT VOLUME	68.00	QUANTITY/NHA	1

UNIT PROD COST 1103.25 COST PROCESS FACTOR 56 MONTHLY PROD RATE 1.01

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	1880.	224.	2104.
DESIGN	5749.	663.	6412.
SYSTEMS	1147.	-	1147.
PROJECT MGMT	1067.	21749.	22815.
DATA	488.	11379.	11867.
SUBTOTAL(ENG)	10330.	34015.	44345.
MANUFACTURING			
PRODUCTION	-	147836.	147836.
PROTOTYPE	10570.	-	10570.
TOOL-TEST EQ	561.	387.	948.
SUBTOTAL(MFG)	11131.	148223.	159354.
TOTAL COST	21461.	182238.	203698.

DESIGN FACTORS	MECHANICAL	PRODUCT DESCRIPTORS	
WEIGHT	6676.000	ENGINEERING COMPLEXITY	1.100
DENSITY	98.176*	PROTOTYPE SUPPORT	2.5
MFG. COMPLEXITY	6.400	PROTO SCHEDULE FACTOR	.250*
NEW DESIGN	1.000	PLATFORM	2.000
DESIGN REPEAT	0.739*	YEAR OF TECHNOLOGY	1978
EQUIPMENT CLASS	*****	RELIABILITY FACTOR	1.0
ENGINEERING CHANGES	.085*	MTBF(FIELD)	16739*
INTEGRATION LEVEL	1.0		

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(11)	APR 86*	(1)	MAY 86*	(12)
PRODUCTION	JAN 88	(18)	JUN 89*	(132)	JUN 00	(150)

SUPPLEMENTAL INFORMATION		TOOLING & PROCESS FACTORS	
YEAR OF ECONOMICS	1982	DEVELOPMENT TOOLING	1.00*
ESCALATION	0.00	PRODUCTION TOOLING	1.00*
T-1 COST	2115.24*	RATE TOOLING	0
AMORTIZED UNIT COST	1359.98*	PRICE IMPROVEMENT FACTOR	******
DEV COST MULTIPLIER	1.35	UNIT LEARNING CURVE	.889*
PROD COST MULTIPLIER	1.35		

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	18250.	149147.	167397.
CENTER	21461.	182238.	203698.
TO	26190.	230398.	256589.

- - - PRICE 84 - - -
INTEGRATION AND TEST

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PAYLOAD MODULE INTEG/ASSY/TEST

PRODUCTION QUANTITY	134	INT WEIGHT	2723.196*	MODE	5
PROTOTYPE QUANTITY	1.250	INT VOLUME	181.546*	QUANTITY/NHA	1

UNIT PROD COST 891.60 MONTHLY PROD RATE 1.15

PROGRAM COST($ 1000)	DEVELOPMENT	PRODUCTION	TOTAL COST
ENGINEERING			
DRAFTING	5459.	549.	6009.
DESIGN	15725.	1920.	17645.
SYSTEMS	1682.	-	1682.
PROJECT MGMT	1588.	13520.	15109.
DATA	564.	7049.	7613.
SUBTOTAL(ENG)	25019.	23038.	48057.
MANUFACTURING			
PRODUCTION	-	92674.	92674.
PROTOTYPE	4485.	-	4485.
TOOL-TEST EQ	375.	324.	699.
SUBTOTAL(MFG)	4860.	92998.	97858.
TOTAL COST	29879.	116036.	145915.

DESIGN FACTORS	MECHANICAL	PRODUCT DESCRIPTORS	
WEIGHT	2723.196*	ENGINEERING COMPLEXITY	1.000*
DENSITY	15.000*	PROTOTYPE SUPPORT	1.0
MFG. COMPLEXITY	6.689*	PROTO SCHEDULE FACTOR	.250*
NEW DESIGN	1.000	PLATFORM	2.000
DESIGN REPEAT	0.000	YEAR OF TECHNOLOGY	1976
EQUIPMENT CLASS	*****	RELIABILITY FACTOR	1.0
ENGINEERING CHANGES	.069*	MTBF(FIELD)	19015*
INTEGRATION LEVEL	0.5		

SCHEDULE	START		FIRST ITEM		FINISH	
DEVELOPMENT	JUN 85	(32)	JAN 88	(0)	JAN 88	(32)
PRODUCTION	JAN 88	(17)	MAY 89*	(118)	JAN 99	(133)

SUPPLEMENTAL INFORMATION		TOOLING & PROCESS FACTORS	
YEAR OF ECONOMICS	1982	DEVELOPMENT TOOLING	1.00*
ESCALATION	0.00	PRODUCTION TOOLING	1.00*
AMORTIZED UNIT COST	865.94*		
DEV COST MULTIPLIER	1.35		
PROD COST MULTIPLIER	1.35		

COST RANGES	DEVELOPMENT	PRODUCTION	TOTAL COST
FROM	26582.	98509.	125091.
CENTER	29879.	116036.	145915.
TO	34312.	136660.	170971.