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LIGHTWEIGHT  
TACTICAL DIGITAL FACSIMILE  
PROGRAM

⑥ TACTICAL DIGITAL FACSIMILE (TDF)  
COST GUIDE

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Prepared for  
Naval Electronic Systems Command  
(ELEX-51011)

U.S. NAVAL WEAPONS ENGINEERING SUPPORT ACTIVITY ✓

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Cost Management Division  
Washington Navy Yard  
Washington, D.C. 20374

407935

PREFACE

This guide was prepared by Naval Weapons Engineering Support Activity (ESA-84) for use by the TRI-TAC Lightweight Tactical Digital Facsimile (TDF) contractor(s) in preparation of life cycle cost estimates required for Phase III, Full Scale Development. The life cycle costing methodology presented in this guide has been prepared in accordance with the methodology and guidelines of Volume III, "Life Cycle Costing" of the Cost Effectiveness Program Plan for Joint Tactical Communications.

Prepared by: David F. Johnson  
D.F. Johnson  
ESA-842

Reviewed by: J.W. Bartholomew  
J.W. Bartholomew  
ESA-84

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SECTION 1  
INTRODUCTION

1.1 ↓ PURPOSE

The purpose of this Guide is to provide specific detailed guidance for applying life cycle cost analysis in the Lightweight Tactical Digital Facsimile Program.

In August 1974, the Joint Tactical Communications (TRI-TAC) Office issued Volume III, "Life Cycle Costing", of the Cost Effectiveness Program Plan for Joint Tactical Communications. This document provides basic concepts, methodologies, techniques and models for life cycle cost analysis for tactical communications systems, subsystems, and equipments. It is the purpose of this LCC Guide to supplement the TRI-TAC methodology and provide refinements necessary for computing valid life cycle costs for the Tactical Digital Facsimile. The specific application to the facsimile equipment is reflected in the Navy's guidance relative to the selection of cost elements, specific cost rules and assumptions and other cost factors that are peculiar to the TDF equipment.

←  
1.2 ORGANIZATION

The basic approach in the preparation of this Guide was to document additional guidance for each of the eight (8) steps of the general life cycle costing methodology presented in TRI-TAC's Life Cycle Costing Volume.

The steps of the methodology are:

- Step 1 State Objectives
- Step 2 Define Assumptions
- Step 3 Select Cost Elements
- Step 4 Select Cost Estimating Relationships
- Step 5 Collect Data
- Step 6 Estimate Element Cost
- Step 7 Perform Sensitivity Analysis
- Step 8 Present Results

Step 1: Section 2 of this guide defines the basic objectives of the cost analysis and the general scope of the cost study.

Step 2: Section 3 of this Guide establishes the costing rules and assumptions which shall be used in the preparation of life cycle estimates. As more is learned about the system and cost information is available, these initial assumptions may be refined to make results of the cost analysis more representative of the real world.

Step 3: A life cycle cost estimating model is presented in Section 4 of this Guide. The cost breakdown structure of this model specifies the cost categories and elements for which costs are to be quantified. The structure was established so that the LCC analysis will consider all pertinent costs associated with the Tactical Digital Facsimile Program. Definitions of the elements in the structure are provided in Appendix A.

Step 4: Section 5 of this guide presents cost estimating relationships for computing the Operating and Support Costs for the facsimile equipment. These basic relationships involve functional relationships that utilize cost factors such as reliability and maintainability parameters.

Step 5, Step 6, Step 7: These three steps of the methodology are task requirements of the contractor. These steps are iterative during the design process and ensure the validity of the final results. Sensitivity analysis identifies those cost elements which strongly influence the total life cycle cost and warrant additional research by collecting more cost data and repeating the estimating cycle.

Step 8: The final section of this guide specifies the general form in which those cost estimates shall be presented to the Navy, in order to facilitate review, analysis and evaluation.

This guide establishes the procedures for performing a life cycle cost analysis which is complimentary and compatible with the design-to-cost program requirements. Appendix B provides a description of the specific design-to-cost program, a definition of the contractual targets and an explanation of target tracking and economic adjustment procedures.

## SECTION 2

### OBJECTIVES OF THE COST ANALYSIS

#### 2.1 GENERAL OBJECTIVES

The overall objective of the life cycle cost analysis during the full-scale development phase is to ensure the successful development of a Lightweight Tactical Digital Facsimile equipment that can be produced for the lowest possible unit production cost and life cycle cost.

#### 2.2 SPECIFIC OBJECTIVES

- a. To provide a consistent framework for collecting, analyzing, estimating, and reporting valid life cycle costs for the proposed system.
- b. To develop cost data for the purpose of evaluating management, engineering and logistic tradeoffs.
- c. To provide a basis for projecting the total program cost and funding requirements.
- d. To monitor the contractor's Design-to-Cost program so that the unit production cost for the system/equipment will not be achieved at the expense of life cycle cost.
- e. To provide cost data for the Government's selection of the most cost-effective system/equipment design for full production.

### 2.3 SCOPE

The cost analysis effort involves three basic subtasks:

- a. Development of life cycle cost estimates for the facsimile equipment and the various configuration options.
- b. Tracking of the design to unit production cost estimate to ensure the achievement of the Design-to-Cost target.
- c. Exercise of the life cycle cost model during the design process and the utilization of the results as factors impacting the design decision process.

## SECTION 3

### COSTING RULES AND ASSUMPTIONS

#### 3.1 GENERAL

a. Constant FY76 Dollars. All costs for the system should be initially stated in constant fiscal dollars of the 1976 fiscal year. Although any base year could be used, DOD guidance suggests that costs for cost studies normally be stated in constant dollars of the latest fiscal year.

b. Time Phasing of Costs. All cost estimates shall be summarized on a fiscal year basis. The program schedule presented in Figure 3-1 shall be used to allocate costs for each major category by year over the entire program life cycle.

c. Inflation. To detect the effect of changes in the purchasing power of a dollar, the cost estimate shall be computed in terms of current (inflated) dollars. Price indices promulgated by the Office of the Assistant Secretary of Defense (Comptroller) for use in escalating cost estimates are presented in Figure 3-2.

d. Discounting. After escalated cost estimates have been developed, the present value technique shall be used to discount costs. At the present time, the discount rate prescribed by DOD Inst. 7041.3 is 10 percent per year. Figure 3-2 presents the annual factors for this purpose.

FIGURE 3-1

LIGHTWEIGHT TACTICAL DIGITAL FACSIMILE PROGRAM SCHEDULE

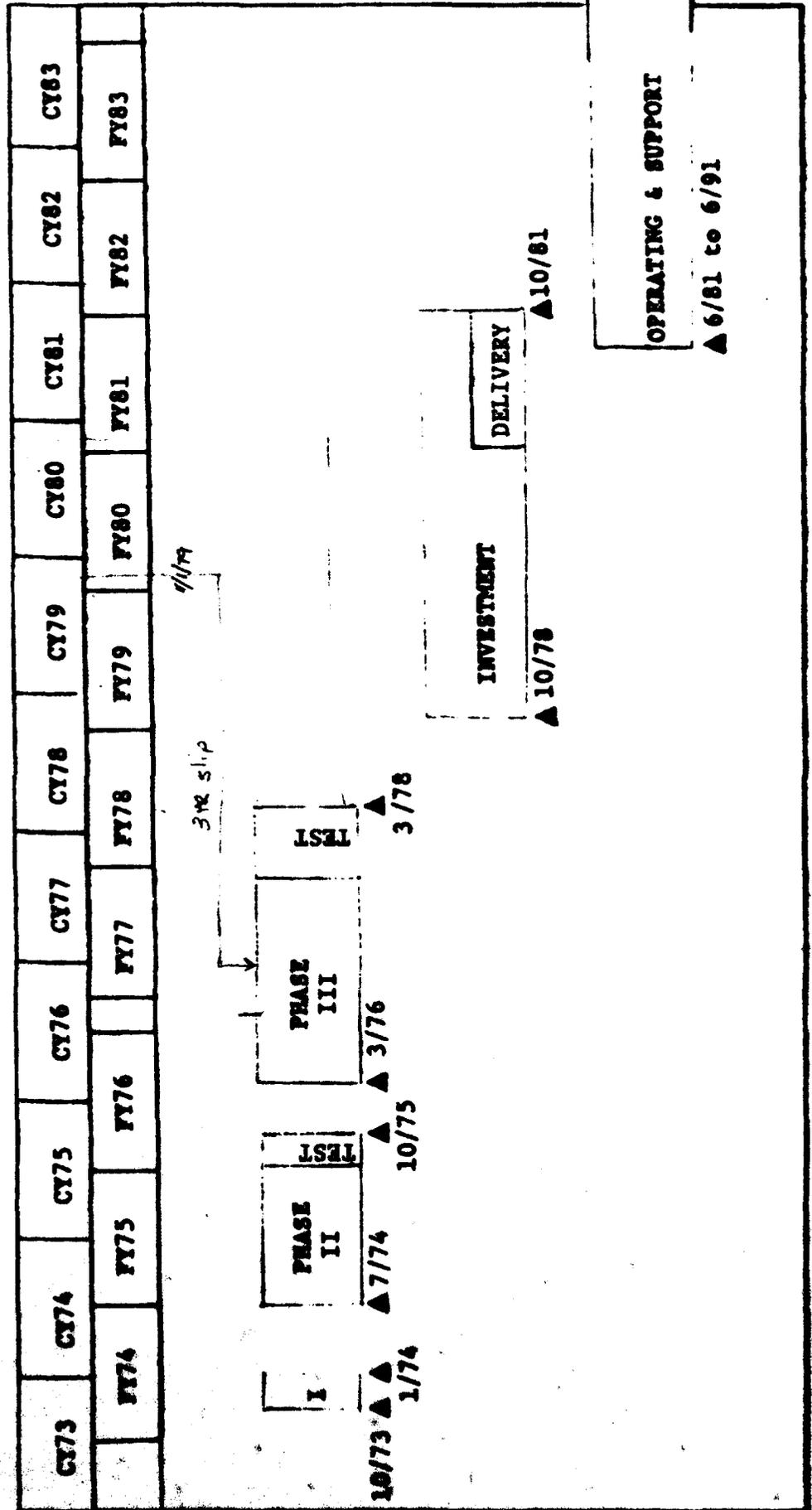


FIGURE 3-2

ANNUAL DISCOUNT FACTORS\*\*

PRICE ESCALATION INDICES\*

<u>Fiscal Year</u>	<u>RDT&amp;E</u>	<u>Procurement</u>	<u>10%</u>
BASE YR? 1975	100.0	100.0	1.000
1976	109.0	110.0	.954
1977	113.6	115.4	.898
1978	118.3	120.4	.846
1979	124.8	127.4	.769
1980	130.1	132.5	.699
1981	135.3	137.5	.635
1982	140.7	142.7	.577
1983	146.0	148.4	.525
1984	151.5	154.3	.477
1985	157.1	160.5	.434.
1986	163.1	166.9	.395
1987	169.3	173.6	.359
1988	175.7	180.5	.326
1989	182.4	187.7	.296
1990	189.3	195.2	.269
1991	196.5	203.0	.244
1992	204.0	211.1	.223
1993	211.8	219.5	.203
1994	219.8	228.3	.184
	228.2	237.4	.167

\* Source: ASD (Comptroller) Memorandum for Assistant Secretaries of the Military Departments, 13 March 1975

\*\* Source: DOD Instruction 7041.3, dated 18 October 1972

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### 3.2 RESEARCH AND DEVELOPMENT COSTS

a. Sunk Costs. Technical Verification (Phase I) costs and Validation (Phase II) costs shall not be included in the contractor's life cycle cost estimates. These will be considered "sunk" costs.

b. Full Scale Development Costs. Full scale development (Phase III) costs shall be a preliminary price estimate based on the preliminary project work breakdown structure outlined in the Statement of Work for Phase III. The Phase III contract will provide eighteen (18) months for the contractor's full scale development program followed by six (6) months contractor support for the Government's joint service test and evaluation.

### 3.3 INVESTMENT (PRODUCTION) COSTS

a. Production Quantities. Investment costs shall be based on a single production contract for a total of 1,000 units and all items necessary for their support.

b. Production Rates. The contractor shall assume an economical production rate of at least eighty (80) units per month following production acceptance test and evaluation. Production deliveries shall extend over a nominal one year period.

c. Production Learning Curve. The recurring investment costs shall be computed utilizing the recurring cost elements for the first production unit projected on the contractor's production learning curve. The contractor shall use an 86.5% log linear cumulative average learning curve. The contractor may use another learning curve slope only if it can be sufficiently documented and justified by evidence of the contractor's actual experience on analogous systems.

d. Initial Provisioning. The contractor shall assume the initial spare and repair parts cost is equal to 15 percent of the recurring investment cost.

Support and Test Equipments. Common and peculiar support equipment shall be based upon the tools and test equipment requirements for 20 line maintenance facilities (1 SE set/50 units) and 1 depot maintenance facility.

### 3.4 OPERATING AND SUPPORT COSTS

- a. Economic Life. The economic life of the facsimile equipment shall be assumed to be ten (10) years for this life cycle cost exercise.
  
- b. Operational Concept. In estimating operating costs, it shall be assumed that the facsimile equipment will operate on a 12-hour shift per day, 365 days per year. It further shall be assumed that the equipment shall be in a fully operational mode approximately 15 minutes each hour and in a standby mode for the remaining time.
  
- c. Operational Personnel. Operating personnel costs shall not be included in the life cycle cost analysis. The facsimile equipment is supplementary to the operators prime mission and does not demand an increase in the number, types or skill level of personnel available.
  
- d. Consumable Costs. Consumable costs shall be based on the assumption that the facsimile recorder will process an average of 27½ copies per day, or 10,000 copies per year. A standard copy is considered a 9-inch by 11-inch size.
  
- e. Residual Value/Disposal Costs. The residual value of the facsimile equipment at the end of its economic life and the cost of disposal shall be assumed to be equal. Therefore, residual value and disposal costs shall be neglected.

f. Logistic Support Concept. The design and support of the facsimile equipment shall be to maximize on-site corrective and preventive maintenance by assigned personnel using general purpose tools and test equipment.

(1) Preventive Maintenance. Preventive Maintenance will be performed by the organizational level and will consist of inspecting, lubricating, adjusting and periodic cleaning. The maximum outage time of the "full communication capability" for preventive maintenance shall not exceed one 20-minute period over a 24-hour day and one hour for a 30-day period.

(2) Corrective Maintenance. Specific organizational, intermediate and depot level maintenance requirements shall be determined by application of an economic LOR (Level of Repair) analysis. The following maintenance concept shall be assumed until the first LOR analysis has been made.

Module Replacement. A minimum of 95 percent of the malfunctions shall be repairable at the organizational level through module replacement. Organizational corrective maintenance will be performed by an E-4 technician and will consist of fault location, removal, replacement of an integral unit (e.g., module, printed circuit card, or a specific chassis mounted piece part) and checkout of the repaired equipment.

Module Repair. Modules removed for repair as primary maintenance actions by the organizational level shall be discarded or forwarded for repair at the intermediate or depot levels. Intermediate and depot corrective maintenance will be performed by an E-5 technician and will consist of piece part fault location, removal, replacement and checkout of the repaired modules.

(3) Major Overhaul. Major overhaul will be performed by the depot level and will consist of complete rework and restoration of the facsimile equipment. The equipment overhaul rate shall be based on the contractor's mean-time-between-overhaul estimate. (If not available, the contractor shall assume a mean-time-between-overhauls of 8 years.)

MILITARY PERSONNEL & TRAINING COSTS

Navy E4 and E5 Facsimile Repairman

<u>COST COMPONENTS</u>	<u>E-4</u>	<u>E-5</u>
<u>Annual Composite Standard Pay Rate</u>		
Base Pay	\$5,504	\$6,475
Allowance for Quarters	693	1,099
Miscellaneous Expenses	1,756	1,820
Incentive & Special Pay	286	331
	<u>\$8,239</u>	<u>\$9,725</u>
<u>Permanent Change of Station (PCS)</u>		
PCS Cost (Enlisted)	\$ 468	\$ 468
<u>Retirement</u>		
Standard Pay Rate	\$8,239	\$9,725
Normal Retirement Cost Percentage	29.2%	29.2%
Expected Retirement Percentage	21.9%	47.9%
	<u>\$ 527</u>	<u>\$1,360</u>
<u>Support Costs</u>		
Annual Medical Cost	\$ 606	\$ 606
Annual Base Operations Cost	580	580
	<u>\$1,186</u>	<u>\$1,186</u>
<u>Replacement Training (Basic &amp; Specialized Training Costs)</u>		
NEC Training Cost (Estimated)	\$20,500	\$20,500
Replacement Turnover Rate	.274	.274
	<u>\$ 5,617</u>	<u>\$ 5,617</u>
ANNUAL PERSONNEL BILLET COST	\$16,037	\$18,356
HOURLY PERSONNEL COST = $\frac{\text{ANNUAL COST}}{1656 \text{ HOURS}}$	\$9.68/hr	\$ 11.08/hr

Source: Report No. TTO-ORT-032-75-V3-APD, "Military Personnel and Training Costs," Appendix D to Volume III, "Life Cycle Costing," Cost Effectiveness Program Plan for Joint Tactical Communications. Joint Tactical Communications Office (TT-RT-OR), Fort Monmouth, New Jersey, February, 1975.

## SECTION 4

### LIFE CYCLE COST ESTIMATING MODEL

#### 4.1 LIFE CYCLE COST (LCC)

Life Cycle Cost is defined as the total cost of an item or system over its full life. It includes the cost of development, acquisition, ownership (operation, maintenance, support, etc.) and, where applicable, disposal.

This Section establishes a life cycle cost estimating model for identifying and assembling valid cost categories and valid cost elements for the Tactical Digital Facsimile. The LCC model is totally compatible with the TRI-TAC LCC model and provides a framework for collecting, analyzing, estimating, synthesizing, computerizing, and reporting valid life cycle costs. The following paragraphs present the LCC breakdown structure of the model, a description of the cost categories, subcategories and elements and the method of numerical coding the cost elements in this structure.

#### 4.2 LCC BREAKDOWN STRUCTURE

The LCC breakdown structure of the life cycle cost estimating model provides the basis framework for cost collection and analyses. It provides a check list to assure that all pertinent costs are included in the analysis without duplication. It also provides the basic structure for keeping track of the various costs and aggregating them into appropriate summary cost categories for presentation of the results of the cost analysis.

Life cycle costs are divided into three major categories: research and development, investment (or production), and operating and support (Figure 4-1). These categories and associated subcategories are defined as follows.

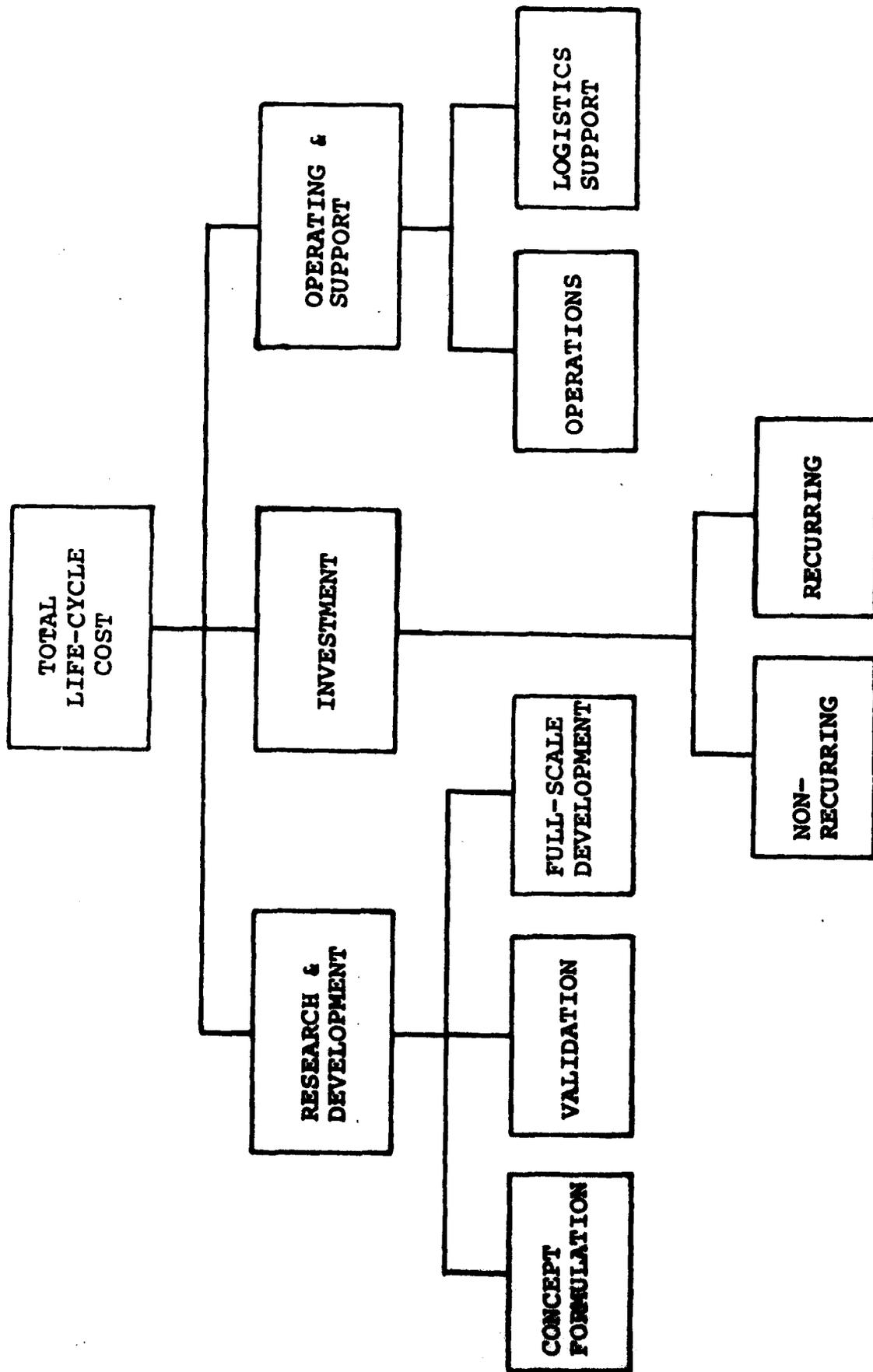
#### 4.2.1 RESEARCH AND DEVELOPMENT COSTS

Research and development costs refer to all costs associated with the research, development, test and evaluation of the system/equipment. Specifically, this covers all costs during the concept formulation, validation and full-scale development phases of the program. This category includes costs for feasibility studies; engineering design, development, fabrication, assembly and test of engineering prototype models; initial system evaluation; and associated documentation. The cost incurred in this category terminates with the satisfactory completion of the Initial Operational Test and Evaluation and Government's approval for Service use.

#### 4.2.2 INVESTMENT COSTS

Investment costs refer to all costs associated with the production of system/equipments. This category includes costs for management; materials, fabrication, assembly, and test of the production units; initial logistics support requirements (e.g., spares provisioning, support equipment and tools, technical publications, initial training, facility construction, etc.) and installation and checkout of the system equipment for operational use. The costs incurred in this category terminates with the satisfactory turnover of an operationally usable system to the using command or organization.

FIGURE 4-1 LIFE CYCLE COST CATEGORIES



Investment costs are further divided into two subcategories, recurring and non-recurring investment costs. Recurring costs refer to investment costs which recur with each unit produced. These costs tend to be subject to a learning curve concept in which the cost per unit decreases as the quantity increases. Non-recurring costs refer to investment costs which are one time costs incurred during the production phase. These costs can recur if there is a change in contractors, designs, or manufacturing processes during the production phase.

#### 4.2.3 OPERATING AND SUPPORT COSTS

Operating and support costs refer to all costs associated with the operation and logistics support of the system subsequent to equipment turnover to the using command or organization. Specifically, this covers all Government ownership costs including operation costs, maintenance costs, logistic support costs and system/equipment phaseout costs.

The major subcategories of operating and support cost are operations and logistics support. Operation costs refer to all costs associated with the direct operation of the system/equipment. This includes the costs of electrical power, consumable materials, operational personnel and formal training of such personnel, and operational facilities. Logistics support costs refer to all costs associated with the maintenance and supply support of the system/equipment during the systems operational life. System phaseout cost refers to the residual value or disposal cost incurred when an item is removed at the end of its economic life.

#### 4.3 COST ELEMENTS

A complete listing of the cost elements of the life cycle cost estimating model are presented in Figure 4-2. These cost elements for the life cycle cost estimating model were chosen to be consistent with the TRI-TAC life cycle cost model and compatible with the Tactical Digital Facsimile program requirements. Only those elements that are expected to vary from alternative to alternative, or to be a function of the contractor's design, are included in the LCC breakdown structure. These cost elements are defined in detail in Appendix A, to establish precisely where each begins and ends in relation to costs included. The contractor is encouraged to identify and present any missing cost elements to the LCC structure.

#### 4.4 IDENTIFICATION CODING

The identification coding established for the LCC model provides identification of the various cost elements with respect to the major and subsidiary cost categories. With the application of this coding format, each cost element in the LCC model is identified by means of a three digit prefix. This three digit prefix identifies the major cost category (the level 1 element of the LCC model), the subsidiary cost category (the level 2 element), and the sub-subsidiary cost category (the level 3 element) respectively. The suffixes after the decimal point, provide numerical identification of the respective cost elements. Further breakdown of the cost elements are provided by additional decimal points and numerical identification of the respective subelements.

FIGURE 4-2 LIFE CYCLE COST MODEL

000 TOTAL LIFE CYCLE COST

100 RESEARCH AND DEVELOPMENT

110 CONCEPT FORMULATION

- 111 Research
- 112 Exploratory Development

120 VALIDATION

130 FULL SCALE DEVELOPMENT

- 130.1 Program Management
- 130.2 Engineering
- 130.3 Fabrication
- 130.4 Development Tests
- 130.5 Test and Evaluation Support
- 130.6 Data
- 130.7 Producibility Engineering and Planning
- 130.8 Other

200 INVESTMENT

NON-RECURRING INVESTMENT

- 210.1 Program Management
- 210.2 Producibility Engineering and Planning
- 210.3 Initial Production Facilities
  - 210.3.1 Production Engineering
  - 210.3.2 Production Tooling
  - 210.3.3 Production Facilities
  - 210.3.4 Mfg. Support Equipment
- 210.4 Initial Spares and Repair Parts
  - 210.4.1 Total Allowance Quantity
  - 210.4.2 System Stock Requirement
- 210.5 Common Support Equipment
  - 210.5.1 Organizational Support Equipment
  - 210.5.2 Intermediate Support Equipment
  - 210.5.3 Depot Support Equipment
- 210.6 Peculiar Support Equipment
  - 210.6.1 Organizational Support Equipment
  - 210.6.2 Intermediate Support Equipment
  - 210.6.3 Depot Support Equipment
- 210.7 Data
  - 210.7.1 Engineering Data
  - 210.7.2 Support Data
  - 210.7.3 Management Data
  - 210.7.4 Technical Manuals and Orders
- 210.8 Initial Training
  - 210.8.1 Training Facilities
  - 210.8.2 Training Devices and Equipment
  - 210.8.3 Initial Student Training
    - 210.8.3.1 Operator Training
    - 210.8.3.2 Maintenance Training
    - 210.8.3.3 Instructor Training
- 210.9 Technical Support
  - 210.9.1 Production Acceptance Test and Evaluation (PATE) Support
  - 210.9.2 Operational Test and Evaluation (OTE) Support
- 210.10 Other

FIGURE 4-2 (Cont'd)

- 220 RECURRING INVESTMENT
  - 220.1 Manufacturing
    - 220.1.1 Direct Labor
    - 220.1.2 Overhead
  - 220.2 Production Material
    - 220.2.1 Purchased Equipment and Parts
    - 220.2.2 Subcontracted Items
    - 220.2.3 Other Material
  - 220.3 Sustaining Engineering
  - 220.4 Quality Control and Inspection
  - 220.5 Packaging and Transportation
  - 220.6 Operational Site Activation
    - 220.6.1 Site Construction
    - 220.6.2 Site/Ship/Vehicle Conversion
    - 220.6.3 Assembly, Installation, and Checkout
  - 220.7 Other
  
- 300 OPERATING AND SUPPORT
  - 310 OPERATIONS
    - 310.1 Electrical Power
    - 310.2 Special Materials (Consumables)
    - 310.3 Operational Personnel
    - 310.4 Operational Facilities
    - 310.5 Other Operational Cost
  - 320 LOGISTIC SUPPORT
    - 321 Maintenance
      - 321.1 Maintenance Personnel
        - 321.1.1 Organizational Maintenance Personnel
        - 321.1.2 Intermediate Maintenance Personnel
        - 321.1.3 Depot Maintenance Personnel
      - 321.2 Maintenance Facilities
      - 321.3 Support Equipment Maintenance
      - 321.4 Contractor Services
    - 322 Supply
      - 322.1 Inventory Administration
        - 322.1.1 Inventory Management
        - 322.1.2 Inventory Holding
      - 322.2 Replenishment Spares and Repair Parts
      - 322.3 Repair Material
      - 322.4 Transportation and Packaging
      - 322.5 Supply Facilities

## SECTION 5

### COST ESTIMATING RELATIONSHIPS

#### 5.1 GENERAL

A cost estimating relationship is an analytical equation that can be used to compute the cost associated with a particular cost element for specific items. The cost estimating relationships for many of the cost elements are simply multiplications of quantities or levels of efforts by cost factors. For other cost elements the estimation of costs involves functional relationships that combine cost data with other data such as reliability and maintainability parameters.

The cost estimating relationships presented in this section provide analytical techniques for prediction of future Government operating and support costs for the Tactical Digital Facsimile based on projected information relative to the facsimile design.

## 5.2 COST ESTIMATING RELATIONSHIPS FOR OPERATING & SUPPORT COSTS

### 310 Operations

- 310.1 Electrical Power
- 310.2 Special Materials
- 310.3 Operational Personnel
- 310.4 Operational Facilities

### 320. Logistic Support

#### 321. Maintenance

- 321.1 Maintenance Personnel
  - 321.1.1 Preventive Maintenance
  - 321.1.2 Corrective Maintenance (Equipment)
  - 321.1.3 Corrective Maintenance (Repairable Assemblies)
  - 321.1.4 Major Overhaul
- 321.2 Maintenance Facilities
- 321.3 Support Equipment Maintenance
- 321.4 Contractor Services

#### 322. Supply

- 322.1 Inventory Administration
  - 322.1.1 Inventory Management
  - 322.1.2 Holding Inventory
- 322.2 Replenishment Spares and Repair Parts
- 322.3 Repair Material
- 322.4 Transportation and Packaging
- 322.5 Supply Facilities

OPERATIONS (Annual Cost)

310.1 Electrical Power

Cost Formula

$$\left[ \begin{array}{l} \text{Electrical} \\ \text{Power} \\ \text{Cost} \end{array} \right] = \left[ \begin{array}{l} \text{Average} \\ \text{Elect. Power} \\ \text{Rating} \end{array} \right] \left[ \begin{array}{l} \text{Cost of} \\ \text{Electrical} \\ \text{Power} \end{array} \right] \left[ \begin{array}{l} \text{Number of} \\ \text{Operating Hours} \\ \text{per Year} \end{array} \right] \left[ \begin{array}{l} \text{Number of} \\ \text{Operational} \\ \text{Equipment} \end{array} \right]$$

Cost Factors

<u>Cost Factors</u>	<u>Source</u>	<u>Value</u>	<u>Units</u>
Average Electrical Power Rating	Contractor		KW
Cost of Electrical Power	TRI-TAC	\$0.04	\$/KWH
Number of Operating Hours per Year	Assumption	4380	hours <small>12 x 365</small>
Number of Operational Equipment	Assumption	1000	units

Comments

In estimating electrical power costs, the contractor shall compute an average electrical power rating based on the operational concept.

For example:

<u>Mode</u>	<u>Rating</u>	<u>Time</u>	<u>Power</u>
Operation	800 W	15 min/hr	200 WH
Standby	200 W	45 min/hr	150 WH
		60 min	<u>350 WH</u>

Average Power Rating = 350 W

OPERATIONS (Annual Cost)

310.2 Special Material (consumables)

Cost Formula

$$\left[ \begin{array}{l} \text{Special} \\ \text{Materials} \\ \text{Cost} \end{array} \right] = \left[ \begin{array}{l} \text{Annual} \\ \text{Consumption} \\ \text{Rate} \end{array} \right] \left[ \begin{array}{l} \text{Cost of} \\ \text{Consumable} \\ \text{Materials} \end{array} \right] \left[ \begin{array}{l} \text{Number of} \\ \text{Operational} \\ \text{Equipment} \end{array} \right]$$

<u>Cost Factors</u>	<u>Source</u>	<u>Value</u>	<u>Units</u>
Annual Consumption Rate	See Comment		Rolls/Year
Cost of Consumable Materials	Contractor		\$/Roll
Number of Operational Equipment	Assumption	1000	units

Comments

Consumables costs shall be based on the assumption that each facsimile recorder will process 10,000 copies (9-inch x 11-inch size) per year. The recording copy material shall be supplied on rolls, with a minimum length of 400 feet. In computing the annual consumption rate (in terms of 400-foot rolls), the contractor shall include the following factors:

- copy leading-edge waste
- copy trailing-edge waste
- unusable roll leader
- unusable roll trailer
- routine preventive maintenance requirements  
(e.g. diagnostic copies of facsimile test charts)

In computing the unit cost of consumable materials, the contractor shall include the cost of special spooling, cassette packaging, etc.

OPERATIONS (Annual Cost)

310.3 Operational Personnel

Operating personnel costs are not to be apportioned to the facsimile equipment.

310.4 Operational Facilities

Operational facilities costs are not to be apportioned to the facsimile equipment.

LOGISTIC SUPPORT (Annual Cost)

321. Maintenance

Cost Formula

$$\left[ \begin{array}{l} \text{Maintenance} \\ \text{Cost} \end{array} \right] = \left[ \begin{array}{l} \text{Maintenance} \\ \text{Personnel} \\ \text{Cost} \end{array} \right] + \left[ \begin{array}{l} \text{Maintenance} \\ \text{Facility} \\ \text{Costs} \end{array} \right] + \left[ \begin{array}{l} \text{Support} \\ \text{Equipment} \\ \text{Maintenance} \end{array} \right] + \left[ \begin{array}{l} \text{Contractor} \\ \text{Services} \end{array} \right]$$

Cost Factors

Source

Maintenance Personnel Cost	321.1
Maintenance Facility Cost	321.2
Support Equipment Maintenance	321.3
Contractor Services	321.4

Comment

## LOGISTIC SUPPORT (Annual Cost)

### 321.1 Maintenance Personnel

#### Cost Formula

$$\left[ \begin{array}{l} \text{Maintenance} \\ \text{Personnel} \\ \text{Cost} \end{array} \right] = \left[ \begin{array}{l} \text{Preventative} \\ \text{Maintenance} \\ \text{Cost} \end{array} \right] + \left[ \begin{array}{l} \text{Corrective} \\ \text{Maintenance} \\ \text{Cost} \end{array} \right] + \left[ \begin{array}{l} \text{Major} \\ \text{Overhaul} \\ \text{Cost} \end{array} \right]$$

#### Cost Factors

#### Source

Preventative Maintenance Cost	321.1.1
Corrective Maintenance Cost	321.1.2 and 321.3
Major Overhaul Cost	321.1.4

#### Comment

Corrective Maintenance Costs for the organizational, intermediate and depot level maintenance personnel shall be determined through an economic LOR (Level of Repair) analysis. In lieu of an LOR analysis, the following cost elements shall be used to compute the maintenance personnel costs.

$$\left[ \begin{array}{l} \text{Corrective} \\ \text{Maintenance} \\ \text{Cost} \end{array} \right] = \left[ \begin{array}{l} \text{Corrective} \\ \text{Maintenance Cost} \\ \text{(Equipment)} \end{array} \right] + \left[ \begin{array}{l} \text{Corrective} \\ \text{Maintenance Cost} \\ \text{(Repairable Assemblies)} \end{array} \right]$$

LOGISTIC SUPPORT (Annual Cost)

321.1.1 Preventive Maintenance Cost

Cost Formula

$$\left[ \begin{array}{l} \text{Preventive} \\ \text{Maint.} \\ \text{Cost} \end{array} \right] = \left[ \begin{array}{l} \text{Number of} \\ \text{Preventive} \\ \text{Maint. Actions} \end{array} \right] \left[ \begin{array}{l} \text{Mean} \\ \text{Preventive} \\ \text{Maint. Time} \end{array} \right] \left[ \begin{array}{l} \text{Cost of} \\ \text{Organizational} \\ \text{Personnel} \end{array} \right]$$

where:

$$\left[ \begin{array}{l} \text{Number of} \\ \text{Preventive} \\ \text{Maint. Actions} \end{array} \right] = \frac{\left[ \begin{array}{l} \text{Number of} \\ \text{Operational} \\ \text{Equipments} \end{array} \right] \left[ \begin{array}{l} \text{Number of} \\ \text{Operating Hours} \\ \text{per Year} \end{array} \right]}{\left[ \begin{array}{l} \text{Mean Time} \\ \text{Between} \\ \text{Inspections} \end{array} \right]}$$

<u>Cost Factors</u>	<u>Source</u>	<u>Value</u>	<u>Units</u>
Number of Preventive Maint. Actions	-	-	units
Mean Preventive Maint. Time (Mpt)	Contractor	-	hours
Cost of Organizational Personnel	TRI-TAC	\$9.68 <sup>2.3.9</sup>	\$/hour
Number of Operational Equipments	Assumption	1000	units
Number of Operating Hours per Year	Assumption	4380	hours
Mean Time Between Inspections	Contractor	-	hours

Comments

Preventive maintenance will be performed by the organizational level and will consist of routine inspections using built-in test features and diagnostic facsimile test charts, simple adjustments and periodic cleaning.

LOGISTIC SUPPORT (Annual Cost)

321.1.2 Corrective Maintenance Cost (Equipment)

Cost Formula

$$\left[ \begin{array}{l} \text{Corrective} \\ \text{Maint.} \\ \text{Cost} \end{array} \right] = \left[ \begin{array}{l} \text{Number of} \\ \text{Corrective} \\ \text{Maint. Actions} \end{array} \right] \left[ \begin{array}{l} \text{Mean} \\ \text{Corrective} \\ \text{Maint. Time} \end{array} \right] \left[ \begin{array}{l} \text{Cost of} \\ \text{Organizational} \\ \text{Personnel} \end{array} \right]$$

where:

$$\left[ \begin{array}{l} \text{Number of} \\ \text{Corrective} \\ \text{Maint. Actions} \end{array} \right] = \frac{\left[ \begin{array}{l} \text{Number of} \\ \text{Operational} \\ \text{Equipments} \end{array} \right] \left[ \begin{array}{l} \text{Number of} \\ \text{Operating Hours} \\ \text{per Year} \end{array} \right]}{\left[ \begin{array}{l} \text{MTBF for} \\ \text{Equipment} \end{array} \right]}$$

<u>Cost Factors</u>	<u>Source</u>	<u>Value</u>	<u>Units</u>
Number of Corrective Maint. Actions	-	-	units
Mean Corrective Maint. Time (Mct)	Contractor		hours
Cost of Organizational Personnel	TRI-TAC	\$9.68	\$/hour
Number of Operational Equipments	Assumption	1000	units
Number of Operating Hours per Year	Assumption	4380	hours
MTBF for Equipment	Contractor		hours

Comments

Organizational level corrective maintenance will consist of fault location, removal and replacement of the failed assemblies, and checkout of the repaired equipment.

LOGISTIC SUPPORT (Annual Cost)

321.1.3 Corrective Maintenance Cost (Repairable Assemblies)

Cost Formula

$$\left[ \begin{array}{l} \text{Corrective} \\ \text{Maint.} \\ \text{Cost} \end{array} \right] = \left[ \begin{array}{l} \text{Number of} \\ \text{Corrective} \\ \text{Maint. Actions} \end{array} \right] \left[ \begin{array}{l} \text{Mean} \\ \text{Corrective} \\ \text{Maint. Time} \end{array} \right] \left[ \begin{array}{l} \text{Cost of} \\ \text{Intermediate/Depot} \\ \text{Personnel} \end{array} \right]$$

where:

$$\left[ \begin{array}{l} \text{Number of} \\ \text{Corrective} \\ \text{Maint. Actions} \end{array} \right] = \frac{\left[ \begin{array}{l} \text{Number of} \\ \text{Operational} \\ \text{Equipments} \end{array} \right] \left[ \begin{array}{l} \text{Number of} \\ \text{Operating Hours} \\ \text{per Year} \end{array} \right]}{\left[ \begin{array}{l} \text{MTBF for} \\ \text{Repairable} \\ \text{Assemblies} \end{array} \right]}$$

<u>Cost Factors</u>	<u>Source</u>	<u>Value</u>	<u>Units</u>
Number of Corrective Maint. Actions	-	-	units
Mean Corrective Maint. Time (Mct)	Contractor		hours
Cost of Intermediate/Depot Personnel	TRI-TAC	\$11.08	\$/hour
Number of Operational Equipments	Assumption	1000	units
Number of Operating Hours per Year	Assumption	4380	hours
MTBF for Repairable Assemblies	Contractor		hours

Comments

Intermediate/depot level corrective maintenance will consist of repair of the failed assemblies which were removed and replaced as primary maintenance actions by the organizational level.

LOGISTIC SUPPORT (Annual Cost)

321.1.4 Major Overhaul Cost

Cost Formula

$$\left[ \begin{array}{l} \text{Major} \\ \text{Overhaul} \\ \text{Cost} \end{array} \right] = \left[ \begin{array}{l} \text{Equipment} \\ \text{Overhaul} \\ \text{Rate} \end{array} \right] \left[ \begin{array}{l} \text{Number of} \\ \text{Operational} \\ \text{Equipments} \end{array} \right] \left[ \begin{array}{l} \text{Depot} \\ \text{Overhaul} \\ \text{Cost} \end{array} \right]$$

where:

$$\left[ \begin{array}{l} \text{Depot} \\ \text{Overhaul} \\ \text{Cost} \end{array} \right] = 0.809 \left[ \begin{array}{l} \text{Unit} \\ \text{Production} \\ \text{Cost} \end{array} \right]^{0.881} + 2 \left[ \begin{array}{l} \text{Unit} \\ \text{Packaged} \\ \text{Weight} \end{array} \right] \left[ \begin{array}{l} \text{Cost of} \\ \text{Transportation} \end{array} \right]$$

Cost Factors

<u>Cost Factors</u>	<u>Source</u>	<u>Value</u>	<u>Units</u>
Equipment Overhaul Rate	Contractor		percent/year
Number of Operational Equipments	Assumption	1000	units
Depot Overhaul Cost	-	-	\$/unit
Unit Production Cost	Contractor		\$
Unit Packaged Weight	Contractor		pounds
Cost of Transportation	TRI-TAC	\$0.50	\$/pound

Comments

This cost element includes the total depot overhaul cost, labor, materials, and transportation. The Source for the depot overhaul cost equation is ECOM Pamphlet No. 11-4, Volume 7, "Cost Estimating Guide (Methods and Factors)". This formula was derived from a data sample from TB 750-5-1 and SB 700-20.

The overhaul rate indicated how often an item is expected to be sent back to the depot for overhaul. The overhaul rate is equal to  $\frac{1}{\text{MTBO}}$ , where:  
MTBO=mean-time-between-overhaul.

LOGISTIC SUPPORT (Annual Cost)

321.2 Maintenance Facilities

Cost Formula

$$\left[ \begin{array}{c} \text{Maintenance} \\ \text{Facility} \\ \text{Cost} \end{array} \right] = \left[ \begin{array}{c} \text{Maintenance} \\ \text{Work} \\ \text{Space} \end{array} \right] + \left[ \begin{array}{c} \text{Support} \\ \text{Equipment} \\ \text{Space} \end{array} \right] \cdot \left[ \begin{array}{c} \text{Cost of} \\ \text{Floor} \\ \text{Space} \end{array} \right]$$

<u>Cost Factors</u>	<u>Source</u>	<u>Value</u>	<u>Units</u>
Maintenance Work Space	Contractor		ft <sup>2</sup> /yr
Support Equipment Space	Contractor		ft <sup>2</sup> /yr
Cost of Floor Space	Navy LOR	\$3.00	\$/ft <sup>2</sup> /yr

Comments

This cost element covers the cost of facilities (property, plant and equipment) and utilities required to support corrective maintenance actions at the intermediate/depot maintenance levels. Facility and utility costs shall be proportionally allocated to the facsimile requirements.

- The maintenance workspace shall be proportional to the annual intermediate/depot corrective maintenance requirements.
- The support equipment space shall be proportional to the annual storage space requirements for the peculiar support and test equipment associated with module repair of the facsimile equipment.

LOGISTIC SUPPORT (Annual Cost)

321.3 Support Equipment Maintenance

Cost Formula

$$\left[ \begin{array}{l} \text{Support} \\ \text{Equipment} \\ \text{Maint. Cost} \end{array} \right] = \left[ \begin{array}{l} \text{Support} \\ \text{Equipment} \\ \text{Support Factor} \end{array} \right] \left[ \begin{array}{l} \text{Cost of} \\ \text{Support} \\ \text{Equipment} \end{array} \right]$$

<u>Cost Factors</u>	<u>Source</u>	<u>Value</u>	<u>Units.</u>
Support Equipment Support Factor	Navy LOR	10%	percent
Cost of Support Equipment	Contractor		\$

Comments

This cost element refers to the costs for support of common and peculiar support equipments associated with the facsimile equipment. Acquisition costs for the support equipments are included in the non-recurring investment cost category.

LOGISTIC SUPPORT (Annual Cost)

321.4 Contractor Services

Cost Formula

$$\left[ \begin{array}{l} \text{Contractor} \\ \text{Services} \\ \text{Costs} \end{array} \right] = \left[ \begin{array}{l} \text{Contractor} \\ \text{Depot} \\ \text{Maintenance} \end{array} \right] + \left[ \begin{array}{l} \text{Contractor} \\ \text{Field} \\ \text{Services} \end{array} \right] + \left[ \begin{array}{l} \text{Engineering} \\ \text{Change} \\ \text{Support} \end{array} \right]$$

Cost Factors

Contractor Depot Maintenance  
Contractor Field Services  
Engineering Change Support

Source

See Comment  
See Comment  
See Comment

Comment

This cost element is a projection of contractual costs for engineering and technical support for the system/equipment, to include:

Efforts associated with the operation of an interim depot specialized repair activity.

Field Services (contractor engineering technical services).

Special engineering modifications (modification kits and instructions) accomplished by the contractor either at his facility or in the field.

LOGISTIC SUPPORT (Annual Cost)

322. Supply

Cost Formula

$$\left[ \begin{array}{l} \text{Supply} \\ \text{Cost} \end{array} \right] = \left[ \begin{array}{l} \text{Inventory} \\ \text{Admin.} \\ \text{Cost} \end{array} \right] + \left[ \begin{array}{l} \text{Replenishment} \\ \text{Spares \&} \\ \text{Repair Parts} \end{array} \right] + \left[ \begin{array}{l} \text{Repair} \\ \text{Material} \\ \text{Cost} \end{array} \right] + \left[ \begin{array}{l} \text{Transp. \&} \\ \text{Packaging} \\ \text{Cost} \end{array} \right]$$

Cost Factors

Source

Inventory Administration Cost	322.1.1 and 321.1.2
Replenishment Spares & Repair Parts	322.2
Repair Material Cost	322.3
Transportation & Packaging Cost	322.4

Comment

Inventory Administration Cost is the summation of two separate costs: Inventory Management Cost (322.1.1) and Holding Inventory Cost (322.1.2). Hence:

$$\left[ \begin{array}{l} \text{Inventory} \\ \text{Administration} \\ \text{Cost} \end{array} \right] = \left[ \begin{array}{l} \text{Inventory} \\ \text{Management} \\ \text{Cost} \end{array} \right] + \left[ \begin{array}{l} \text{Holding} \\ \text{Inventory} \\ \text{Cost} \end{array} \right]$$

LOGISTIC SUPPORT (Annual Cost)

322.1.1 Inventory Management

Cost Formula

$$\left[ \begin{array}{l} \text{Inventory} \\ \text{Management} \\ \text{Cost} \end{array} \right] = \left[ \begin{array}{l} \text{Number of} \\ \text{FSN Items} \\ \text{(Dollar Value)} \end{array} \right] \left[ \begin{array}{l} \text{Amortized} \\ \text{Annual Costs} \\ \text{(Dollar Value)} \end{array} \right]$$

<u>Cost Factors</u>	<u>Source</u>	<u>Value</u>	<u>Units</u>
Number of FSN Items (New)	Contractor		Units
Amortized Annual Costs	See Comments & Table		\$/Unit

Comment

Inventory management cost refers to identification; description; submission to screening and editing by the Data Documents Center; inclusion in maintenance catalog and supply catalog; establishing by supply management of inventory and replacement rate; provisioning, requisitioning, rebuild directions, and procurement directives. Multiply the number of parts by the appropriate value from the table below:

**Inventory Line Item Management Costs**

<u>Line Item Dollar Value</u>	<u>First Year Cost</u>	<u>Recurring Costs</u>	<u>Amortized Annual Costs*</u>
\$25,000 - over	\$1,070	\$720	\$755
\$10,000 - \$24,999	\$ 770	\$420	\$455
\$ 2,500 - \$ 9,999	\$ 580	\$130	\$175
Under - \$ 2,500	\$ 460	\$110	\$145
<b>Weighted Average</b>	<b>\$ 510</b>	<b>\$160</b>	<b>\$195</b>

\* Introduction Cost is amortized over the 10-year period.

SOURCE: ECOM Pamphlet No 11-4, Volume 7  
"Cost Estimating Guide (Methods and Factors)"

LOGISTIC SUPPORT (Annual Cost)

322.1.2 Holding Inventory

Cost Formula

$$\left[ \begin{array}{l} \text{Holding} \\ \text{Inventory} \\ \text{Cost} \end{array} \right] = \left[ \begin{array}{l} \text{Holding} \\ \text{Inventory} \\ \text{Cost Factor} \end{array} \right] \left[ \begin{array}{l} \text{Initial} \\ \text{Spares and} \\ \text{Repair Parts} \end{array} \right]$$

<u>Cost Factors</u>	<u>Source</u>	<u>Value</u>	<u>Units</u>
Holding Inventory Cost Factor	See Comment	23%	percent
Initial Spares and Repair Parts	Contractor		\$/unit

Comment

Holding Inventory is the cost of holding inventory in the supply system for one year, which involves the measurement of resources expended in storage, inventory adjustment, interest and obsolescence. Holding Inventory cost may be calculated by a factor of 23% times line item costs.

<u>Holding Inventory</u>	<u>Value</u>
Investment cost	10% - not included
Storage costs	1%
Obsolescence losses	20%
Other losses	<u>2%</u>
TOTAL	23%

Source: DODI 4140.39, "Procurement Cycles and Safety Levels of Supply for Secondary Items" July 17, 1970

LOGISTIC SUPPORT (Annual Cost)

322.2 Replenishment Spares and Repair Parts

Cost Formula

$$\left[ \begin{array}{l} \text{Replenishment} \\ \text{Spares and} \\ \text{Repair Parts} \end{array} \right] = \left[ \begin{array}{l} \text{Discard Assy.} \\ \text{Replenishment} \\ \text{Costs} \end{array} \right] + \left[ \begin{array}{l} \text{Assembly} \\ \text{Scrap} \\ \text{Rate} \end{array} \right] \left[ \begin{array}{l} \text{Repair Assy.} \\ \text{Replenishment} \\ \text{Costs} \end{array} \right]$$

where:

$$\left[ \begin{array}{l} \text{Discard Assy.} \\ \text{Replenishment} \\ \text{Costs} \end{array} \right] = \frac{\left[ \begin{array}{l} \text{Number of} \\ \text{Operational} \\ \text{Equipments} \end{array} \right] \left[ \begin{array}{l} \text{Number of} \\ \text{Operating Hours} \\ \text{per Year} \end{array} \right]}{\left[ \begin{array}{l} \text{MTBF for} \\ \text{Discard} \\ \text{Assemblies} \end{array} \right]} \left[ \begin{array}{l} \text{Ave. Cost of} \\ \text{Discard} \\ \text{Assemblies} \end{array} \right]$$

$$\left[ \begin{array}{l} \text{Repair Assy.} \\ \text{Replenishment} \\ \text{Costs} \end{array} \right] = \frac{\left[ \begin{array}{l} \text{Number of} \\ \text{Operational} \\ \text{Equipments} \end{array} \right] \left[ \begin{array}{l} \text{Number of} \\ \text{Operating Hours} \\ \text{per Year} \end{array} \right]}{\left[ \begin{array}{l} \text{MTBF for} \\ \text{Repairable} \\ \text{Assemblies} \end{array} \right]} \left[ \begin{array}{l} \text{Ave. Cost of} \\ \text{Repairable} \\ \text{Assemblies} \end{array} \right]$$

<u>Cost Factors</u>	<u>Source</u>	<u>Value</u>	<u>Units</u>
Discard Assy. Replenishment Costs	-	-	\$
Repair Assy. Replenishment Costs	-	-	\$
Assembly Scrap Rate	Navy LOR	15%	percent
Number of Operational Equipments	Assumption	1000	units
Number of Operating Hours per Year	Assumption	4380	hours
MTBF for Discard Assys.	Contractor		hours
Ave. cost of Discard Assys.	Contractor		\$
MTBF for Repairable Assys.	Contractor		hours
Ave. Cost for Repairable Assys.	Contractor		\$

Comments

This cost element refers to the cost of annual spares and repair parts to resupply the system stock requirement due to items discarded at the organizational level and items scrapped during repair of the equipment at the intermediate and depot levels of maintenance.

LOGISTIC SUPPORT (Annual Cost)

322.3 Repair Material

Cost Formula

$$\boxed{\text{Repair Material Cost}} = \boxed{\text{Assembly Repair Rate}} \boxed{\text{Repair Assy. Replenishment Costs}} \boxed{\text{Repair Material Rate}}$$

where:

$$\boxed{\text{Repair Assy. Replenishment Cost}} = \frac{\boxed{\text{Number of Operational Equipments}} \boxed{\text{Number of Operating Hours per Year}}}{\boxed{\text{MTBF for Repairable Assemblies}}} \boxed{\text{Ave. Cost of Repairable Assemblies}}$$

<u>Cost Factors</u>	<u>Source</u>	<u>Value</u>	<u>Units</u>
Assembly Repair Rate	Navy LOR	85%	percent
Repair Material Rate	Navy LOR	8%	percent
Repair Assembly Replenishment Cost	-	-	\$
Number of Operational Equipments	Assumption	1000	units
Number of Operating Hours per Year	Assumption	4380	hours
MTBF for Repairable Assemblies	Contractor		hours
Ave. Cost for Repairable Assemblies	Contractor		\$

Comments

This cost element refers to the cost of materials (wire, pieceparts, etc.) utilized to repair assemblies at the Intermediate and Depot levels.

LOGISTIC SUPPORT (Annual cost)

322.4 Transportation and Packaging

Cost Formula

$$\left[ \begin{array}{l} \text{Transportation} \\ \text{\& Packaging} \\ \text{Cost} \end{array} \right] = \left[ \begin{array}{l} \text{Transp. \&} \\ \text{Packaging} \\ \text{Cost Factor} \end{array} \right] \left[ \begin{array}{l} \text{Replenishment} \\ \text{Spares \&} \\ \text{Repair Parts} \end{array} \right] + \left[ \begin{array}{l} \text{Repair} \\ \text{Material} \\ \text{Cost} \end{array} \right]$$

<u>Cost Factor</u>	<u>Source</u>	<u>Value</u>	<u>Units</u>
Transp. & Packaging Cost Factor	TRI-TAC	5%	percent
Replenishment Spares & Repair Parts	322.2		\$
Repair Material Cost	322.3		\$

Comments

This element refers to the cost of packaging, handling, and transportation associated with the shipping of spares and repair parts from the central supply point to the operational site.

LOGISTIC SUPPORT (Annual Cost)

322.5 Supply Facilities

Cost Formula

$$\left[ \begin{array}{l} \text{Supply} \\ \text{Facility} \\ \text{Costs} \end{array} \right] = \left[ \begin{array}{l} \text{General} \\ \text{Storage} \\ \text{Costs} \end{array} \right] + \left[ \begin{array}{l} \text{Special} \\ \text{Storage} \\ \text{Costs} \end{array} \right]$$

Comments

General storage costs for inventory items are included in the holding inventory cost (322.1.2).

Special storage costs include the cost of special storage facilities to maintain the required shelf life for inventory items. Specifically, facsimile recording copy material may require refrigeration to achieve the required minimum 2-year shelf life.

## SECTION 6

### LIFE CYCLE COST REPORTING

- 6.1    FORMAT 1    -    LIFE CYCLE COST ESTIMATE
- 6.2    FORMAT 2    -    RESEARCH & DEVELOPMENT COSTS
- 6.3    FORMAT 3    -    INVESTMENT COSTS (NON-RECURRING)
- 6.4    FORMAT 4    -    INVESTMENT COSTS (RECURRING)
- 6.5    FORMAT 5    -    OPERATING & SUPPORT COSTS
- 6.6    FORMAT 6    -    LCC DOCUMENTATION SUMMARY
- 6.7    FORMAT 7    -    LCC SUMMARY BY FISCAL YEAR
- 6.8    FORMAT 8    -    DESIGN TO COST ESTIMATE
- 6.9    FORMAT 9    -    HARDWARE ELEMENT ESTIMATE
- 6.10    FORMAT 10    -    ENGINEERING DESIGN TARGETS/TRACKING
- 6.11    FORMAT 11    -    COST TRADE-OFF ANALYSIS

FORMAT 1

LIFE CYCLE COST ESTIMATE

CONTRACTOR \_\_\_\_\_

DATE \_\_\_\_\_

UNIT DESCRIPTION

Configuration:

Features:

- Scanning Technique -
- Recording Technique -
- Recording Copy Media -

LIFE CYCLE COST

TOTAL COST  
ESTIMATE

UNIT COST  
ESTIMATE

100 Research and Development

    110 Concept Formulation

    120 Validation

    130 Full Scale Development

200 Investment  
    (1000 Production Units)

    210 Non-Recurring

    220 Recurring

300 Operating and Support  
    (10-Year Economic Life)

    310 Operations

    320 Logistic Support

        321 Maintenance

        322 Supply

TOTAL

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INVESTMENT COSTS

210. NON-RECURRING INVESTMENT	TOTAL COST
210.1 Program Management	_____
210.2 Producibility Engineering & Planning	_____
210.3 Initial Production Facilities	_____
210.3.1 Production Engineering	_____
210.3.2 Production Tooling	_____
210.3.3 Industrial Facilities	_____
210.3.4 Manufacturing Support Equipment	_____
210.4 Initial Spares & Repair Parts	_____
210.5 Common Support Equipment	_____
210.5.1 Organizational	_____
210.5.2 Intermediate	_____
210.5.3 Depot	_____
210.6 Peculiar Support Equipment	_____
210.6.1 Organizational	_____
210.6.2 Intermediate	_____
210.6.3 Depot	_____
210.7 Data	_____
210.7.1 Management Data	_____
210.7.2 Engineering Data	_____
210.7.3 Support Data	_____
210.7.4 Technical Manuals/Orders	_____
210.8 Initial Training	_____
210.8.1 Training Facilities	_____
210.8.2 Training Equipment	_____
210.8.3 Student Training	_____
210.9 Technical Support	_____
210.10 Other	_____
Subtotal	_____
General & Administrative (Rate _____)	_____
Subtotal	_____
Fee or Profit (Rate _____)	_____
<b>TOTAL</b>	_____



OPERATING & SUPPORT COSTS

	Annual Cost	10-Year Cost
310. OPERATIONS		
310.1 Electrical Power	_____	_____
310.2 Special Materials	_____	_____
310.3 Operational Personnel	_____	_____
310.4 Operational Facilities	_____	_____
310.5 Other	_____	_____
	TOTAL	_____
320. LOGISTIC SUPPORT		
321. Maintenance		
321.1 Maintenance Personnel	_____	_____
321.1.1 Preventive Maintenance	_____	_____
321.1.2 Corrective Maintenance (Equipment)	_____	_____
321.1.3 Corrective Maintenance (Repairable Assemblies)	_____	_____
321.1.4 Major Overhaul	_____	_____
321.2 Maintenance Facilities	_____	_____
321.3 Support Equipment Maintenance	_____	_____
321.4 Contractor Services	_____	_____
322. Supply		
322.1 Inventory Administration	_____	_____
322.1.1 Inventory Management	_____	_____
322.1.2 Holding Inventory	_____	_____
322.2 Replenishment Spares & Repair Parts	_____	_____
322.3 Repair Material	_____	_____
322.4 Transportation & Packaging	_____	_____
322.5 Supply Facilities	_____	_____
	TOTAL	_____

FORMAT 6

LIFE CYCLE COST DOCUMENTATION SUMMARY

TECHNICAL APPROACH	R&D FULL-SCALE DEVELOP- MENT COSTS	INVESTMENT		OPERATING & SUPPORT		TOTAL PROGRAM LIFE CYCLE COST	TOTAL UNIT LIFE CYCLE COST
		NON- RECURRING COSTS	RECURRING COSTS	OPERATION COSTS	LOGISTICS SUPPORT COSTS		
SCANNING: RECORDING: RECORDING MEDIA:							
TRANSMITTER							
RECEIVER							
TRANSCIVER (HALF-DUPLEX)							
TRANSCIVER (FULL-DUPLEX)							

FORMAT 7

LCC SUMMARY BY FISCAL YEAR

FISCAL YEAR	ELEMENT COSTS			TOTAL DOLLARS (1)	PRICE INDEX (2)	(1) X (2) INFLATED DOLLARS (3)	DISCOUNT FACTOR (4)	(3) X (4) TOTAL INFLATED DISCOUNTED DOLLARS
	R & D	INV.	O & S					
1974	\$XXX			\$XXX	-	\$XXX	-	\$XXX
1975	\$XXX			\$XXX	-	\$XXX	-	\$XXX
1976	\$XXX	\$XXX		\$XXX	-	\$XXX	-	\$XXX
1977		\$XXX		\$XXX	-	\$XXX	-	\$XXX
1978		\$XXX	\$XXX	\$XXX	-	\$XXX	-	\$XXX
1979		\$XXX	\$XXX	\$XXX	-	\$XXX	-	\$XXX
1980			\$XXX	\$XXX	-	\$XXX	-	\$XXX
1981			\$XXX	\$XXX	-	\$XXX	-	\$XXX
1982			\$XXX	\$XXX	-	\$XXX	-	\$XXX
1983			\$XXX	\$XXX	-	\$XXX	-	\$XXX
1984			\$XXX	\$XXX	-	\$XXX	-	\$XXX
1985			\$XXX	\$XXX	-	\$XXX	-	\$XXX
1986			\$XXX	\$XXX	-	\$XXX	-	\$XXX
1987			\$XXX	\$XXX	-	\$XXX	-	\$XXX
TOTAL	\$XXX	\$XXX	\$XXX	\$X,000X	-	\$X,000X	-	\$X,000X

FORMAT 8

DESIGN TO COST ESTIMATE

<u>Unit Production Costs*</u>		<u>Per Unit</u>
Production Materials		_____
Purchased Parts	_____	
Subcontracted Items	_____	
Other	_____	
Manufacturing		_____
Direct Labor	_____	
Overhead	_____	
Sustaining Engineering		_____
Quality Control, Inspection & Test		_____
Packaging and Transportation		_____
Other (specify)		_____
	Subtotal	_____
General & Administrative Expenses	Rate _____	_____
	Subtotal	_____
Fee or Profit	Rate _____	_____
	TOTAL	_____

<u>Copy Consummable Costs**</u>		<u>Per Copy</u>
Paper (9" x 11" copy)		_____
Other (specify)		_____
	TOTAL	_____

\* Based on production of 1,000 units

\*\* Based on procurement of 25,000 (400ft) cassettes annually

FORMAT 9

HARDWARE ELEMENT ESTIMATE

OPTICAL ASSEMBLY

DTC GOAL: \$2,000

Material and Labor Estimate  
(Based on 1,000 units of production)

	<u>Mat'l (\$)</u>	<u>Fab (hr)</u>	<u>Assy (hr)</u>
<u>Laser Assembly</u>			
Laser	\$ 400	-	-
Other	11	2	2
<u>Resolution Turret Assembly</u>			
Beam Expander (150)	\$ 50	-	-
Beam Expander (200)	50	-	-
Turret Mechanism	20	5	1
Drive Motor	30	-	-
Other	8	2	1
<u>Acoustic Modulator Assembly</u>			
A/O	\$ 210	-	-
Other	20	4	2
<u>Beam Scanner Assembly</u>			
Galvanometer	\$ 300	-	-
Galvo Control	100	3	1
Sweep Generator	100	3	1
Other	39	2	-
<u>Other (Itemize)</u>			
Beam Splitters	\$ 243	4	2
Flat Mirrors			
Light Collector			
<u>TOTAL</u>	<u>\$1,581</u>	<u>25 hrs</u>	<u>10 hrs</u>

Assembly Production Cost Estimate

Total Material		\$1,581
Material Overhead	Rate 10%	158
Total Labor	Rate \$5/hr	175
Labor Overhead	Rate 120%	210
QC, Test and Inspection		<u>26</u>
<b>Unit Production Cost</b>		<b>\$2,150</b>



FORMAT 11

COST TRADE-OFF ANALYSIS

DESIGN STUDIES

DTC IMPACTS\*

LCC IMPACTS\*\*

Scanner

HeNe Laser (Red)  
HeCd Laser (Blue)  
Xenon-Arc Lamp  
CCD

\$ XXXX  
XXXX  
XXXX  
XXXX

\$ XX,XXX  
XX,XXX  
XX,XXX  
XX,XXX

Recorder

Dry Silver  
Electro Photographic  
Dielectric  
Electrolytic  
Electrosensitive

\$ XXXX  
XXXX  
XXXX  
XXXX  
XXXX

\$ XX,XXX  
XX,XXX  
XX,XXX  
XX,XXX  
XX,XXX

Data Compression

Variable Word Length RLC  
Fixed Word Length RLC

\$ XXXX  
XXXX

\$ XX,XXX  
XX,XXX

Electronics

Navy Standard Modules (SHP)  
Commercial LSI  
Custom LSI

\$ XXXX  
XXXX  
XXXX

\$ XX,XXX  
XX,XXX  
XX,XXX

\* Includes basic manufacturing costs (materials & labor) associated with design.

\*\* Includes production, operations, maintenance and supply support costs associated with design.

APPENDIX A  
COST ELEMENT DEFINITIONS

This Appendix presents a detailed list of elements for life cycle costing. These elements have been selected from Appendix A to Volume III, "Life Cycle Costing," of the Cost-Effectiveness Program Plan for Joint Tactical Communications and are included here for completeness.

## 110 CONCEPT FORMULATION

This subcategory refers to all costs associated with the efforts categorized as "Research" and "Exploratory Development" within the Department of the Navy. The costs included in this subcategory shall be limited to the contractual research and exploratory development costs.

## 111 RESEARCH

Research refers to scientific study and experimentation directed toward increasing knowledge and understanding for the solution of specific military problems. It also provides part of the base for subsequent exploratory and advanced developments in Defense-related technologies and of new or improved military functional capabilities.

## 112 EXPLORATORY DEVELOPMENT

Exploratory Development refers to all effort directed toward the solution of specific military problems, short of major development projects. This type of effort may vary from fairly fundamental applied research to quite sophisticated breadboard hardware, study programming and planning efforts. It would thus include studies, investigations and minor development effort. The dominant characteristic of this category of effort is that it be pointed toward specific military problem areas with a view toward developing and evaluating the feasibility and practicability of proposed solutions and determining their parameters.

120 VALIDATION

This subcategory refers to all costs associated with the efforts categorized as "Advanced Development" within the Department of the Navy. Advanced developments are those programs which have moved into the development of hardware for experimental or operational tests. A further descriptive characteristic lies in the design of such items being directed toward hardware for test or experimentation as opposed to items designed and engineered for eventual Service use. The costs included in this subcategory shall be limited to the contractual advanced development or validation costs.

130 FULL SCALE DEVELOPMENT

This subcategory refers to all costs associated with the efforts categorized as "Engineering Development" within the Department of the Navy. Engineering developments are those development programs being engineered for Service use, but which have not yet been approved for procurement or operation.

The costs included in this subcategory shall be limited to the contractual full scale development costs. (The costs incurred by a private business while under contract with the Federal Government.)

These include:

- 130.1 Program Management
- 130.2 Engineering
- 130.3 Fabrication
- 130.4 Contractor Development Tests
- 130.5 Test and Evaluation Support
- 130.6 Data
- 130.7 Producibility Engrg. & Planning
- 130.8 Other

In addition, the cost elements of general and administrative expenses and contract fee shall be included.

### 130.1 Program Management

This element refers to the technical and administrative planning, organizing, directing, coordinating, controlling, and approval actions designed to accomplish overall program objectives during the full scale development phase of the equipment life cycle. Examples of these activities are configuration management, cost/schedule management, data management, contract management, liaison, value engineering, quality assurance and integrated logistic support management.

## 130.2 Engineering

This element refers to all engineering efforts associated with the system/equipment design and development. Specifically, this includes the cost of systems engineering and integration, design engineering (electrical, mechanical, drafting, etc.), design support (reliability, maintainability, human factors engineering and safety, value engineering, microelectronics), and the redesign or formulation of engineering changes. It includes the cost of direct labor, materials, overhead and other direct costs which must be incurred during the engineering process. The development of computer software is included herein as well as the cost of computer time.

## 130.3 Fabrication

This element refers to the fabrication and assembly of full scale development models in support of the engineering design activity. Specifically, this includes the cost of direct labor, materials and overhead associated with material procurement and handling, tooling and test equipment in support of manufacturing, fabrication, assembly, system integration and checkout.

## 130.4 Contractor Development Tests (CDT)

These tests are generally conducted on one or more prototype full scale development models at the contractor's facility to demonstrate that design specifications related to performance, control, maintenance, safety, maintainability, reliability, and human factors are satisfied. This cost element includes the cost of direct labor, materials, overhead and other direct charges required to perform CDT.

### 130.5 Test and Evaluation Support

This element refers to those costs which are incurred in support of the Government testing (DTE and IOTE), during the full scale development phase of the equipment life cycle. This element includes, for example, spares and repair parts, support and test equipment, training, publications/manuals, test site activation, facility requirements, and contractor services.

#### 130.5.1 Development Test and Evaluation (DTE) Support

The Development Test and Evaluation (DTE) is designed to determine and/or verify technical performance and safety characteristics of an item, associated tools and test equipment. It includes determination of structural, mechanical, electrical, chemical, and other physical properties of the equipment.

#### 130.5.2 Initial Operational Test and Evaluation (IOTE) Support

Initial Operational Test and Evaluation (IOTE) is that portion of Operational Test and Evaluation performed during the FSD Phase prior to a production decision. The objectives are to provide information at the production decision point as to the system/equipment military use-expected operational effectiveness and operational suitability (including reliability, logistic requirements), maintenance concepts, training needs and technical manual suitability.

## 130.6 Data

The data element refers to all deliverable data acquired during Full Scale Development which is required to be listed on a DD Form 1423. The data requirements will normally be selected from the departmental or agency Authorized Data List. This element includes only such effort that can be reduced or will not be incurred if the data item is modified or eliminated. It includes the effort for acquiring, writing, assembling, reformatting, reproduction, packaging and shipping.

### 130.6.1 Engineering Data

The engineering data element refers to those engineering drawings, associated lists, specifications, and other documentation required by the Government. This element includes all plans, procedures, reports and documentation pertaining to systems, subsystems, component engineering, and testing.

### 130.6.2 Support Data

The support data element refers to those data items required by the Government to develop and acquire the Support System. This includes maintenance data, provisioning data and lists, support and test equipment data and lists, logistic support plans and progress reports, technical publications requirements data, training planning data and transportation and handling data, etc.

### 130.6.3 Management Data

The management data element refers to those data items necessary for configuration management, cost, schedule, contractual data management, programs management, etc., required by the Government.

### 130.6.4 Technical Manuals and Orders

This element refers to those handbooks, technical manuals, technical orders, technical data sheets, etc., required by the Government.

### 130.7 Producibility Engineering and Planning (PEP)

Producibility Engineering and Planning refers to the costs associated with the planning and engineering required to ensure the timely economic producibility of the equipment prior to release for production. PEP is usually performed during Full Scale Development; however, PEP can reoccur during the Production Phase, if there is a change in contractors, designs, or manufacturing processes. PEP includes the efforts required to study the producibility of the system/equipment and the development of production data.

PEP tasks consist of the following type activities: develop technical data packages, design special purpose production equipment and tooling, computer modeling/simulation, engineering drawings, engineering, manufacturing and quality support information, dimensional and tolerance data, manufacture assembly sequences, wiring diagrams, material and finishing information, inspection, test and evaluation requirements, calibration information and quality control data.

130.8 Other

This element includes all costs incurred by the contractor during Full Scale Development not included in the aforementioned elements.

210 NON-RECURRING INVESTMENT

Non-recurring costs refer to investment costs which are one time costs incurred during the production phase. These costs can recur if there is a change in contractors, designs, or manufacturing processes during the production phase. These reoccurrences are usually associated with a system/equipment reprocurement.

The cost elements in this subcategory shall be limited to contractual costs (the costs incurred by a private business while under contract with the Federal Government). These include:

- 210.1 Program Management
- 210.2 Producibility Engrg. & Planning
- 210.3 Initial Production Facilities
- 210.4 Initial Spares and Repair Parts
- 210.5 Common Support Equipment
- 210.6 Peculiar Support Equipment
- 210.7 Data
- 210.8 Initial Training
- 210.9 Technical Support
- 210.10 Other

In addition, the cost elements of general and administrative expenses and contract fee shall be included.

## 210.1 Program Management

This element refers to the technical and administrative planning, organizing, directing, coordinating, controlling, and approval actions designed to accomplish overall program objectives during the investment phase of the equipment life cycle. Examples of these activities are configuration management, cost/schedule management, data management, contract management, liaison, value engineering, quality assurance and integrated logistic support management.

## 210.2 Producibility Engineering and Planning (PEP)

Producibility Engineering and Planning refers to the costs associated with the planning and engineering required to ensure the timely economic producibility of the equipment prior to release for production. PEP is usually performed during Full Scale Development; however, PEP can reoccur during the Production Phase, if there is a change in contractors, designs, or manufacturing processes. PEP includes the efforts required to study the producibility of the system/equipment and the development of production data packages.

PEP tasks consist of the following type activities: develop technical data packages, design special purpose production equipment and tooling, computer modeling/simulation, engineering drawings, engineering, manufacturing and quality support information, dimensional and tolerance data, manufacture assembly sequences, wiring diagrams, material and finishing information, inspection, test and evaluation requirements, calibration information and quality control data.

### 210.3 Initial Production Facilities (IPF)

IPF consists of the final full-scale production hard tooling, plant modernization in connection with production of the end item and the actual setup of the final production lines.

#### 210.3.1 Production Engineering

This cost element refers to the engineering effort necessary to translate the technical data package into an operational production line. It also includes required changes or fixes to the technical data package.

#### 210.3.2 Production Tooling

This cost element refers to the procurement, fabrication, modification, assembly, and installation of tools and machinery for production purposes. Specifically, this includes the costs of dies, templates, patterns, form blocks, manufacturing jigs, fixtures, gauges, handling equipment, work platforms, etc.

#### 210.3.3 Industrial Facilities

The industrial facilities element refers to the construction, conversion, or expansion of facilities for production. This includes real property acquisition or modernization where applicable. The cost of direct labor, material, overhead and other direct charges incurred in the setup of the final production line is also included here.

#### 210.3.4 Manufacturing Support Equipment

The manufacturing support equipment refers to the equipment, including tools, required to assemble, install, and checkout the system or portions of the system in support of the manufacturing processes. This includes any special test devices, circuit checkout equipment, automatic machines, test assemblies, etc. This element includes the cost of material, labor and overhead required to produce the test and support equipment.

#### 210.4 Initial Spares and Repair Parts

The initial spares and repair parts element refers to the initial provisioning of modules, assemblies and spare components to be used for maintenance replacement purposes in end items of equipment and for repair of end items. This cost element is the one time expenditure of funds to insure support of newly fielded equipment. Its purpose is to provide the necessary items to operate and maintain the equipment until the supply system comes into routine operations.

Quantitative requirements for initial spare and repair parts are determined through logistics support analysis, and are based on the Total Allowance Quantity and the System Stock Requirement.

##### 210.4.1 Total Allowance Quantity

The total allowance quantity cost is the cost of the quantity of each type of assembly stocked at each operational site where a maintenance action will be performed.

##### 210.4.2 System Stock Requirement

The SSR (System Stock Requirement) cost is a cost derived from the quantity of each type of assembly which is initially procured for the first year of operation on the basis of the predicted annual demand and the assembly procurement lead time, multiplied by the assembly cost.

## 210.5 Common Support Equipment

The common support equipment element refers to the equipment, including tools, required to maintain and care for the system or portions of the system while not directly engaged in the performance of its mission and which are presently in the DOD inventory for support of other systems. This element includes all effort required to assure availability of this equipment for support of the particular defense material item. It also includes the acquisition of additional quantities of these equipments if caused by the introduction of the defense material item into operational service.

### 210.5.1 Organizational Support Equipment

This element includes that portion of the common support equipment costs associated with the organizational level of maintenance.

### 210.5.2 Intermediate Support Equipment

This element includes that portion of common support equipment associated with the intermediate level of maintenance.

### 210.5.3 Depot Support Equipment

This element includes that portion of common support equipment associated with the depot level of maintenance.

## 210.6 Peculiar Support Equipment

The peculiar support equipment element refers to the equipment, including tools, required to maintain and care for the system or portions of the system while not directly engaged in the performance of its mission, and which have application peculiar to a given defense material item. This element includes; for example, vehicles, equipment, and tools used to service, transport and hoist, repair, overhaul, assemble, disassemble, test, inspect, or otherwise maintain the mission equipment. It also includes all effort associated with the design, development, and production of peculiar support equipment.

### 210.6.1 Organizational Support Equipment

This element includes that portion of the peculiar support equipment costs associated with the organizational level of maintenance.

### 210.6.2 Intermediate Support Equipment

This element includes that portion of peculiar support equipment costs associated with the intermediate level of maintenance.

### 210.6.3 Depot Support Equipment

This element includes that portion of peculiar support equipment costs associated with the depot level of maintenance.

## 210.7 Data

The data element refers to all deliverable data acquired during the investment phase which is required to be listed on a DD Form 1423. The data requirements will normally be selected from the departmental or agency Authorized Data List. It includes the effort for acquiring, writing, assembling, reformatting, reproduction, packaging and shipping.

### 210.7.1 Engineering Data

The engineering data element refers to those engineering drawings, associated lists, specifications, and other documentation required by the Government. This element includes all plans, procedures, reports and documentation pertaining to systems, subsystems, and components engineering and testing.

### 210.7.2 Support Data

The support data element refers to those data items required by the Government to develop and acquire the Support System. This includes maintenance data, provisioning data and lists, support and test equipment data and lists, logistic support plans and progress reports, technical publications requirements data, training planning data and transportation and handling data, etc.

### 210.7.3 Management Data

The management data element refers to those data items necessary for configuration management, cost, schedule, contractual data management, programs management, etc., required by the Government.

### 210.7.4 Technical Manuals and Orders

This element refers to those handbooks, technical manuals, technical orders, technical data sheets, etc., required by the Government.

## 210.8 Initial Training

This element represents the initial training costs necessary to insure that trained personnel are available to operate and maintain the equipment when it arrives in the field. It includes the costs associated with making fielded equipment operational from a personnel viewpoint.

### 210.8.1 Training Facilities

This element includes the cost incurred in construction and general provisioning of special facilities for training. It accounts for only those facilities required by the system/equipment under consideration.

### 210.8.2 Training Devices and Equipment

This is the cost of any special training devices and equipment. This cost is a one time cost for the special equipment required in the training of operators and maintenance personnel. The cost of vugraphs, charts, test papers, and supplies is included under this element. Mission equipment used for training is covered as a recurring cost.

### 210.8.3 Initial Student Training

This element accounts for the costs of training the initial operator, maintenance and instructor personnel.

#### 210.8.3.1 Operator Training

This element represents the cost of training operators for the equipment.

#### 210.8.3.2 Maintenance Training

This element represents the cost of training maintenance personnel for the equipment.

#### 210.8.3.3 Instructor Training

This element represents the cost of training instructor personnel.

## 210.9 Technical Support

This element refers to those costs which are incurred in support of Government testing (PATE and OTE) during the investment phase of the equipment life cycle.

### 210.9.1 Production Acceptance Test and Evaluation (PATE) Support

The production acceptance tests are conducted on production items produced early in the production run (generally identified as the "initial production run"). They are designed to assure that production systems and equipment conform to design specifications and performance requirements when manufactured in accordance with production specifications and quantity production processes.

### 210.9.2 Operational Test and Evaluation (OTE) Support

User Operational Tests and Evaluation (OTE) are tests generally conducted by user personnel (military unit(s)) under conditions of operational tactical environments. They are designed to determine the system/equipment operational effectiveness and validate organization doctrine, tactics, basis of issue, training requirements and logistic support.

210.10 Other

This element includes any contractor incurred non-recurring investment costs not contained in aforementioned cost elements.

80

220. RECURRING INVESTMENT

Recurring costs refer to those production costs that recur with each unit produced. These costs tend to be subject to a learning curve concept in which the cost per unit decreases as quantity increases. The costs incurred in this category terminate with the satisfactory turnover of an operationally usable system to the using command or organization.

The cost elements in this subcategory shall be limited to contractual costs (the costs incurred by a private business while under contract with the Federal Government):

- 220.1 Manufacturing
- 220.2 Production Material
- 220.3 Sustaining Engineering
- 220.4 Quality Control and Inspection
- 220.5 Packaging and Transportation
- 220.6 Operational Site Activation
- 220.7 Other

In addition, the cost elements of general and administrative expenses and contract fee shall be included.

## 220.1 Manufacturing

This cost element refers to the conversion of raw materials into products and/or components thereof, through a series of manufacturing processes. It includes functions of production scheduling and control, prime equipment fabrication, assembly and test and other related processes.

### 220.1.1 Direct Labor

Any item of cost (or the aggregate thereof) in a manufacturing or similar establishment which may be identified specifically with any objective, such as a product, service, program, function, or project. This cost element is limited to items of direct and indirect labor costs.

### 220.1.2 Overhead

Any item of cost (or the aggregate thereof) in a manufacturing or similar establishment which is not readily identifiable with the cost of manufacture of a specific product.

## 220.2 Production Material

Production material includes all the purchased equipment and parts, subcontracted items and other material that is used in the production of the prime mission equipment. It includes, but is not limited to, raw and processed material, parts, components, assemblies, and small tools and supplies which may be consumed in normal use during the manufacturing process. Material overhead is also included herein.

### 220.2.1 Purchased Equipment and Parts

This element includes the cost of manufactured and assembled items, usually costs in excess of \$100 per unit and exhibits a wide range of complexity. It is usually termed off-the-shelf equipment and consists of, for example, batteries, motors, generators, air conditioning equipment, hydraulic pumps and instruments. Purchased parts are distinguished from purchased equipment by cost and complexity. Usually purchased parts cost under \$100 per unit and are essentially standard, off-the-shelf hardware items.

### 220.2.2 Subcontracted Items

This element includes the cost of parts, components and assemblies produced by manufacturers other than the prime contractor in accordance with the prime contractor's designs, specifications or directions. It does not include equipment bought off-the-shelf. It does include the cost of transportation or shipment if itemized by the subcontractor.

### 220.2.3 Other Material

This element includes all the raw and semifabricated material, inter-company transfers and other material used in the production of the equipment.

### 220.3 Sustaining Engineering

All engineering performed after quantity production starts is included in this element. This will include such items as maintainability-reliability engineering, maintenance engineering, value engineering, and production engineering. It also includes redesign, evaluation and other sustaining efforts of the engineering function.

### 220.4 Quality Control and Inspection

This includes such tasks as receiving inspection, in-process and final inspection of tools, parts, subassemblies and complete assemblies. Quality control is that function of management relative to all procedures, inspections, examinations, and tests required during procurement, production, receipt, storage, and issue that are necessary to provide the user with an item of the required quality.

### 220.5 Packaging and Transportation

This refers to the cost associated with packing the article for shipment and transportation from the point of procurement, production, or testing to the first destination under contract. This includes the application of use of exterior shipping containers and assembling of items or packages therein, together with necessary blocking, bracing or cushioning, weatherproofing, exterior strapping and marking of shipping containers.

## 220.6 Operational Site Activation

The operational/site activation element refers to the real estate, construction, conversion, utilities, and equipment to provide all facilities required to house, service, and launch prime mission equipment at the organizational and intermediate level. This element includes conversion of site/ship/vehicle, system assembly, checkout, and installation into site, facility or ship to achieve operational status.

### 220.6.1 Site Construction

The site construction element refers to the real estate, site preparation, construction, and other special-purpose facilities necessary to achieve system operational status. This element also includes the construction of utilities, roads, and inter-connecting cabling.

### 220.6.2 Site/Ship/Vehicle Conversion

The site/ship/vehicle conversion element refers to all materials and services required to provide for the conversion of existing site/ship/vehicle to accommodate the mission equipment and selected support equipment directly related to the specific system. This element includes launch, operating support, and other conversion necessary to achieve system operational status.

### 220.6.3 Assembly, Installation, and Checkout

This cost element refers to the materials and services involved in the assembly of mission equipment at the site. It includes, for example, installation of mission and support equipment in the launch, operations, or support facilities, and complete system checkout or shakedown to insure achievement of operational status.

220.7 Other

This element includes any contractor incurred recurring investment costs not contained in the aforementioned cost elements.

## 310 OPERATIONS

This category includes costs associated with the use of the equipment. The costs incurred as a result of direct operation of the equipment and items actually consumed in the operation of the equipment are included in this category.

### 310.1 Electrical Power

The cost of electrical power is the cost of battery, generator, or commercially supplied power required for the operation of the equipment.

### 310.2 Special Materials (Consumables)

This element covers the cost of materials consumed in the operation of the equipment. Examples of some typical items and materials are POL (petroleum, oil and lubricants), facsimile paper and toner, and paper rolls and tapes used with teletypewriter equipment.

### 310.3 Operational Personnel

This cost element is the manpower cost, direct and indirect, that is incurred in operating the equipment. Included within the determination of manpower cost is not only the cost of the operator's pay and allowances, but also the miscellaneous expenses, support costs, incentive and special pay, and replacement training costs.

### 310.4 Operational Facilities

This element refers to the annual maintenance costs of facilities used to house prime mission equipment. This includes the cost of heating and air conditioning of equipment shelters, where applicable. All direct labor, material overhead and other direct charges are included.

### 310.5 Other Operational Cost

This element includes any operational costs not contained in the aforementioned cost elements. The following are examples of these possible costs:

Annual leasing costs for special or peculiar equipment, devices, communication circuits, or material during the operating life cycle phase of the equipment/system.

Transportation costs of the prime mission equipment for purpose of mobile operation (i.e., training exercises, transitive deployments, etc.). For mobile tactical equipment, this basically involves POL for transporting vehicles.

Transportation costs of special materials from central supply point to the organization, if not included in the cost of the special material.

Computer software support required in the maintenance, modification or reprogramming of operational support programs.

320 LOGISTIC SUPPORT

This element includes the cost of personnel, material, facilities and other direct and indirect costs required to maintain and support the equipment/system during the operational phase of its life cycle.

## 321. MAINTENANCE

Maintenance category includes all action taken to retain an end item in a serviceable condition or to restore it to serviceability. It includes inspection, testing, servicing, classification as to serviceability, repair, overhaul, rebuilding, test and reclamation. Maintenance may be performed as a result of failure or in an attempt to increase the mean time between failure (MTBF) by use of scheduled preventive maintenance. Maintenance of the associated common and peculiar support equipment is also included.

### 321.1 Maintenance Personnel

This cost element refers to the maintenance personnel costs associated with the accomplishment of corrective and preventative maintenance at the organizational, intermediate and depot levels. The cost of maintenance personnel includes basic pay and allowances, PCS travel costs, support costs, replacement training and retirement benefits.

#### 321.1.1 Organizational Maintenance Personnel

This element includes that portion of the maintenance personnel costs associated with the organizational level of maintenance.

#### 321.1.2 Intermediate Maintenance Personnel

This element includes that portion of maintenance personnel costs associated with the intermediate level of maintenance.

#### 321.1.3 Depot Maintenance Personnel

This element includes that portion of maintenance personnel costs associated with the depot level of maintenance.

### 321.2 Maintenance Facilities

The facility cost element refers to all facilities, (real property, plant, and equipment) plus utilities required to support maintenance operations at all levels (organizational, intermediate, depot). Facility and utility costs shall be proportionately allocated to the system being evaluated. The facility cost is the summation of three separate space costs: inventory storage, support equipment, and repair work space. Utilities include: electricity, gas, water, telephone, etc.

### 321.3 Support Equipment Maintenance

This is the cost associated with the support of common and peculiar support equipment. Acquisition costs for support equipment are included under the investment category. Support equipment costs are determined for each level of maintenance (organizational, intermediate, depot), and cover anticipated corrective and preventive maintenance associated with the support equipment itself. The spare and repair parts for support equipment are also included.

### 321.4 Contractor Services

This element includes contractor costs for engineering and technical services and maintenance of the system/equipment. Contractor engineering and technical services include those services provided by commercial or industrial companies for advice, instruction and training to DOD personnel in the installation, operation and maintenance of the equipment/system. Contract maintenance includes the cost incurred for maintenance of the equipment by commercial organizations on a one-time or continuing basis, without distinction as to the level of maintenance accomplished. All direct labor, material, overhead and other direct charges are included.

## 322. SUPPLY

The supply category includes all the personnel, facilities, material, transportation and handling required to insure that all repair parts, consumables and other required material are available at the repair site as required.

### 322.1 Inventory Administration

Inventory administration cost is the cost of entering the spares and repair parts into the supply system and retaining them there over the life cycle of the equipment. Specifically, the cost is a function of two separate costs: inventory management and inventory holding.

#### 322.1.1 Inventory Management

This cost element refers to the management costs for entering and maintaining an item in inventory. The costs include identification, description, submission to and screening and editing by Data Documents Center, inclusion in maintenance and supply catalogs, establishing by supply management of inventory and replacement rates, provisioning, requisitioning, rebuild directions, and procurement directives.

#### 322.1.2 Inventory Holding

Inventory holding is the cost of physically holding inventory in the supply system for one year. The factors included are: general storage cost, deterioration in storage, obsolescence, and losses in storage.

### 322.2 Replenishment Spares and Repair Parts

Replenishment spares and repair parts cost accounts for the recurring cost of inventory (parts, subassemblies, assemblies, units, etc.) purchased to resupply the system stock requirement due to items being discarded or scrapped during the maintenance process. Inventory already purchased as initial spares and repair parts is not included.

### 322.3 Repair Material

The repair material cost is the cost of materials (wire, pieceparts, etc.) utilized to repair the assemblies which have failed. For the discard concept the repair material cost is zero, since no repair parts are required.

### 322.4 Transportation and Packaging

This cost element includes packaging, handling and transportation of spares, repair parts and other material between organizational, intermediate, depot and supply points (overseas and CONUS) in support of maintenance operations. Also included is the transportation of the end item to the depot and return for the purpose of depot overhaul.

### \* 322.5 Supply Facilities

This element refers to the maintenance facilities for supply. It includes maintenance of real property where applicable. All direct labor, material, overhead and other direct charges are included. General storage costs are included in Inventory Holding Costs.

APPENDIX B  
DESIGN TO COST

This Appendix of the TDF Cost Guide provides information to the cost analyst charged with the responsibility of estimating, tracking, and evaluating the Design-to-Unit Production Cost.

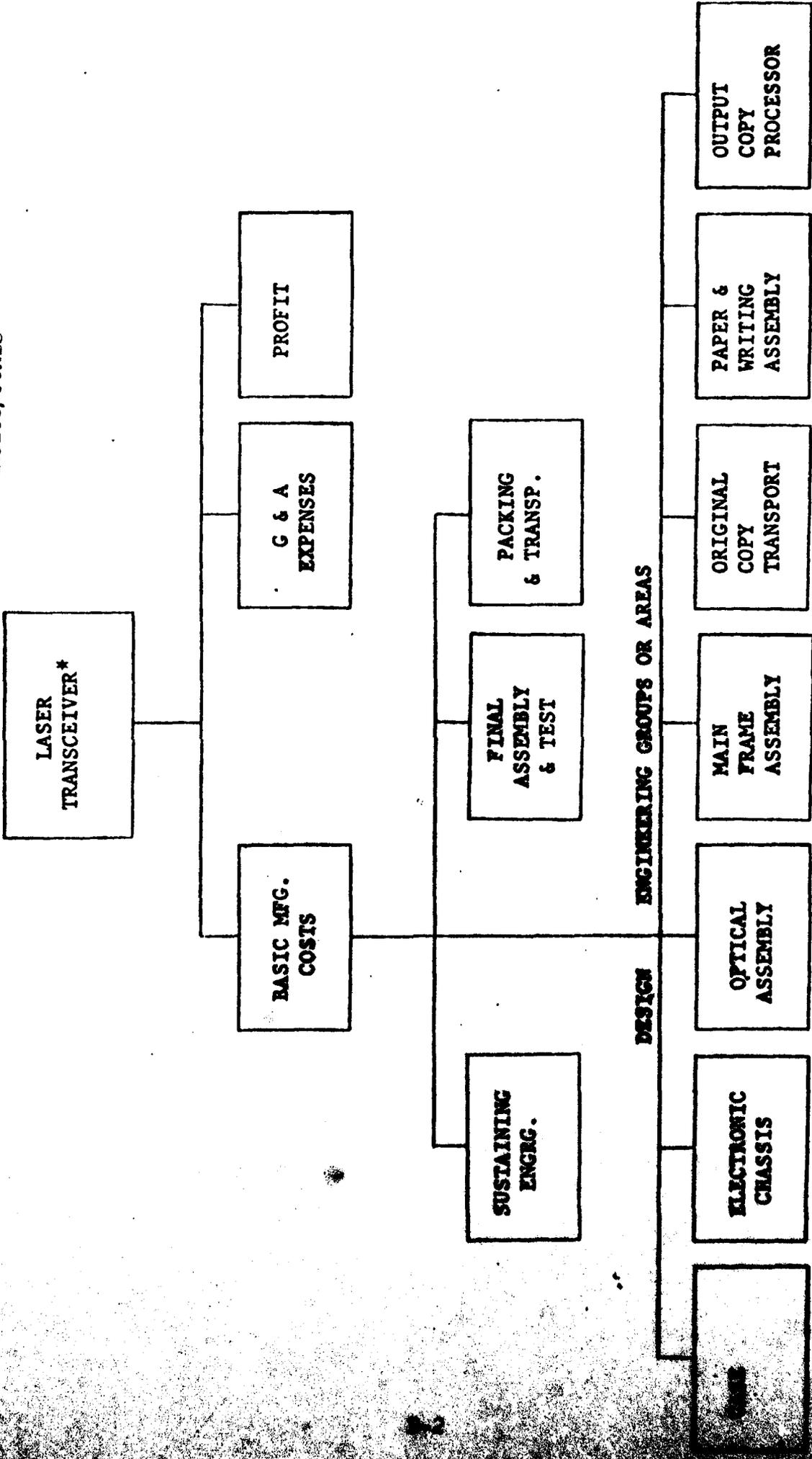
**B.1 DESIGN-TO-COST PROGRAM**

The objective of the Design-to-Cost Program is to ensure the development of the most cost-effective system/equipment design; specifically, the development of a Tactical Digital Facsimile equipment that can be produced at the lowest possible production and life cycle costs.

The Design-to-Cost Program involves four basic tasks:

- a. Assignment of Design-to-Cost subgoals for the different design groups involved in the project and making designers responsible for achieving these cost goals (Figure B-1).
- b. Conducting of design iterations and trade-off studies aimed at providing optimum capability within the design-to-cost target.
- c. Continuously tracking the projected costs for the respective components of the system and evaluating the progress in meeting the design-to-cost target.
- d. Submitting reports in accordance with the requirements of the contract.

FIGURE B-1 DISTRIBUTION OF DESIGN TO COST TARGETS/GOALS



\* Design to cost Target based on 1000 units of production

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NAVAL WEAPONS ENGINEERING SUPPORT ACTIVITY WASHINGTON DC  
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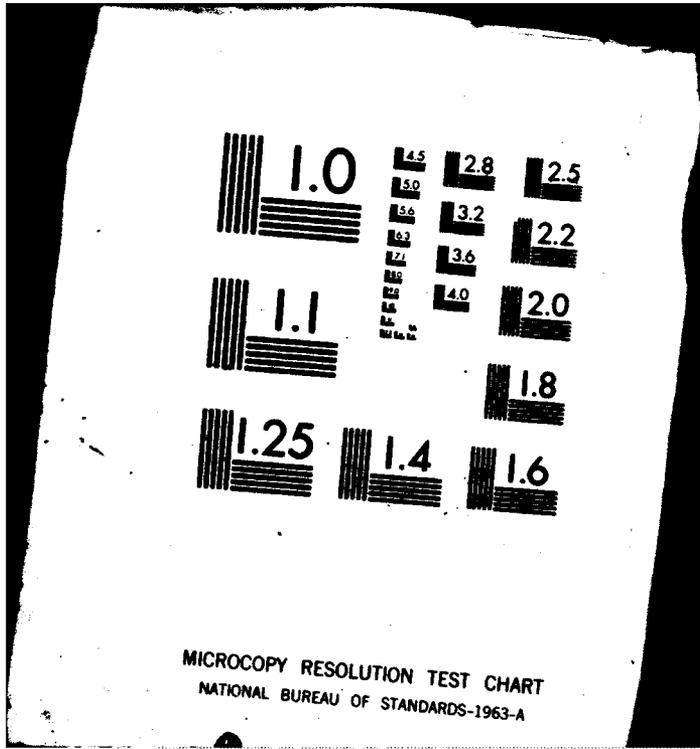
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## B.2 DESIGN-TO-COST TARGETS

The Government has established design-to-cost targets for configuration items of the TDF equipment. These targets are average unit production costs to be achieved in the first production contract. The Government's unit production cost targets are based upon constant FY-76 dollars and the projected production quantities of 1,000 units and production rates of 80 units/month. If adjustments in the production quantities are made during development the unit production cost targets will be adjusted along an 86.5% learning curve.

In order that there be no misunderstanding of the targets, design-to-cost targets have been based upon the cost elements set forth in the recurring investment category of the life cycle costing model. Design-to-cost covers all contractor recurring production cost to include: production materials including purchasing equipment and subcontracted items, manufacturing direct labor and overhead, sustaining engineering, quality control, inspection and test, and packaging and transportation. In addition, the allocation of general and administrative expenses and fee to the fixed production cost of the specific production unit is included.

The contract design-to-cost target should be regarded as a ceiling (not to exceed) cost; hence, a contractual requirement. The setting of additional (and lower) design-to-cost goal should be viewed as a key design parameter (equal to performance requirements) toward which designers are to work.

### B.3 DESIGN-TO-COST TRACKING

Tracking of status against a design-to-cost goal involves generating a series of estimates of the equipment's unit production cost. For the Tactical Digital Facsimile development, there are two significant development areas, the equipment hardware and the recording media, both require cost estimates and tracking.

Design-to-cost estimates should be developed in accordance with the cost elements presented in Section 6 (FORMAT 8) which includes both unit production and consumable copy costs. In addition, the contractor is required to substantiate these estimates by a hardware element summary of the major components and a disclosure of learning curves, burden rates and profit or fee rates, etc. Hardware element estimates (FORMAT 9) in terms of direct labor and materials should be developed for each engineering design group or design area. Pareto's principle can be applied to minimize the requirements of such estimates. Pareto's principle is based on the theory that 20% of the components of the system are responsible for 80% of the cost. That is, if all items of a system were arranged in order of decreasing cost, the cumulative value of the first 20% of the items will approximate 80% of the total cost of the system.

The contractor should continuously track the projected unit production costs for the respective design engineering groups or design areas to evaluate his progress in meeting the design-to-cost targets. In all areas where estimated cost exceeds the design-to-cost goal, the contractor shall establish a method for decreasing cost to meet the goal.

#### B.4 ECONOMIC ADJUSTMENT PROCEDURES

For purposes of evaluating contractor compliance with design-to-cost targets and award of an incentive fee, current year estimates and proposals should be de-escalated to constant FY-76 dollars using the following equation:

$$\left[ \begin{array}{l} \text{Constant - Year} \\ \text{Dollars} \\ \text{(FY-76)} \\ \text{Equivalent} \end{array} \right] = \frac{\left[ \begin{array}{l} \text{Constant - Year} \\ \text{Index} \\ \text{(FY-76)} \end{array} \right]}{\left[ \begin{array}{l} \text{Current - Year} \\ \text{Index} \\ \text{(FY- )} \end{array} \right]} \left[ \begin{array}{l} \text{Current - Year} \\ \text{Dollars} \\ \text{(FY- )} \end{array} \right]$$

The index to be used should be the GNP Implicit Price Deflator (1958 = 100) as published monthly by the U.S. Department of Commerce in "Business Conditions Digest." The period used for both the constant and current year index should be the quarter most recently completed when the evaluation takes place.